Measuring Success:
A Workshop on Biodiversity and Habitat Indicators

Background materials

Summaries

Listed below are short (2-3 page) summaries of several different efforts to measure biodiversity and habitat at the international, national, state, and site level.

Introduction to Program Summaries

National Research Council: Ecological Indicators for the Nation

The John H. Heinz Center for Science, Economics, and the Environment. State of the Nation's Ecosystems.

Natural Resource Conservation Service Natural Resource Inventory. (USDA)

Institute for Environmental Research and Education. Field testing biodiversity indicators on agricultural lands.

Draft Report: Testing Habitat Indicators. Land Use and Habitat Workshop, June 25-26, 2002

Biodiversity / Land Use Indicators Workshop Summary. July 2000, Washington D.C.

Oregon Benchmarks. New environmental indicators.

Food Alliance Wildlife Standards. New draft standards.

The Monitoring Tool Box for Landowners. From the Land Stewardship Project.

Recommended Reading

The State of the Nation's Ecosystems: Measuring the Lands, Waters and Living Resources of the United States.
The John H. Heinz Center for Science, Economics, and the Environment. A 270-page report to be released September 24, 2002.
Available through The Heinz Center. Telephone: 202/737-6307, email: info@heinzctr.org or online at http://www.heinzctr.org
Inventory and Monitoring for Sustainable Development in the Pacific Northwest
The Pacific Northwest Regional Council of the President's Council on Sustainable Development. A 61-page report on the proceedings of the 1999 workshop.

Measuring Success:
A Workshop on Biodiversity and Habitat Indicators

Background materials

Available through Defenders of Wildlife. Telephone: 503/697-3222

Ecological Indicators for the Nation
National Research Council. A 180-page book released in 2000.
Available through the National Academy Press: http://www.nap.edu

Oregon State of the Environment Report 2000
An 80-page report produced for the Oregon Progress Board by the State of the Environment Report Science Panel, Dr. Paul Risser, Chair. Released in September 2000.
Available through the Oregon Progress Board. Telephone: 503/986-0039 or online at http://www.econ.state.or.us/opb/soer2000/index.htm

Measuring Success:
A Workshop on Biodiversity and Habitat Indicators

Background materials

INTRODUCTION TO PROGRAM SUMMARIES:

Biodiversity Indicators in Agricultural Ecosystems (6-11-02)

Biodiversity means the variety of life and its processes. It can be assessed at various levels from genes to species, landscapes to ecosystems. All levels are important to the long-term persistence of native plants and animals in functioning ecosystems.

Agricultural lands are important to biodiversity. The conversion of natural landscapes to agriculture has contributed to the loss of habitat and species throughout the world. At the same time, agricultural lands offer great opportunities to conserve and restore native biodiversity because some plants and animals thrive in agricultural landscapes. Some native habitats can be restored on agricultural lands so that they support at least a part of the natural assemblage of species that were common in the area prior to conversion.

In recent years, there has been an increasing interest in measuring the degree to which biodiversity is conserved across different land uses. For example, the Montreal Criteria and Indicators emerged from an international conference, and includes biodiversity as an important measure of sustainability on forestlands.

Measuring biodiversity across different landscapes and at different scales is very challenging. Ecosystems are so complex that it is difficult to key in on any particular piece or function as representative of overall ecosystem health or integrity. Measuring many elements at frequent intervals is too expensive and time consuming. Ecosystems are subject to a certain degree of natural variability from one season to the next, or over many years or decades, so it is difficult to separate human effects from natural ones. Most scientists tend to specialize, so developing an integrated approach requires more interdisciplinary cooperation than is common in academic or agency cultures. Policy-makers complain that monitoring efforts seldom produce meaningful and relevant information to support management decisions. Funding for monitoring is never adequate, and it is unlikely to be available consistently over ecologically meaningful time periods.

Despite the daunting nature of the task, having reliable information about the status of biodiversity is important for several reasons. We need to know if our conservation efforts are working. Appropriators want to know if public funds are being invested wisely. Consumers want to know if their purchases are contributing to irresponsible and environmentally destructive management practices and inappropriate land uses. We as a society need some kind of yardstick by which to measure the impact of our activities on natural systems.

In the summer of 2000, Defenders of Wildlife and the Institute for Environmental Research and Education sponsored a workshop on biodiversity and land use indicators in Washington, D.C. It

was attended by a diverse group of resource professionals, who discussed different strategies for measuring biodiversity in agricultural landscapes. By the end of the meeting, the group had a tentative list of indicators to test on working farms. Meanwhile, other efforts were underway at the international, national, state, regional, and site level to do the same thing.

The summaries to follow describe the status of a few of those efforts. We offer brief status reports on the programs designed to monitor and report the status of biodiversity at multiple scales. The also summaries highlight some of the problems encountered along the way.

