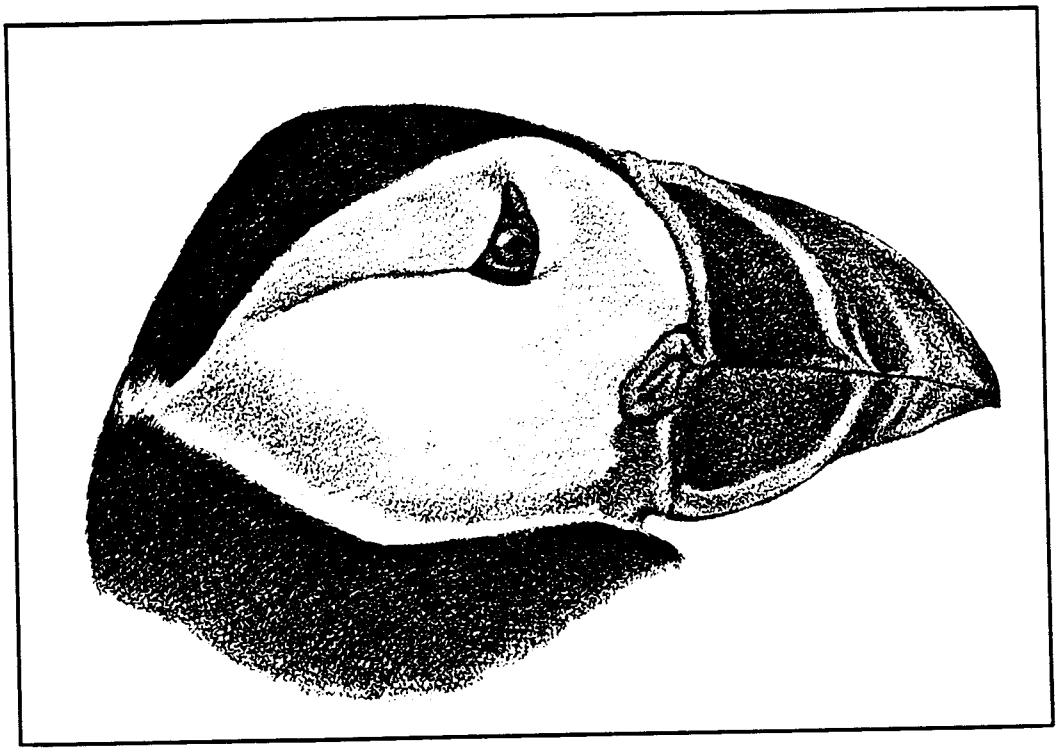
Conservation in Working Landscapes

20th Annual Natural Areas Conference



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Conference Abstracts:
Papers & Posters

TABLE OF CONTENTS

Page

PAPERS

Page

Page

Page

Page

Page

POSTERS

LANDSCAPE ANALYSIS: CATALOGING BIODIVERSITY FOR CONSERVATION ON LARGE LAND AREAS

John Albright
Maine Natural Heritage Program

The first step in determining conservation priorities is obtaining accurate and current information on the distribution and status of the elements of biodiversity -- plants, animals, and natural communities. The potential for effective conservation action is enhanced, however, if such information is available to land owners and managers for early incorporation in long-range land use plans. Landscape Analysis is a "low-tech" approach that assimilates for large land areas existing data on the location and habitat requirements of rare and exemplary species and communities with air photos, land use records, and readily available physical data (topography, soils, geology, hydrology, etc.) to predict the potential occurrences of significant biological features. Subsequent field studies can verify absence, or presence and quality of these "potential" natural areas. The method has yielded increases of nearly 50% in the number of extant occurrences for natural areas in a "heavily botanized" county in Maine, and can thus result in more accurate assessments of relative significance of natural areas. These data are useful in clarifying conservation goals among landowners and conservation interests, and enabling land owners and managers to plan ahead for the potential economic impacts of conservation action. And, because Landscape Analysis can yield data quickly for large areas of a state, it can support new and innovative statewide planning and conservation initiatives, such as a proposed new concept, a "revolving land conservation bank".

