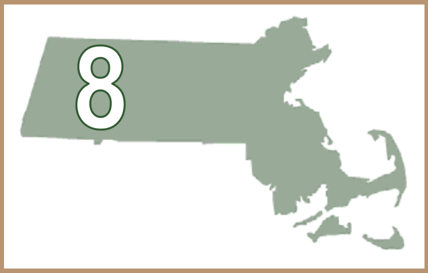


The BioMap Project, Massachusetts

Photo by Kelly Fike/USFWS

Overview

The Massachusetts BioMap Project used 22 years of natural history data to create BioMap, a map of lands that are crucial for preserving the state's extensive biodiversity (Figure 1). The map, which identifies core habitats and supporting natural landscapes, can be used to help make land use and land protection decisions as well as to guide land planning. The Massachusetts Natural Heritage & Endangered Species Program (NHESP) completed BioMap with funding from the state's Executive Office of Environmental Affairs.

Figure 1: Scarlet tanagers breed in large unbroken blocks of deciduous forest.

Photo by Steve Maslowski/USFWS

Highlights

- BioMap is built on sound scientific knowledge and the assessment of rare species and natural communities.
- BioMap provides a tool that can be used to prioritize land protection decisions and to protect biodiversity.
- The BioMap process demonstrates a way in which natural heritage staff from other states can turn their point-specific data records into a spatially delineated map that can then be related to development threat. NHESP staff have made presentations on the process to many groups, including the state of Delaware.

Background and Context

In the late 1990s, the Massachusetts Executive Office of Environmental Affairs (EOEA) became interested in conducting an analysis of the state's biodiversity out of concern that the rapid pace of land development was destroying places that provided haven to a wealth of species, sometimes even before the places and species populations were fully studied. The state's population has increased 28% in the past 50 years, while the area of developed land has increased nearly 200%. The Massachusetts Audubon Society estimates that 44 acres are developed per day in the state. About 45% of the state's forests, fields, and wetlands are currently unprotected from development. The main threats to biodiversity come from habitat destruction and fragmentation, invasive exotic species, fire suppression, and off-road vehicles.

EOEA had previously funded some pilot projects in southeastern and western Massachusetts to see what approaches would work to assess biodiversity. Henry Woolsey, program manager at the Massachusetts NHESP, drafted a proposal suggesting an analysis employing the state natural heritage database. The database includes more than 7,000 records of field-verified species occurrences. This approach was approved, and the BioMap Project began in spring 2000 as a project of NHESP with funding from EOEA.

The state has a great diversity of natural landscapes, from the old mountains and valleys in extreme western Massachusetts to the productive floodplains of the Connecticut River in the center of the state and the sandy plains of Cape Cod. These diverse landscapes provide habitats for more than 1,500 species of native plants and an array of native animals. Of the state's native species, the following percentages are classified as endangered, threatened, or of special concern:

- 15% of breeding birds
- 13% of mammals
- 53% of reptiles
- 29% of amphibians
- many invertebrates
- 15% of plants.

An effective conservation plan must accommodate the needs of the common species as well as the more specialized requirements of rare species. The BioMap Project met these requirements with elegant simplicity applied through sophisticated GIS analysis.

"We have to realize that we rely on our forests for clean air, clean water, recreation, wildlife habitat and wood. The nature of forest loss in the 21st century is different than anything we have seen in the past. Pavement is almost always permanent."

— Dr. David Foster, director of Harvard University's Harvard Forest

BioMap Goals and Objectives

The goal of the BioMap Project was to "promote strategic land protection by producing a map showing areas that, if protected, would provide suitable habitat over the long term for the maximum number of Massachusetts' terrestrial and wetland plant and animal species and natural communities."

To accomplish this goal, the NHESP staff identified and delineated areas determined to be most important to the long-term viability of non-aquatic plants, animals, and natural communities in the state. NHESP defines natural communities as recurring assemblages of distinct physical and biological elements, such as a river floodplain forest, a bog (Figure 2), or a rocky marine shore, that together provide important habitats for plants and animals.

Figure 2: The Mollie Beatty bog is an exemplary natural community in the Silvio O. Conte National Fish and Wildlife Refuge along the Connecticut River.