Before getting into the details, it may be helpful to identify a few of the most difficult issues surrounding the development of biodiversity indicators for agricultural landscapes:

1. Should we focus on institutional mechanisms or actual results on the ground? Tracking program implementation, for example, the number of species listed as endangered, or number of acres in the Conservation Reserve Program, is not too difficult, but its success depends on a strong connection between the programmatic activity and actual impact or effectiveness. Tracking ecosystem response is extremely difficult, as discussed above, and reliable data are often scarce or uneven.

2.Should indicators measure the biodiversity associated with existing agricultural landscapes, the biodiversity that was likely to have been present before land conversion, or both? This issue has been hotly debated and cuts to the heart of the ideological debate between the environmental community, who is interested primarily in natural diversity, and most in the agricultural community who focus primarily on the functioning and productivity of the existing systems.

3. What biodiversity elements should be measured, and at what scale? Presence or absence of certain species does not necessarily indicate a high probability of long-term persistence on a given site or landscape. Total amount of land conserved is not meaningful without contextual information about the overall configuration.

4. What is the relationship between biodiversity and sustainably managed agricultural systems? Is it possible to maintain healthy functioning ecosystems in and around farms by simply modifying farming practices? If land needs to be set aside or removed from production, how much and where? Are small family farms or large agribusiness operations more likely to conserve biodiversity?

5. To what degree are indicators based on desired conditions? If state and/or regional habitat goals were in place, there would be something to measure against. In the absence of an overall conservation strategy or plan, monitoring results may not be meaningful.

---

6. Should biodiversity indicators be applied consistently across different landscapes? Economic, academic, agency and nonprofit interest groups tend to specialize and focus on different sectors or jurisdictions that do not align with ecological processes.

In the section to follow are examples of several programs that have attempted to develop and test biodiversity indicators at a variety of scales. Although they share common elements, there are substantial differences among them.

The purpose of this summary is to share information and experiences among different groups who share similar goals. Ultimately, it would be beneficial to have a common set of biodiversity indicators across different land uses and multiple scales.

The summaries to follow are all works in progress. They should be helpful as background information for the workshop, and will be modified after the workshop to reflect the discussion and recommendations.

Sara Vickerman
Defenders or Wildlife
(503) 697-3222
svickerman@defenders.org

National Research Council: Ecological Indicators for the Nation
(6-11-02)

As part of the Environmental Protection Agency's efforts to examine its approach to environmental monitoring, the agency contracted with the National Research Council to conduct a critical scientific evaluation of indicators to monitor ecological changes. Specifically, EPA asked the NRC to identify criteria for evaluating biological indicators, evaluate methods of indicator development, to provide examples of indicators that have proven useful, and to identify areas where more research is needed. The results of the study were published in 2000. (ix)

The committee recommended the following set of indicators in three categories:

As indicators of the extent and status of the nation's ecosystems, the committee recommended land cover and land use.

As indicators of the nation's ecological capital, the committee recommended total species diversity, native species diversity, nutrient runoff, and soil organic matter.

As indicators of ecological functioning or performance, the committee recommended carbon storage, production capacity, net primary productivity, lake trophic status, stream oxygen, and for agricultural ecosystems, nutrient use efficiency and nutrient balance. (7)

For the purposes of this summary, the focus will be on the land and species indicators, although ecological function is clearly a central concern in the conservation of biodiversity.

Indicators of Ecosystem Extent and Status

The largest ecological changes caused by humans result from land use modifications. These include conversion of natural habitats to agricultural systems, modifying hydrological and biogeochemical cycles, and changing the surface of the earth with buildings and transportation systems.

The committee recommended creating a land cover indicator that includes both dryland and aquatic ecosystems. The indicator would record the percentage of land in each of many land cover categories. The major questions concern how many land cover types to recognize, how to account for their spatial configurations, and how to accommodate changes in the number and kinds of categories recognized. (9)

An indicator on total species diversity would measure species richness. It would be based on land cover, with a diversity score assigned to each category of land cover based on its total contribution to total species diversity.

The second species indicator would measure native species diversity that compares the number of native species a land area supports with the number of native species one would expect such a landscape type to support. Both native and non native species would be counted.

For specific areas, like parks or areas exploited for human use, the committee suggested three additional measures: independence of the area, species density, and deficiency of natural diversity.

Independence assesses the degree to which an area depends on immigration of species from surrounding areas. Source species (whose births exceed deaths in an area) can provide individuals to populate other areas. Sink species are present only because immigrants compensate for excess deaths in the area. According to the theory, sink species will disappear from isolated areas.