USING GIS TO MAP POTENTIAL *ISOTRIA MEDEOLOIDES* (PURSH) RAF. HABITAT IN NEW HAMPSHIRE AND MAINE

Molly B. Sperduto
Department of Natural Resources
University of New Hampshire

Isotria medeoloides (Small Whorled Pogonia) is the rarest orchid in eastern North America. Although it has a wide ranging distribution, more than one half of the known plants are found in New Hampshire and Maine. A geographic information system will be used to determine whether *I. medeoloides* populations in New Hampshire and Maine prefer particular site conditions. Criteria including soil type, forest cover, slope, aspect, hydrology, historic land use, and geologic features will be overlaid on a subset of known populations. The importance of each of the criteria will be examined. Using the GIS, habitat characteristics will be located in selected quadrangles in New Hampshire and Maine. Potential *I. medeoloides* habitat will be mapped where key criteria coexist. To determine the effectiveness of the model to predict potential habitat field surveys will be conducted. Information on microsite habitat characteristics including leaf litter depth, vegetative associations, canopy cover, and the presence of rotten stumps or logs will be collected and analyzed to refine the general model.

HABITAT SHIFTS IN ISLAND-NESTING SEABIRDS: A PRELIMINARY REPORT

John G.T. Anderson
College of the Atlantic

Petit Manan Island is the site of a significant nesting colony of Common, Arctic, and Roseate terns and also supports numbers of Laughing Gulls, Guillemots and Atlantic Puffins. College of the Atlantic and the U.S. Fish and Wildlife Service are engaged in a long-term management study of the island's seabirds. The island was surveyed in 1989, and a 30 m grid system was developed during subsequent seasons. All data relating to seabird nesting success and habitat choice and availability is entered as a series of ARC/INFO GIS data layers. Data derived from GIS analysis is transferred to statistical software for subsequent examination, and the results of statistical manipulations may in turn be fed back into the GIS. Although we are still in the early stages of this study, some patterns are beginning to emerge. This paper will discuss the costs and benefits of a GIS approach to habitat monitoring and will present results of work to date. Appropriate technology will be discussed, as will time commitments and future applications, including use of Global Positioning Systems (GPS) and remote sensing.

ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM: OVERVIEW

James M. Colby
Bureau of Land Management

The Environmental Monitoring and Assessment Program (EMAP) was established in response to the need for systematic and reliable information on the status and trends of the condition of the nation's ecological resources. The EMAP is an interagency, interdisciplinary program that will contribute to decisions on environmental protection and management by integrating research, monitoring, and assessment. EMAP is organized to focus on the following resource groups: Agroecosystems, Arid Ecosystems, Forests, Surface Waters, Wetlands, Great Lakes, and Coastal Estuaries.

Under EMAP, around 15,000 long-term monitoring sites will be established to track ecosystem conditions over time. Further, attempts will be made to establish, with known confidence, associations between ecosystem condition and natural or human-induced stresses.

This paper will describe the basis for EMAP, the major features of the program, the status of the program, and the principal issues which have been raised. The presentation will also illustrate, with slides, some of the early results which have been obtained through pilot and demonstration work with EMAP giving emphasis to Northeastern experiences.

MONITORING RARE SPECIES: THE DEMISE OF THE 1M^2 PLOT

Dan Salzer
The Nature Conservancy, Oregon Chapter

The monitoring of rare species frequently involves sampling procedures that involve counting individuals within quadrats. Three decisions must be made when a quadrat-based sampling procedure is used: (1) quadrat size; (2) quadrat shape; and (3) the number of quadrats to use (sample size). Standardized methods are often used in a wide variety of situations without the careful consideration of these three decisions. This problem is most severe with regards to the decisions of quadrat size and shape. Square quadrats measuring 1 m^2 are one of the most frequently used quadrat sizes for many ecological field monitoring studies.