Photo by Ryan Haggerty/USFWS

Natural Heritage Database

Massachusetts' natural heritage database served as the foundation for the BioMap process. The database was begun in 1978 to gather and manage information about the state's biodiversity for use in environmental assessments, conservation planning, and research. Each record is based on data collected in the field by Natural Heritage program staff or by biologists, consultants, or knowledgeable citizens. Records indicate the population or natural community size, the vigor and integrity of the area and the surrounding ecosystem, the presence of invasive species or other threats, and other important information.

NHESP staff developed and implemented a three-step process to identify Massachusetts' most ecologically important lands for inclusion on the BioMap: (1) identify core habitats, (2) identify supporting natural landscapes, and (3) identify unprotected biodiversity.

Process

Step 1: Identify Core Habitats

NHESP staff conducted a comprehensive database evaluation, analyzing and updating the more than 7,000 current records in the state's natural heritage database of species occurrences. Estimates of the quality and viability of each population were made from the record information. These data describing the rare plant and animal habitats and important natural communities, which are collectively called "element occurrences," provide the scientific foundation on which BioMap is based. These data were entered into a GIS mapping database. NHESP staff used the BioMap Project as the impetus to switch to GIS recording of species occurrence data. NHESP staff also checked the field status of historical records from museums and universities dating back to the 1800s. The BioMap assessment did not include species or natural communities that are completely aquatic.

State scientists then considered the degree of rarity of the state's element occurrences (Table 1), assessed the viability of populations (Tables 2 and 3) in various locations across the state, and mapped the highest quality natural communities and rare species habitats. They assessed species and community rarity at the state and global levels using a ranking system developed cooperatively with the Association for Biodiversity (now NatureServe) and The Nature Conservancy (Table 4).

Table 1: Ranking system used to quantify the degree of rarity of each species and natural community type tracked by the Natural Heritage program.

Rarity	Description	State Rank	Global Rank
Critically imperiled	Fewer than 5 occurrences or fewer than 1,000 individuals	S1	G1
Imperiled	6 to 20 occurrences or 1,000 to 3,000 occurrences	S2	G2
Vulnerable	21 to 100 occurrences or 3,000 to 10,000 individuals	S3	G3
Apparently secure	More than 100 occurrences or 10,000 individuals	S4	G4
Secure	Common, widespread, and abundant	S5	G5

Credit: NHESP 2001a

Table 2: Viability ranks estimate the probability of long-term persistence.

Viability Rank	Estimated Viability
A	Excellent
B	Good
C	Fair
D	Poor

Credit: Adapted by MA NHESP from Association for Biodiversity Information and The Nature Conservancy. NHESP 2001a

Staff then used standard methods to rank the viability of each element occurrence. Rankings were made on the basis of the size and condition of the occurrence and the characteristics of the area around the occurrence. A-ranked occurrences have the greatest chance of long-term survival; occurrences ranked D are most likely to disappear. Approximately 2,500 occurrences of 246 rare plant species were assessed for viability, along with 750 occurrences of 92 different natural community types. All occurrences of the rarest biological elements were included in BioMap, as were the highest quality examples of the more common elements. Viability analysis showed that nearly 1,700 rare plant occurrences (67% of the total) and 643 natural community occurrences (86% of the total) met the criteria (Table 4) for inclusion in BioMap. To translate "point" occurrence data into spatial information on the BioMap (e.g., a polygon instead of a point), rare plant occurrences were surrounded with a circle 660 feet in diameter. Natural communities were mapped with the aid of aerial and color infrared photos, which show vegetation types, and topographic maps.

Table 3: Factors and components used to determine viability rank of rare plant and natural community occurrences.

Factor	Component
Size	• Area of occupancy • Number of individuals • Population density • Population fluctuation
Condition	• Reproductive success and health • Maturity of natural community • Species composition, biological structure, and presence of exotic species • Ecological processes and degree of disturbance • Physical and chemical factors
Landscape context	• Landscape structure, connectivity, fragmentation, and patchiness • Condition of the surrounding landscape

Credit: Adapted by MA NHESP from Association for Biodiversity Information and The Nature Conservancy. NHESP 2001a

Table 4: Natural Heritage program staff used the rarity rank of each species and natural community type, in conjunction with the viability rank of each occurrence, to determine which rare plant populations and natural communities would be included in BioMap.