Species density assesses whether a given area supports more or fewer species that a reasonably defined reference area does. An area with high species density may indicate that more species are being forced into smaller habitats than they can eventually support.

Deficiency in natural diversity measures whether an area is supporting exotic species or native ones. Disturbed areas tend to attract exotic species that replace the native assemblages. (16)

The index of biotic integrity for aquatic ecosystems is the most commonly used system to evaluate the health of aquatic ecosystems. It requires general agreement about which organisms indicate poor or good ecological and water quality. It is primarily a community-level indicator because the organisms found in different ecosystems will vary. The indicator was originally developed for use in the Midwest, but recently similar indicators have been applied to other aquatic and terrestrial systems.

Discussion

According to the NRC report, local assessments of species diversity have several potential weaknesses that make them unreliable:

Diversity counts are biased by sample size. The larger the sample, the more species in the count, and the rarest are most likely to be missed.

Diversity counts vary with extent of area. More species are found in larger areas.

Diversity counts are biased by length of time over which they are measured. Longer surveys produce more species.

Diversity is a dynamic property of ecosystems.

The diversity of any area is dependent on the larger area in which it is imbedded.

Therefore, the report suggests that simple species counts need to be processed and analyzed before being incorporated into indicators. There are some new and sophisticated methods to guard against the inherent bias in these inventories. (123-4)

Heinz Center - Biodiversity Indicators for Farmlands (6-11-02)

The Heinz Center for Science, Economics and the Environment has undertaken a multi-year project to develop a set of environmental indicators for the nation. A diverse group of scientists and representatives of the private sector worked on committees to develop a set of proposed indicators for each of six "ecosystems. " The ecosystems include farmlands, rangelands, forests, freshwater wetlands, coastal areas, and urban-suburban areas.

For each ecosystem, there are eighteen indicators in three categories: system dimensions, chemical and physical conditions, and biological components. Although there is considerable consistency between the indicators in each system, there are also differences between them.

The report on this project will be released in the fall of 2002. Information for this summary was taken from the draft report, and is not to be distributed until the report is released.

Although all of the indicators for farmlands have some relevance to biodiversity, four are particularly important:

The farmland landscape measures the relative percentages of forest, grass, shrubland, wetland or developed land within the agricultural landscape.

The size and shape of "natural" patches in the farmland landscape measures the amount and configuration of forest, grassland/shrub, and wetlands in agricultural ecosystems.

The status of animal species in farmland areas reports the condition of wildlife in areas heavily dominated by farming.

The native vegetation cover in areas dominated by croplands measures the proportion of vegetation (excluding crops) that is native or non-native.

The farmland landscape indicator reports the percentage of cropland that is actively used for production compared to the patches of woodlands, grasses, shrubs or wetlands. The areas that aren't cropped provide wildlife habitat, serve as streamside buffers and windbreaks, and add character to the landscape. The data is derived from satellite imagery and shows considerable variation from one section of the country to another. In the East and Southeast, croplands make up about half of the overall farmland landscape. Most of the remainder is forest, and in the southeast, wetlands. In the Midwest, only about a quarter of the farmland landscape is in something other than crops. About 60% of the farmland landscape is croplands in the South Central, Northern Plains, and Western regions. Grasslands and shrublands dominate the non-cropland portion in the West and Northern Plains. In the South Central region forests and grass and shrublands are about equal in area.

The size and shape of natural patches in the farmland landscape indicator reports on the overall configuration of natural vegetation in agricultural areas. Patches are classified as compact (circles) elongated (narrow rectangles) or medium (intermediate shape). The classes are defined using edge to area ratio of each patch to its area. The "natural" areas include forests, grasslands, shrublands, wetlands, and lands enrolled in the Conservation Reserve Program.

These natural lands within the farmland landscape control erosion, facilitate groundwater recharge, provide critical habitat for wildlife, and serve other important ecological functions. The size and shape of these small and isolated remnants, along with restored lands (CRP, for example) directly influence the ecosystem services provided. Fragmented habitats may be colonized by generalist native species or exotics. Small and linear patches have mostly "edge," and little or no interior habitat. Large contiguous areas of forest, grassland, or other natural cover is needed to support species dependent on interior habitat.

The Heinz Center was unable to report on the patch indicator at this time, as the resources were not available to conduct the analysis. Data are available however.

The status of animal species indicator would report on the current status of wildlife that would have been found in the forests, grasslands, or shrublands from which the farms were created. These native species may exist in reduced numbers in the habitat remnants that remain in agricultural areas. Other species may favor the conditions found in farmlands, and are therefore more common than they were prior to conversion.

An index is needed to account for both types of wildlife - the ones favoring pre-agricultural landscapes and those found in landscapes dominated by agriculture. However, such an index does not exist at present, because it is not deemed possible to define a set of "farmland" species.