If populations consisted of randomly distributed individuals then quadrat size and shape would not impact the precision of population estimates as long as the same total number of individuals were counted in each sample. However, very few populations consist of randomly distributed individuals. Plants and many animal populations consist of individuals distributed with some degree of aggregation. The precision of population estimates from clumped populations is strongly influenced by the size and shape of the quadrats as well as by sample size.

Computer simulated sampling was used to evaluate precision levels for samples where a variety of different quadrat sizes and shapes and sample sizes were used. One thousand samples were drawn from the population for each combination of quadrat size, quadrat shape, and sample size. Results of this sampling demonstrate that long rectangular quadrats provide substantial gains in precision over square quadrats when quadrat size or number of quadrats sampled are held constant. Elongated quadrats have a greater likelihook of encountering clumps or patches of individuals and therefore among-quadrat variance is lower. This lower variance leads to more precise estimates of population size and to monitoring studies capable of tracking smaller between-year changes in density.

GAP ANALYSIS: A SPATIAL APPROACH TO IDENTIFYING REPRESENTATIVE AREAS FOR MAINTAINING BIODIVERSITY

J. Michael Scott, A. Ross Kiester, Blair Csuti,
Reed F. Noss and Bart Butterfield
Idaho Wildlife Cooperative Wildlife Research Unit and
U.S.D.A. Forest Service

Gap analysis uses satellite remote sensing and geographic information system technology to compare the distribution of several elements of biodiversity (vegetation cover, animal distributions) with that of areas currently managed primarily for native species and natural ecosystems. Species and vegetation types not currently represented in reserves are identified as "gaps." The goal of gap analysis is to identify a set of areas in which all elements of biodiversity are represented. Using a data set for the State of Idaho, we subdivided the state into 404 635 km hexagons. An exact set coverage analysis identified several families of four hexagons in which 96% of all species "gaps" are predicted to be represented. Field studies should be directed toward these areas as potential components of a fully representative reserve network.

AN ECOLOGICAL EVALUATION OF PROPOSED NEW CONSERVATION AREAS IN IDAHO USING GAP ANALYSIS

R. Gerald Wright
National Park Service Cooperative Studies Unit

Four new National Park Service administered areas have been proposed by various interest groups to be established in the State of Idaho. The areas encompass an average of 220,000 ha and contain important scenic, recreational, and geological resources. The biological resources protected by these proposals however have received little comparative regional evaluation. This paper used the U.S. Fish and Wildlife Service's GAP Analysis Project Idaho databases to evaluate the vegetal resources contained in each proposal and its respective ecoregion. Databases included vegetation, land ownership, and land protection maps which were analyzed using a geographic information system. Vegetation types were used as surrogates for information on the distribution of other biological resources. A conservation strategy was evaluated that would preserve each vegetation type in proportion to its occurrence with at least 10% of the land area of each type protected. Although an average of 85% of the lands in the three ecoregions were publicly owned, only 15% of the vegetation types were fully protected. The four proposals added little to this figure because the majority of the vegetation resources (67-78%) found in the proposals were already protected elsewhere in the ecoregion. Land areas providing new protection in the proposals ranged from 16-30%. We analyzed the effect of modifying the boundaries of the proposals to enhance resource protection. None of the proposals could be feasibly modified to fully protect all of the vegetation types. However, the protection provided by all of the proposals could be enhanced to varying degrees with the addition of relatively small areas of land.

DESIGNING AN ECOLOGICAL RESERVES SYSTEM USING A LANDSCAPE APPROACH

Janet McMahon
The Nature Conservancy, Maine Chapter

An ecological reserve system has been proposed for Maine that is designed to encompass the full range of biological and landscape diversity of the state. This system would accommodate three broad purposes: research and long-term environmental monitoring activities, conservation of biological diversity, and science education. Reserves would be selected using both natural community and biophysical region classifications. The biophysical classification developed for Maine relates distribution patterns of woody plant species to climate, topography, bedrock and surficial geology, and soils. Preliminary boundaries for 15 regions were determined by examining the spatial patterns of a number of mapped environmental variables and distributions of 240 native woody taxa. These regions vary primarily along a climatic gradient associated with net available energy. Individual reserves would be established to maintain one or more natural ecosystems that are representative of a given biophysical region and would be large enough to maintain the functions and processes naturally present in each ecosystem type. Based on preliminary inventory work, approximately half of the more than 100 natural ecosystem types that have been described for Maine are represented on existing public and private conservation lands. A complete ecological reserves system could be expected to include about 120 reserves.