Element Rarity	Occurrence Viability Ranks Selected for BioMap	
	Rare Plant Species	Natural Community Types
Globally critically imperiled (G1)	All occurrences (A-D)	All occurrences (A-D)
Globally imperiled (G2)	All occurrences (A-D)	All occurrences (A-D)
Globally vulnerable (G3)	Best occurrences (A-C)	All occurrences (A-D)
State critically imperiled (S1)	All occurrences (A-D)	All occurrences (A-D)
State imperiled (S2)	Best occurrences (A-C)	Best occurrences (A-C)
State vulnerable (S3)	Very best occurrences (A-B)	Best occurrences (A-C)
State secure (S4 & S5)	Not explicitly selected	Very best occurrences (A-B)

Credit: NHESP 2001a

Because of the mobility of animals and the difficulty in tracking them, occurrences for rare animals were not specifically included in BioMap. Instead, high quality habitats known to support these rare animals or to meet their habitat needs were included. Digital habitat maps were created for each rare animal species using GIS and aerial photos. By mapping the habitat that supported rare animal species, the needs of more common species and broad classes of organisms, such as grassland birds, were also met.

"Core habitats" are based on actual data points for rare species and natural communities and represent the areas of highest priority for conservation (Figure 3). After separately mapping the most viable rare plant and animal habitats and natural communities currently known in the state, these data layers were combined into one to produce the core habitat map.

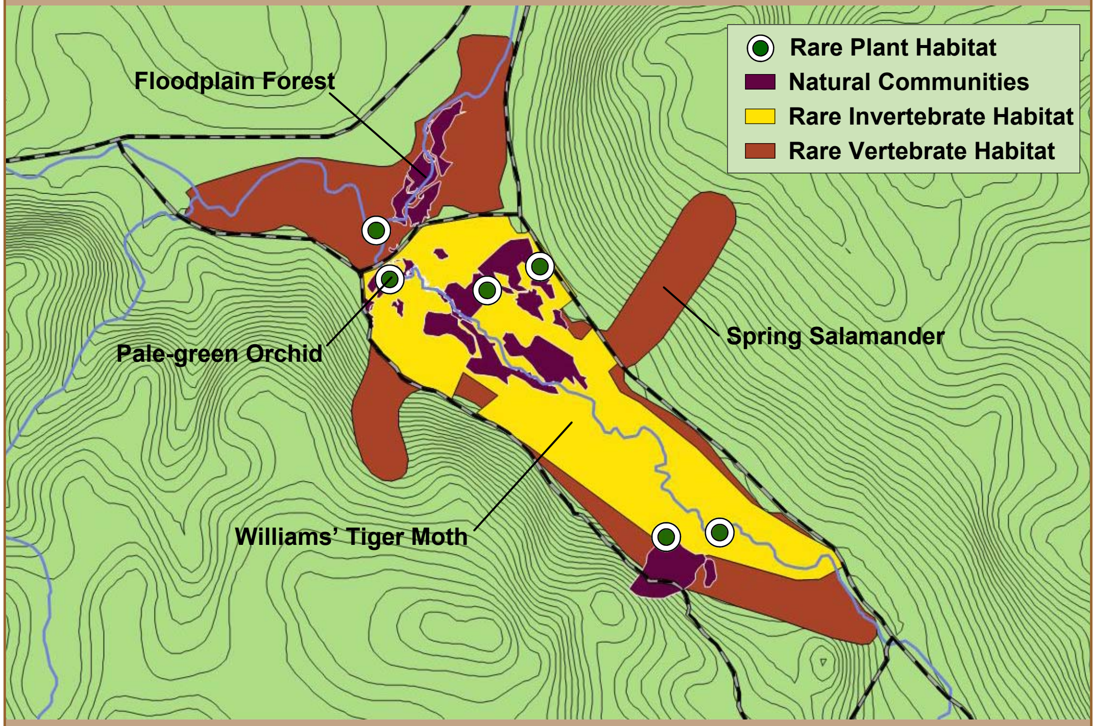
Step 2: Identify Supporting Natural Landscapes

"Supporting natural landscapes" are important to the viability of all of the state's biodiversity, including more common plant and animal species. They consist of buffers to core habitats, large patches of natural vegetation, large roadless areas, and undeveloped watersheds that together provide buffers, connectivity, and ecological processes that maintain biodiversity and support the ecological integrity of the core habitats.