Native vegetation in areas dominated by croplands reports, for areas with more than 50% cropland, how much of the un-cropped area is native, and how much is dominated by exotic vegetation. Where croplands dominate the landscape, wildlife rely more heavily on the remaining areas. Since native vegetation has greater habitat value than exotic vegetation, it is important to make the distinction.

This indicator will not be reported on until some important questions are answered. What is the appropriate scale for reporting? How can native and non-native vegetation be determined using existing data sources?

USDA National Resources Inventory - Habitat Indicators for Agricultural Lands (6-11-02)

The Rural Development Act of 1972, the Soil and Water Resources Conservation Act of 1977, and other supporting acts direct the Natural Resources Conservation Service (NRCS) of US Department of Agriculture to assess the status, condition, and trends of soil, water and related resources on the Nation's non-federal lands. To help accomplish this assessment, the Natural Resources Inventory was developed to provide critical information regarding natural resources.

The Inventory is a compilation of natural resource information on non-federal land. The inventory captures data on land cover and use, soil erosion, prime farmland soils, wetlands, habitat diversity, selected conservation practices, and related resource attributes at more than 800,000 sample points. The data covers all 50 States.

The Inventory provides a record of trends in the nation's resources over time and documents conservation accomplishments. At each sample point, information is available for 1982, 1987, 1992, and 1997, so that trends in changes in land use can analyzed. Because the it is based on recognized statistical sampling methods, the inventory data are valuable in examining issues at national, regional, and state levels.

Many data elements are collected for each of the 800,000 sample points, but Brady (2000) and Brady and Flather (1995) found that only a few have proven useful to wildlife interpretations. As Brady and Flather (1995) observe, "Although habitat assessment methodologies are traditionally focused on developing single species models for important game species, species threatened with extinction, or species thought to represent a group of species,.... conserving biological diversity will require more emphasis on how wildlife communities respond to human-induced alterations of habitat."

Brady and Flather (1995) provide three major data recommendations for enhancing the capability of the Inventory to assess wildlife. These data recommendations are aimed at providing a comprehensive evaluation of wildlife resource response to land management by using a combination of single-species and multiple-species approaches.

Recommendation 1: Expand the data collection effort to include all federal lands. Because much of the western third of the United States is federally owned it is difficult to associate NRI land-based patterns with wildlife distribution and abundance, water, or other resources that are independent of land ownership boundaries.

Recommendation 2: Digitize land cover on primary sample units. This would allow an investigation into the influence that spatial configuration of habitat has on the distribution and abundance of species. Patch size, connectivity, and fragmentation could be quantified and other fine scale elements could be identified including the presence of odd habitat areas and green belts, etc.

Recommendation 3: In the past, case studies on wildlife impacts of land management practices have been limited to avian taxa. There is no nationally standardized inventory of biological organisms that corresponds to the sampling intensity and design of the Inventory. A coordinated and comprehensive inventory of biological resources within the land based the data would be very helpful in associating land use alternatives with biological responses.

Brady (1997) developed a Habitat Composition and Configuration module for the Inventory that was first implemented in 1997. This module contains new data not required in prior inventories and replaces some data elements of previous ones. As of June 2000, however, the data had not been released to test the new module and there has not been any analysis. For each of the 800,000 sample points, three new types of data would be collected to expand habitat analysis. These new data include:

Habitat Composition: The make-up or relative proportion of the general cover categories occurring about a point. Nine general cover categories are defined based upon vegetative structure or substrate characteristics.

Habitat Configuration: The arrangement of nine general cover categories occurring about a point (crop, herbaceous, short woody plants, tall woody plants, open canopy short woody plants, open canopy tall woody plants, barren, water, artificial and modified surfaces).

Importance: This data element would be designed to collect information the composition and relative configuration in areas surround the point. Spatial information related to habitat composition can be used to compute diversity indices. Habitat composition information can be used to support the use of models that analyze diversity within defined geographical areas.

These data were collected in the 1997 NRI, but have not yet been thoroughly analyzed. There are plans to do a complete analysis over the next two years.

Institute for Environmental Research and Education
Biodiversity and Land Use Indicators (6-11-02)

In the summer of 2000, Defenders of Wildlife and the Institute for Environmental Research and Education hosted a workshop in Washington, D.C. to discuss the development of indicators for biodiversity and land use, particularly in agricultural settings. The group developed a list of potential indicators, which the Institute then tested on actual working farms, over the next two years. Since one of the objectives of the project was to develop indicators that are useful at multiple scales, they were also tested on a larger scale, on Vashon Island in Washington State. The purpose of the field tests was to determine how practical it is to measure these attributes of biodiversity. The indicators are listed below:

Protection of priority habitats and species: This indicator measures the habitat that is physically protected (fenced, for example), particularly along streams and where endangered species are known to occur.