BIOLOGICAL DIVERSITY IN MANAGED FORESTS

Dr. Malcolm L. Hunter
University of Maine

SUSTAINABLE FORESTRY OR SUSTAINABLE FORESTS?

Dr. Reed F. Noss
Oregon State University

CHANGES IN GULF OF MAINE COASTAL FOODWEBS DUE TO DECLINE IN PREDATORY FINFISH

Dr. Robert Stenick
Darling Center
University of Maine

TOURISM AND STEWARDSHIP: A NEWFOUNDLAND AND LABRADOR CASE STUDY

Tom Horn
Atlantic Center for the Environment

LAND USE CORRELATES OF FARMLAND BIRD DISTRIBUTIONS

Dr. Raymond O'Connor
University of Maine

NATURAL COMMUNITIES CONSERVATION PLANNING: SOUTHERN CALIFORNIA'S ECOSYSTEM APPROACH TO ENDANGERED SPECIES CONSERVATION

Susan A. Cochrane
California Department of Fish and Game

Continued single species listing has often not worked quickly enough to save ecosystems from decline. In Southern California the State has begun an innovative program designed to take an ecosystem approach to conservation. It is hoped that NCCPs will reduce the need for listings of most of the more than 50 species in decline in this region. The Natural Communities Conservation Program's goal is to conserve long term viable populations of California's native plant and animal species, and their habitats, in areas large enough to safeguard their continued existence. The opportunities and challenges of efforts of this magnitude will be discussed as well as current progress.

A CASE STUDY OF MANAGEMENT IN A LARGE NATIONAL PARK: GLACIER BAY AND ITS RESOURCES

S. James Taggart
National Park Service

Extensive commercial fisheries began before Glacier Bay National Monument was established in 1925. These fisheries continue today even though they are considered illegal under National Park Service (NPS) 1982 regulations prohibiting commercial fishing in Parks (commercial harvest from Park waters exceeds 1,000,000 pounds annually). Glacier Bay was designated a National Park by the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), which designated certain areas of the Park as wilderness waters, including portions of the traditional commercial fishing grounds. Commercial fishing continues in these wilderness areas despite its prohibition by the Wilderness Act of 1964. Proposed NPS regulations will close commercial fishing in wilderness waters as soon as they are finalized and in all Park waters by the year 2002, unless scientific studies indicate that the fisheries are compatible with ANILCA and with the NPS Organic Act of 1916. In addition to providing managers with critical information, the research on commercial fishing will provide the opportunity to begin studying the Glacier Bay National Park marine ecosystem, one of the largest marine Parks in the world. This talk will focus on Pacific halibut (*Hippoglossus stenolepis*) and Dungeness crab (*Cancer magister*).

Pacific Halibut. We have initiated seven studies on Pacific halibut: 1) home range/movement behavior, 2) inter-year home range fidelity using implanted sonic tags, 3) sport harvest assessment, 4) commercial harvest assessment, 5) feeding ecology by stomach content analysis, 6) fecundity analysis, and 7) a mark-recapture demographic study. Among our findings are the following: Halibut have much smaller home ranges than previously thought; the mean minimum polygon home range size is only 497 m^2, while the 95% utilization distribution is only 236 m^2 (Anderson-Fourier method). Larger halibut have smaller home ranges, individuals in areas with greater topographic relief also have smaller home ranges, and males have larger home ranges than females. The spatial distribution of the population may be highly structured. There is a high spatial variability in the commercial fishing effort.