NHESP staff used a GIS program to identify supporting natural landscapes. They divided the state into 100-foot square grid cells and analyzed each undeveloped cell on the basis of seven factors for its contribution to the supporting natural landscape. The factors included:

- *distance to core habitat*. Cells within 400 feet of core habitat received the highest scores.
- *size of undeveloped natural vegetation patch*. Cells within undeveloped patches of at least 15,000 acres received the highest scores.

Figure 3: A concentration of biodiversity and exemplary natural communities results in areas of core habitat.



Credit: NHESP 2001a

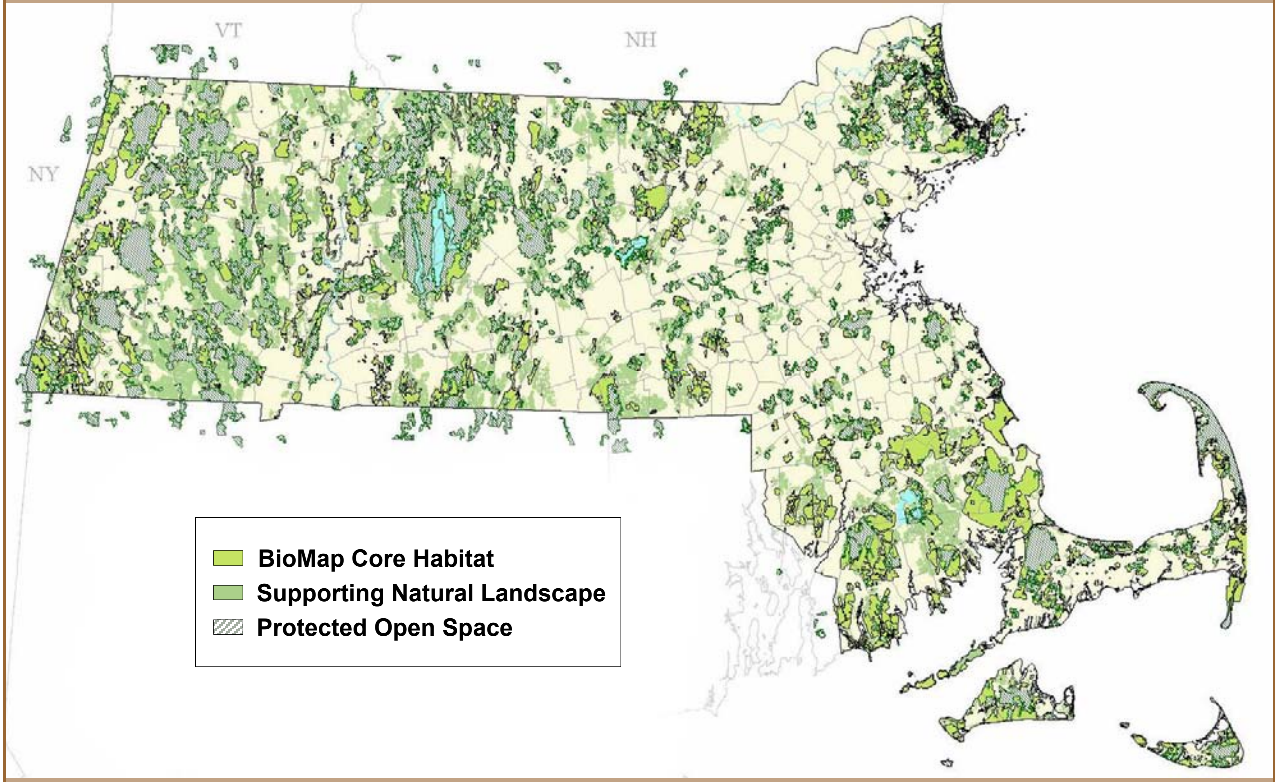
- *distance to the edge of developed land*. Cells more than 3,250 feet from developed land scored highest.
- *forested in both the 1830s and 1990s*. Seeking to preserve areas with old-growth characteristics, cells within patches greater than 100 acres received the highest scores.
- *size of roadless block*. The largest blocks (greater than 15,000 acres) received the highest scores.
- *size of clustered roadless block*. Roadless blocks larger than 1,000 acres were clustered, and those areas greater than 25,000 acres scored highest.
- *percent of watershed with natural vegetation*. Intact watersheds with more than 90% undeveloped natural vegetation scored highest.