Soil characteristics. Soil quality is determined by measuring concentration of organic carbon.

Protection of high priority habitats. This indicator measures the area of habitat set aside (not farmed or developed) that is identified as high priority by the state Heritage program.

Interface between water and terrestrial habitats (buffers). This indicator measures the total linear space of habitat adjoining water bodies as a percentage of total area managed. Area must be physically or legally protected.

Assimilative capacity of water and land. This was intended to be a) a measure of the degree to which land and water can assimilate toxic substances, b) the degree to which the natural hydrologic function has been modified, or c) the degree which surface and groundwater sources are depleted relative to the recharge rate. This proposed indicator turned out to be problematic, in part because as it evolved, it addressed several separate elements of water quality and quantity. Initially, it was intended to link to the process developed by the Environmental Protection Agency to determine total maximum daily pollution loads (TMDLs) in watersheds.

Coverage of invasive species within protected areas. This indicator measures the degree to which the vegetation in protected areas is dominated by invasive species.

Road density. A measure of the degree of habitat fragmentation by roads.

Percent of area dominated by native vegetation. Measures the footprint of native vegetation on the landscape.

Restoration of native vegetation. Amount of land area newly returned to native vegetation or newly legally protected in previous year.

Adoption of best management practices linked to biodiversity objectives. Measures number of best management practices adopted.

Distribution (patchiness, evenness). Measures size of native managed acres vs. total area managed and size of managed area vs. average field size.

Connectivity of native habitat. Number of adjacencies for areas managed as natural habitat.

Discussion

It was clear from this process that the notion of measuring environmental performance is new to many farmers. They were particularly unfamiliar with the notion of protecting endangered species or priority habitat types on their land, and were not experienced in taking measurements to determine soil quality. However, they were familiar with the problems caused by invasive species, and the importance of protecting water quality by properly managing vegetation along streams and other water bodies. They were also able to describe some best management practices in place to protect water and wildlife.

When the same list of indicators was used to determine how well biodiversity is conserved at a larger scale (on Vashon Island in Washington), it was possible to find data for all indicators except the ones addressing organic matter in the soil and water use vs. recharge. These data may be available at other locations.

The set of indicators used in this project is similar in many ways to the biodiversity measures used or proposed elsewhere. The next step for the Institute for Environmental Research and Education will be to refine the list based on the field tests and expert review, then test a revised set. There is also a need for a thorough review of the technical and popular literature on the subject, to determine whether there are relevant, user-friendly tools available to landowners, certifying organizations, and resource professionals to expedite monitoring and improve its relevance to land management and allocation for decision-makers at all levels.

Oregon's Environmental Benchmarks (6-11-02)

In the late nineties, The Oregon Progress Board facilitated a process to update and revise the state's environmental benchmarks. The process involved several committees of scientists, stakeholders, and agency personnel. A group of scientists, chaired by Oregon State University President Paul Risser, ultimately proposed 18 new or modified indicators to the Board. These indicators were described in the Oregon State of the Environment Report 2000 (15). The indicators most relevant to biodiversity are listed below (excluding three indicators for environmental health in urban areas).

WATER:
1. Water quantity: the degree to which stream flows meet ecological needs based on the proportion of in-stream water rights that can be met.

2. Water quality: proportion of streams and rivers with good to excellent water quality according to the Oregon Water Quality Index.

3. Estuarine resources: area of estuarine wetlands compared to historical distribution (acres and percent).

4. Freshwater wetlands: change in area of freshwater wetlands as compared to the historical distribution (acres and percent).

LAND:
5. Forest resources: amount of forest types in different structural stages compared to amounts in healthy forest systems, and timber harvest relative to sustainable levels.

6. Agricultural ecosystems: trends in soil quality, erosion rates and area of land in agricultural production.

PLANTS AND WILDLIFE:
7. Marine ecosystems: number of at-risk stocks of marine fish and shellfish, as defined by federal designations.

8. Riparian ecosystems: the amount of intact or functional riparian vegetation found along streams and rivers, and trends in the health of stream communities using an index comparing invertebrate populations to those expected in healthy aquatic habitats.

9. Freshwater fish communities: the percentage of wild, native fish populations, including wild salmon that are classified as healthy.

10. Biological diversity: change in area of native vegetation types, percentage of at-risk species that are protected in dedicated conservation areas, and number of nuisance invasive species.

The Progress Board evaluated the indicators submitted by the scientists and, after extensive discussion with agency personnel, adopted and/or modified most of them. For some benchmarks, the Board also set targets or performance goals. The Progress Board released its report called Achieving the Oregon Shines Vision: the 2001 Benchmark Performance Report, in March 2001. The Board adopted additional changes to the environmental benchmarks during the May 2002 meeting. The current status of the benchmarks most relevant to biodiversity is discussed below.

1. Water. Lack of good data forced the Board to change the state's measure for freshwater and estuarine wetland to acreage change per year. The recommended target for 2005 is zero for freshwater and addition of 250 acres per year for estuarine. For water quality, the measurements are percentage of monitored streams with increasing trends in water quality, water quality in good to excellent condition and decreasing trends in water quality. The percentage of streams that are improving is much higher than streams that are in good condition, so the agency preferred the trend measurement. Targets for 2010 are 75% improving, 45% in good to excellent condition and zero percent with decreasing trends. The measurement of functioning riparian lands was deferred, along with the benchmark showing trends in the health of stream communities using an index of invertebrate populations.

2. Land. The Board decided to measure the percentage of agricultural land converted to urban or rural development and forest land still preserved for resource use. A new benchmark was adopted to measure actual timber harvest compared to potential harvest levels and distinguished between public and private lands in reporting the numbers. Target ranges were set for both public and private lands at a 90 to 110% range. Actual harvests on both public and private lands were reported to be about three quarters of sustainable levels.

The Board adopted the measurement of soil quality and erosion as a developmental benchmark, along with a proposed assessment of the proportion of agriculture or rangelands managed with sustainable practices. The Department of Agriculture objected to the notion of measuring the number of farms, acres, or crops managed sustainably, although there are plans underway to hold a workshop to define sustainable management for this purpose. Adoption of the benchmark showing percentage of land in native vegetation types was also deferred because of the difficulty in reporting without a consistent land-use, land cover mapping program.

The proposed forest measurement that would have compared current land conditions to ecological reference conditions was not adopted because of objections by people who feared that the historical condition would become the target. It has been very challenging to measure forest health because there is no agreement on what that is.

3. Plants and Wildlife. The Board adopted new benchmarks for percentage of monitored wild native fish populations that are healthy, and percentage of assessed marine species that are at risk, but set no targets. About a quarter of salmon and steelhead populations are considered healthy, compared to nearly half of other species. Almost a quarter of marine species are at risk.

The board adopted a new benchmark for percentage of at-risk plant and animal species populations) that are protected in dedicated to conservation (about a third). Aquatic and terrestrial areas were divided for measurement purposes. Targets for the total weighted average are 35% in 2005 and 38% in 2010. Targets for species found in rivers and streams are 20% for 2005 and 25% for 2010. Targets for all other species were 38% for 2005 and 40% for 2010.

The Board revised the benchmark for percentage of native plant species that are healthy to say percentage of animal and plant species that are not at risk. This benchmark is divided into fish, animals and plants. The board approved 2005 and 2010 targets - 57% and 60% for fish, 77% and 78% for animals, and 89% and 91% for plants (respectively).

Initially, the Board adopted a benchmark for the number of nuisance invasive species established in Oregon (341). Later, at the urging of the Department of Agriculture, the benchmark was modified to focus on the introduction of new species, using the present as a baseline. At the May meeting the Board approved the wording for the benchmark, which is number of most threatening invasive species not successfully excluded or contained since 2000. The 2005 target has been set at five.

Discussion

The Oregon Benchmarks represent among the most sophisticated approaches taken by state government to track progress in achieving environmental goals. However, many challenges remain. Among the most troubling are the technical difficulties inherent in measuring conditions across jurisdictional boundaries. It is also challenging to persuade state agencies to measure something different than they have measured in the past. Interest groups are reluctant for the state to track their activities if they believe tracking will result in additional regulations. Also, agencies are reluctant to be judged on their performance in meeting environmental goals if they lack the resources or authority to take the steps necessary to be successful.

The Institute for Natural Resources was created by the legislature (Sustainability Act of 2001, HB 3948). With adequate support and resources, the Institute will be able to help agencies track environmental conditions across agency boundaries, and provide a more objective, third party assessment.

According to the group of scientists who recommended the new environmental benchmarks, the state needs to invest in a four year pilot study of regularly updated information on land use and

land cover change to develop, demonstrate and test the utility of a system for relating trends in land use and land use cover change, with trends in key natural resources.

Scientists at the Institute were recently asked to provide the Progress Board with recommendations concerning "ecologically optimal values" for several of the environmental benchmarks. The outcome of this process will be discussed at a later date.

Food Alliance, Wildlife Standards (6-11-02)

The Food Alliance is a nonprofit organization that certifies sustainably produced food products. It operates in the Northwest and has recently developed a partnership with the Land Stewardship Project to form the Midwest Food Alliance. The organization works directly with individual producers to evaluate performance on a wide range of environmental and social attributes on the farm. The Food Alliance label has been actively promoted to consumers, whose knowledge about the organization and sustainable agriculture has increased over time.