Scores for each factor were them summed for each grid cell and the highest scoring cells were included as supporting natural landscapes on the final BioMap. Comparable data from surrounding states were used to assess grid cells on the borders of Massachusetts.

Step 3: Identify Unprotected Biodiversity

NHESP staff then assessed core habitat and supporting natural landscape areas' current level of protection. Data from the Massachusetts Office of Geographic and Environmental Information (MassGIS) describing areas of currently protected open space were overlain on the delineated core habitat and supporting natural landscape areas. The combined map shows which areas of the state with high biodiversity are vulnerable to development (Figure 4). The land protection community around the state can use the map proactively to make land protection decisions.

Figure 4: BioMap core habitat and supporting natural landscapes in relation to protected open space.



Credit: NHESP 2001a

Public Outreach

NHESP staff completed an engaging, full-color summary report and a full-color poster. These products are available to the public for free on request. The map and information about the process are available on the NHESP Web site (http://www.mass.gov/dfwele/dfw/nhesp/nhbiomap.htm). Also available on the Web site are interactive features that allow viewers to explore areas of specific interest to them and downloadable GIS data relating to BioMap (http://www.mass.gov/dfwele/dfw/nhesp/nhpubgis.htm).

Public input was not specifically sought during the production of the BioMap final products. However, public reaction has been "awfully positive," according to Pat Swain, natural community ecologist with NHESP. Natural Heritage staff sent local maps that combine BioMap and Living Waters (aquatic) core areas to conservation commissions, town planning boards, community development plan committees, community preservation act committees, and local land trusts. The maps detail town-specific information about the species and important natural community occurrences in their jurisdictions. Swain indicated that towns want the information so they know what lands they should protect. The reports are available free on-line and maps are provided on request, sometimes for a small fee.

EOEA's efforts in biodiversity preservation include an educational component called Biodiversity Days, intended to generate citizen interest in biodiversity and appreciation for the complexity and beauty of the natural world. Participants are encouraged to explore the biodiversity of their neighborhoods with help from state agency staff, local experts, and a workbook called *Exploring Biodiversity*.

Results and Products

The BioMap analysis (Table 5) generated the following results:

- core habitat - 1,160,000 acres (23% of state), 61% of which are unprotected;
- supporting natural landscape - 970,000 acres (19% of state), 78% of which are unprotected; and
- Total - 2.3 million acres (core habitat + supporting natural landscape) (42% of state), 69% of which are unprotected.

Table 5: Species and natural communities included on the BioMap.

Biodiversity Group	Verified Communities and Rare Species	Total Community Types and Native Species
Vascular plants	246	1,538
Birds	21	221 breeding species
Reptiles	11	25
Amphibians	6	21
Mammals	4	85
Moths and butterflies	52	An estimated 2,500 to 3,000
Damselflies and dragonflies	25	An estimated 165
Beetles	10	An estimated 2,500 to 4,000
Natural communities	92	At least 105 community types

Credit: NHESP 2001a

NHESP staff produced a full-color, beautifully illustrated final report called *BioMap, Guiding Land Conservation for Biodiversity in Massachusetts*. They also completed a set of GIS maps, a technical appendix detailing the methods used, and a poster.

Massachusetts has a statewide land conservation plan that was drawn up in partnership with land trusts, municipal governments, and federal agencies. The plan outlines land protection priority areas regionally and statewide (Figure 5). The committee working on this plan voted to incorporate the core habitat areas of BioMap into the plan.