In 2002, the Food Alliance decided to incorporate wildlife standards into the certification process in addition to the following areas of evaluation: soil and water conservation, fair and safe working conditions, reducing or eliminating pesticide use. The advisory council, (a group of producers, resource agency personnel, and representatives from conservation groups) assisted the organization with the development and field-testing of the standards. The wildlife standards remain a work-in-progress, and are still being refined.

General Strategies

Unlike the some of the indicator projects described in this summary, the Food Alliance standards are derived from a vision describing how agricultural lands could be managed to provide better habitat for fish and wildlife. The conversation began with a focus on biodiversity, but soon shifted to the more common terminology thought to be more easily understandable to consumers and farmers. The general strategies are listed below:

Avoid converting sensitive habitats to agricultural production.

Restore sensitive habitats using native vegetation that historically occupied the site, focusing on priority areas identified by landscape scale conservation plans.

Provide as much native vegetation as possible around water bodies to provide habitat and protect water quality.

Manage habitats on farms/ranches with an eye toward the larger landscape and needs of wide-ranging species. Large, connected patches are the best.

Prevent the introduction and contain the spread of invasive species of plants and animals.

Mange to meet the habitat needs of fish and wildlife, including endangered species if they exist, or have the potential to exist on the farm.

Develop a working knowledge of the native plants and animals found in the area, and monitor for selected indicator species from different groups.

Wildlife pests, when not endangered species, are managed using integrated pest management techniques.

Performance Evaluation

Performance in each of the categories below is evaluated and placed in one of four categories. Level one is the lowest level of performance, while four is considered exemplary. A passing score for certification under the wildlife standards is seventy percent.

Continuing education. In order to reach level four, the manager is well-informed about the wildlife and habitat values on the farm, and conducts regular monitoring.

Habitat conservation. A range of low and high impact activities are listed and checked off as part of the evaluation. Low impact activities include placement of bird boxes and perches, and use of native plants around buildings. Higher impact activities, required for stronger performance evaluation, address the conservation and restoration of priority habitats within the context of a regional conservation plan.

Invasive species prevention and management. In order to reach the highest level of performance, a manager must have successfully implemented an integrated and comprehensive invasive species management strategy that controls the spread and prevents establishment of invasive species.

Endangered species protection. The highest level of performance in this category requires knowledge of endangered species that are or could be present on the farm, and active management to meet their habitat needs, preferably within the larger regional context. Credit is possible for off-site recovery efforts.

Wildlife food, cover, and water. Fish and wildlife habitat needs are addressed within and outside of cropped areas by adjusting management to make the areas attractive to wildlife. Highest performance requires wildlife monitoring on the farm.

Linking individual actions to larger landscapes. This standard encourages land mangers to gain a better understanding of the ecological and social context in which they are operating. Highest level of performance requires that habitat improvements are consistent with broader habitat and/or biodiversity plan.

Discussion

The development and implementation of the wildlife standards has been difficult. Field tests revealed that few farmers had given much thought to the conservation and/or restoration of

habitat on their land, and few had sufficient knowledge of biodiversity values in a regional context to understand what actions are most appropriate. The wide diversity of farm types, sizes, locations, resource values, degree of development etc. makes it virtually impossible and unacceptable to develop prescriptive, one-size-fits all descriptions of management activities that are desired. Although knowledge about wildlife and biodiversity values is a prerequisite to proper management, knowledge is not improved environmental performance. Quantification of accomplishments on-the-ground for this standard is extremely difficult.

The wildlife standard will be field tested again during the summer of 2002, and modified as appropriate before adoption by the Food Alliance Board later in the year.

Land Stewardship Project - The Monitoring Tool Box

The Land Stewardship Project, based in Minnesota, developed The Monitoring Tool Box to provide farmers and other rural landowners with a management tool they can use to help achieve farm-related and community goals. The "tool box" is actually a 161-page, 3-ring binder notebook. It is a comprehensive guide for farmers and others who want to be strategic in managing their land. The tool box was developed by a monitoring team, consisting of six farm families who worked closely with biologists, economists, sociologists and government agency staff to develop common-sense, user-friendly monitoring techniques. The tool box was created from the experiences of farmers, however it is applicable to all landowners. This is especially important due to the trend of increasing non-farm rural residents. The project is known nationally for its unique integration of wildlife observation, soil testing, water analysis, and quality of life analysis to create a well-rounded system for measuring the success of a farm.

The tool box encourages farmers to achieve desired goals through a monitoring process and gives step by step instructions for monitoring for a variety of elements including: quality of life, farm sustainability, birds, amphibians, soil, streams, pests, and pasture vegetation. The subjects most relevant to biodiversity indicators are birds, amphibians, streams and vegetation. By monitoring these elements, the farmer's awareness of environmental changes is improved. Ideally the landowner will modify farming practices as a result.

The members of the Monitoring Project team found that effective monitoring is aided by:

A shared long-term vision or goals for the farm and family;

General awareness of one's environment as well as one's place in the environment;

Habitat or practices that enhance observation skills; and

Well-organized and thorough documentation of thoughts, measurements, and observations.

A summary of each of the monitoring subjects is listed below.

Quality of Life
According to the tool box farm sustainability not only requires concern for profitability and ecosystem health, but also for the quality of life of the people who live and work on the farm. This section discusses tools for creating and monitoring quality of life including how to diagram values and life objectives. Although quality of life does not directly relate to biodiversity, farm families who build a shared life vision create a base from which to achieve goals for the farm and community.

Farm Sustainability

Measuring Success:
A Workshop on Biodiversity and Habitat Indicators

Background materials

Determining the sustainability of the farm means looking beyond maximizing profits, and looking at the bigger picture, including quality of life, environment, and community. The tool box uses four primary indicators to measure farm sustainability: reliance on government programs; use of equipment, chemicals, and non-renewable energy; creation of jobs; and balance between feed use and feed production. The tool box provides worksheets that help measure these indicators along with worksheet examples from several different farms. This section also gives tips on how to maximize farm efficiency from an ecological perspective.

Birds

The tool box refers to birds as "biodiversity barometers" because they respond to short term and long term changes in habitat. Monitoring changes within bird populations on the farm can help the manager see the impact of management on biodiversity and ecosystem health. The bird section in the tool box describes how to do a modified Point Count Method to track changes in bird presence and abundance. It also tells the farmer how to enhance bird habitat on the farm, such as using natural and native landscaping around buildings, leaving areas of woodlands and other natural areas, and protecting stream corridors and wetlands.

Amphibians

Monitoring frog and toad populations can help farmers assess the environmental impact of management practices because of amphibians' sensitivity to changes in water quality and land use practices. Monitoring frogs on farms involves learning the calls of the different species and then listening for them periodically throughout the year. The tool box comes with an audio cassette with identified frog and toad calls. Additionally, frog and toad sightings may also be used to monitor amphibians on the farm.

Soil

Soil health is vital to a farm's long-term productivity and profitability as well as to environmental and human health. Soil monitoring techniques can be used to assess the current status of soil resources; track changes in soil health due to management practices; and investigate specific soil problems, such as compaction. The tools discussed in this chapter assists the farmer in assessing the soil with regard to its general characteristics, physical fitness, fertility, biological activity, and crop health.

Streams

By observing the physical, biological, and chemical changes in and along resident streams, the farmer can become familiar with the natural processes that keep stream ecosystems healthy, and observe how farm practices affect the stream. The tool box instructs the landowners how to monitor the stream's physical conditions, organisms (macroinvertabrates), and water chemistry. The stream section also discusses how land use practices affects stream conditions (such as pesticide use and continuous grazing) and ways in which the farmer can protect resident streams.

Note: The last two chapters "Monitoring Pests and Pesticide Use" and "Monitoring Pasture Vegetation" are still being developed by The Land Stewardship Project.

Discussion

The Monitoring Tool Box is based on the assumption that holistic management of a farm that integrates wildlife conservation into the overall operation will provide social, environmental, and economic benefits to the farmer and the community. It is an excellent example of site monitoring conducted by landowner, who gains intimate familiarity with the particular landscape in which his operation is located. The Monitoring Tool Box is used at the discretion of the landowner, and isn't designed to be applied as an evaluation tool to measure performance against government or private certification standards. In this system, there is no direct linkage to regional or watershed level restoration plans, and no apparent attempt to feed monitoring results into a larger framework.

However, to the extent that the Tool Box provides landowners with the skills and knowledge to effectively manage the full spectrum of resources on their land, including fish, wildlife and natural habitat, it is completely compatible with more formal monitoring efforts. If and when basic biodiversity monitoring is standardized across regions, it should be relatively easy for individual landowners to determine how effective their conservation efforts have been compared to other landowners or an agreed upon standard for green payments, tax benefits, certification, or other societal rewards for good management.

Some issues that need to be addressed as the site monitoring program evolves include the effects of invasive species on ecosystems, the relative importance of species at-risk compared to those that typically thrive in agricultural landscapes, and the management of natural processes (like fire and flooding). Also, as states and regions develop biodiversity and/or habitat conservation strategies, it will be important for individual landowners to understand how their lands fit within the larger ecological context.

Measuring Success:
A Workshop on Biodiversity and Habitat Indicators

Background materials