The state Department of Fish and Game and other state agencies use BioMap to identify lands for purchase. Since BioMap was completed, Massachusetts has protected more than 44,000 acres of land. A GIS analysis of the purchases shows that about two-thirds of the acres acquired by EOEA agencies since the BioMap Project was published were in BioMap core habitats or supporting natural landscapes. Acquisition and protection of land continue to occur within BioMap and Living Waters core areas, but state money devoted to land protection has declined from the high level of funding received in 2002.

The Department of Conservation and Recreation's Division of Water Supply Protection (formerly the Metropolitan District Commission) oversees the Boston metro area water supply, which includes three watershed areas for 43 communities. The department mapped land recently acquired and land targeted for protection on the basis of 12 weighted criteria. They found more than 75% coincidence between BioMap and acquired areas.

Figure 5: Great blue lobelia is found only on calcium-rich soils in Massachusetts.

Photo by Chris Evans, The University of Georgia, www.forestryimages.org

"I believe that the resulting BioMap is a national model for proactive biodiversity conservation at a landscape scale. It is also my hope that it will be used as a tool for local open space protection plans in Massachusetts."

— Bob Durand, former Secretary of Environmental Affairs, Commonwealth of Massachusetts

Management and Stewardship

Lands included on the BioMap remain under the management and stewardship of their present owner. NHESP staff may be able to provide advice, if desired, about managing rare species (Figure 6) or habitats. BioMap lands should be among the highest priorities for acquisition and management of open space.

Financing, Costs, and Benefits

Financing

EOEA funded BioMap through NHESP at about $1 million over slightly more than two years. The money came from the state environmental bond fund. (An environmental bond is floated every four to five years at the legislators' discretion. It is used primarily to buy land and to support land use planning projects.) This funding allowed NHESP to double its staff. They hired 15 additional people to complete the work of BioMap, including ecologists, botanists, zoologists, a project manager, a data management specialist, and a GIS specialist. The program bought a trailer to house the additional staff, as well as new computers, GIS software for every computer, a GIS plotter, digital cameras, and other equipment. The EOEA funding also covered salaries, travel costs for field surveys, and the writing, design, and production of a technical report and a full-color book and poster about BioMap for the general public.

Figure 6: The bog turtle, a federally threatened species, is Massachusetts' most vulnerable turtle.

Photo by R. G. Tucker, Jr./USFWS

Benefits

The BioMap Project provides improved information that helps to protect:

- biodiversity and the health of the natural world for future generations.
- water supplies and watersheds.
- aesthetic beauty.
- working landscapes such as farms and forests.

In addition, BioMap:

- provides improved information for identifying the lands most urgently in need of protection.
- resulted in the nomination of some species for listing as threatened or endangered based on new information gathered through BioMap, giving them a better chance for survival.
- provides a process model and staff expertise for other state natural heritage programs to use in conducting a statewide biodiversity survey.
- developed a scientifically supportable process whereby a point-based natural heritage database could be translated into a map that represents the spatial "footprint" of these important features. This technique represents a strategic green infrastructure-based approach to land conservation.
- increased the availability of GIS programs and tools and improved proficiency in GIS skills among NHESP staff, which facilitates standard environmental reviews of new developments.
- improved the accuracy and scope of the state's natural heritage database.

Application of Green Infrastructure Principles

Principle 1: Protect green infrastructure before development.

The BioMap Project allowed the Massachusetts Division of Fisheries and Wildlife to identify the lands richest in biodiversity and/or important as habitat for rare species or supporting natural processes, thereby prioritizing these lands for future land protection decisions.

Principle 2: Engage a diverse group of stakeholders.

Partnerships are key to land protection in Massachusetts. The Massachusetts Audubon Society, the Massachusetts Land Trust Coalition, the Trustees for Reservations, and The Nature Conservancy cooperated with the state on the BioMap Project. Harvard Forest and The Nature Conservancy had already mapped some areas as potential hotspots of biodiversity. Many of these areas were field-checked for rare species (Figure 7) and natural communities. The Nature Conservancy had also defined ecological land units and ranked pieces of land according to land use and distance from roads. These approaches proved useful in formulating the procedures for compiling the BioMap. Many of the collaborating groups participated in designing the BioMap protocol and helped assess the completed maps.

Principle 3: Linkage is key.

The design of the BioMap Project promotes connectivity among conservation lands; for example, core habitats are buffered and linked by supporting natural landscapes. The statewide GIS analysis of connectivity and proximity used to rank supporting natural landscapes demonstrates a sound approach to designating buffer zones. The BioMap Project also brought together the efforts of the Executive Office of Environmental Affairs, the state Division of Fisheries and Wildlife, MassGIS, Manomet Center for Conservation Sciences, The Nature Conservancy, Harvard Forest, the natural heritage programs of five neighboring states, and other groups.

Figure 7: The piping plover is listed as threatened in Massachusetts.

Photo by Gene Nieminen/USFWS

Principle 4: Work at different scales and across boundaries.

The BioMap Project works across jurisdictional lines because rare species and natural communities do not reflect these delineations. Natural heritage information was sought from neighboring states. Various output products allow users to look at the big picture of biodiversity on a statewide basis or focus in on a specific town.

Principle 5: Use sound science.

BioMap was based on 22 years of biological records gathered by biologists and concerned, knowledgeable citizens. The viability of species populations and natural communities was assessed systematically, taking into account the degree of rarity within the state and around the world. The cumulative analysis of grid cells in undeveloped areas statewide represents a scientifically defensible and objective way to assess the degree of connectivity and lack of disturbance of areas near core habitat. The results of the BioMap analysis allow state and local governments, land trusts, and others with an interest in land preservation to prioritize their purchases based on the protection of biodiversity.

Principle 6: Fund up-front as a public investment.

The BioMap Project was funded by the EOEA with money from the state environmental bond fund. Having a reliable up-front source of funds allowed project managers to take a broad view of the work and efficiently assemble the many components needed to do a thorough job.

Principle 7: Green infrastructure benefits all.

The BioMap Project highlights the habitats of the state's rarest species and important natural communities for protection. The project greatly expanded the breadth and depth of knowledge about the state's biodiversity. This helps ensure that important natural communities and species populations (Figure 8) aren't wiped out before they're studied. The methodical process used to create the BioMap offers to other state natural heritage programs a way to turn point-based species occurrence data into a map representing the spatial extent of biodiversity that can be related to vulnerability to development.

Principle 8: Make green infrastructure the framework for conservation and development.

BioMap includes the lands that are critical for the protection of biodiversity and, by default, ecosystem services. It provides a tool to help make land protection decisions.

Figure 8: Black-crowned night herons nest in only 19 colonies in Massachusetts.

Photo by Gary M. Stolz/USFWS

Evaluation

Unique, innovative, outstanding elements

NHESP staff take pride in the fact that BioMap was based on the state's extensive natural heritage database of known rare species and natural communities locations (Figure 9) and descriptions. They are pleased that they were able to make sense of all those records and turn them into a scientifically based map. A key to accomplishing this was having various staff who were able to use GIS and other new technologies. The bond funding helped bring the program up to speed technologically and to double the size of its staff. As a result, standard environmental reviews for new developments can now be done more quickly and easily.

NHESP benefited from the strong and continuous support of EOEA. Knowing that the money was committed to the project allowed staff to focus on the task instead of on political wrangling and penny-pinching.

Lessons Learned

The short timeframe for the project presented the greatest challenge. NHESP staff had 2.5 years to determine exactly how they would proceed, to do the analysis, including field-checking hundreds of records, to produce the GIS map, and to write and produce two documents explaining the whole process, one for the public and one a technical report. The push to get the work done was intense, but because everyone involved strongly believed in the effort, it was doable and exciting. There was a lot of skepticism both inside and outside of the program about whether they could produce something in the time allotted. But the staff felt that because they'd been given what amounted to unbelievable "riches" for a state natural heritage program they were motivated to produce a terrific product. The rapid doubling in staff numbers was jarring and labor-intensive, and facility and space problems had to be addressed quickly and efficiently.

Related Efforts

Living Waters Project

With funding from the EOEA, the state Division of Fisheries and Wildlife also analyzed and mapped aquatic biodiversity—rare fish, aquatic invertebrates, and plants, and exemplary aquatic ecosystems. This 2-year project was completed in summer 2003. Components of the Living Waters project include an extensive literature survey to glean rare species records; updating and field-checking rare and historical aquatic plant location data; collecting and analyzing freshwater macroinvertebrates, including non-insects; assessing lakes, ponds, and streams; reviewing mussel data and rare and critical fish data; and GIS analysis of exemplary natural communities and rare species occurrences. Staff completed an initial GIS analysis, on the basis of which they selected water bodies for further assessment. Biologists then visited the sites to gather additional data. They also mapped core habitats and searched for new locations containing rare aquatic species. The results identified 429 critical sites for 58 rare aquatic plants and animals (23 plants, 24 invertebrates, and 11 fish species). Only 24% of riparian land adjacent to aquatic core habitats is currently protected.

In addition to a full-color map and report, NHESP staff produced a field guide to the damselflies and dragonflies of Massachusetts.

Technical Assistance

NHESP has proposed funding for technical assistance to municipalities, land trusts, and other land protection groups in creating open space plans and using the BioMap data. While no funding has been provided explicitly for local technical assistance, maps were provided to towns and some outreach work is done through other NHESP information assistance. In 2003, with recent tight state finances, NHESP lost its line item funding in the state budget.

The new administration has provided discretionary bond funding for NHESP's new “Species Habitat Mapping” project. This project will delineate and assess the species habitats “of each of Massachusetts' 450 rare plant and animal species based on more than 6,800 point observations documented within the last 25 years. The resulting species habitats will help inform the delineation of rare species regulatory areas and will enhance species-specific habitat assessments, conservation and management plans, and more.” (NHESP. Personal communication. November 21, 2005.)

Figure 9: Harvard Forest, in central Massachusetts, is an example of a mixed oak, maple, and birch woodland.

Photo by John D. Hodges, Mississippi State University, www.forestryimages.org

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About Green Infrastructure

Green infrastructure is a strategic approach to land and water conservation that links lands for the benefit of nature and people, helps identify conservation priorities, and provides a planning framework for conservation and development. Green infrastructure is different from conventional approaches to conservation because it looks at conservation values and actions in concert with land development and growth management. Green infrastructure projects bring public and private partners together to work collaboratively toward a common land conservation goal. They help move beyond jurisdictional and political boundaries by providing a process for identifying, protecting, and restoring interconnected green space networks that conserve natural ecosystem functions and provide associated benefits to human populations. The green infrastructure approach appeals to people concerned about biodiversity, habitat, and land conservation as well as people interested in open space and land use planning at the community, region, or statewide scale. It also appeals to smart growth advocates because of its potential to lessen impacts and reduce the costs of built infrastructure.

Green Infrastructure Case Study Series

This series of case studies highlights successful and innovative green infrastructure projects from around the country. The series was undertaken so that readers can learn from and improve upon approaches tried by others. We hope that thorough, well-documented examples will allow readers to see the many possibilities and to adapt successful practices to their unique situations and challenges. Each case study addresses the same basic pieces of the story: overview, highlights, background and context, process, public education and participation, results and products, management and stewardship, financing, application of green infrastructure principles, and evaluation. Eight principles of green infrastructure, which are elements of most successful efforts, form the core of the case studies. The series illustrates concrete, real-life examples of how to assess and protect green infrastructure, including details about how each step was implemented.

About The Conservation Fund

The Conservation Fund is a national, nonprofit land conservation organization that forges partnerships to protect America's legacy of land and water resources. Through land acquisition, community planning, and leadership training, the Fund and its partners demonstrate sustainable conservation solutions emphasizing the integration of economic and environmental goals. Since 1985, the Fund has protected more than 4 million acres of open space, wildlife habitat, and historic sites across America.

The Conservation Fund's Green Infrastructure Program was created in 1999 to build the capacity of land conservation professionals and their partners to undertake strategic conservation activities that are proactive, systematic, well integrated, and applied at multiple scales. The program is a cooperative effort of the Fund and multiple public and private partners. Program products include a national course, workshops and conference sessions, publications, case studies, demonstration projects, a Web site, and related educational materials.

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