Dungeness Crab. Controlled experiments testing the impact of human exploitation on the population structure of harvested marine species are rare. Through an interagency effort (NMFS, NPS, University of Alaska, and ADF&G) we are conducting a comparative population study of exploited and unexploited Dungeness crabs. Half of the selected study sites are within wilderness waters (i.e. soon to be closed to fishing), and half are in areas which will not be closed to crab fishing. Twice a year (spring and fall) we sample each site to measure the following parameters: population density, size class distributions of populations, physical condition of individual crabs, and the reproductive condition of female crabs.

PROTECTED AREAS AND MARINE RESOURCE MANAGEMENT

Gary E. Davis
National Park Service

Truly natural areas are rare in coastal marine environments. The lack of protected marine ecosystems makes it difficult to assess potential productivity of coastal systems, to determine the effects of coastal developments, or to evaluate resource management strategies and actions. Case studies of recent coastal fishery failures and sewage spills in southern California demonstrate the values of marine protected areas. Monitoring ecological dynamics in marine protected areas has the potential to improve society's knowledge base for critical decisions regarding such pressing issues as waste disposal and sustainable fisheries management. A study in Cabrillo National Monument in San Diego, California showed that a massive spill of 11 billion gallons of urban sewage had less negative impact on intertidal communities than the cumulative, chronic effects of 85,000 visitors a year trampling, rock turning, and handling organisms. Traditional single species fishery management practices have led to serial depletion of coastal resources world-wide in the 20th century. Ecologically discrete fishery replenishment zones could be used to restore these fisheries, support truly sustainable fisheries, and provide society with marine natural areas. Marine protected areas should be an important part of coastal zone management, but have not been in the United States.

PRESERVATION AND MANAGEMENT OF MARINE AND COASTAL FISHERIES IN THE NATIONAL PARK SYSTEM

Frank M. Panek
National Park Service

The National Park Service administers a network of 367 park units scattered across the continental United States, Alaska, Hawaii and the Virgin Islands. The 80 million acres in the park system represents about 12% of the total federal landholdings. Recent inventories show that 153 of these units support fisheries resources. Forty-five (45) park units, or 12% of all parks, provide habitats for marine and coastal fisheries resources. Many of these parks represent some of the finest examples of living marine ecosystems in the world, providing relatively undisturbed habitats supporting a diversity of fisheries and marine invertebrate populations.

The health and productivity of the world's oceans rely in part on the preservation and prudent management of nearshore coastal resources. The 26.5 million acres of estuarine waters along the continental U.S. coastline provide spawning and nursery habitats supporting 63% of the Atlantic coast commercial fisheries harvest and 90% of the recreational harvest. Each acre of temperate zone tidal wetland provides about 2,100 pounds of biological production. In addition, these wetlands provide a host of other values for water quality, erosion control, and flood control. The barrier islands at Cape Hatteras, Fire Island, and Canaveral National Seashores provide significant protection for wetlands, shoals, and mudflats. The barrier islands also protect the productive coastal bays and estuaries from the tides and salinities of the open sea. The ecological complex provided by Everglades, Big Cypress and Biscayne Bay National Parks are vital to both the ecology and economy of southern Florida.

National Park Service fisheries and marine conservation research and management programs emphasize the needs to preserve habitats, species diversity and ecological functions. Service management policies provide for the protection and restoration of rare, threatened and endangered species; provide for the protection of spawning and nursery habitats of endemic species; and strive to maintain natural distributions, densities, and community structures of coastal fisheries resources.

MANAGEMENT-ORIENTED RESEARCH AND MONITORING PROGRAMS IN NATIONAL ESTUARINE RESEARCH RESERVES AND MARINE SANCTUARIES

Dr. Michael P. Crosby
National Oceanic and Atmospheric Administration

The focus of this presentation will be on NOAA's National Estuarine Research Reserve System (NERRS) and National Marine Sanctuary Program (NMSP), and how these sites offer opportunities for management-oriented, long-term research and monitoring in the U.S. and its Territories.

The NERRS was established by the Coastal Zone Management Act of 1972 to provide financial assistance to the states for the acquisition, development and operation of estuarine ecosystems as field laboratories. OCRM currently has 21 NERRS sites throughout the coastal U.S. (including the Great Lakes Region), representing the Nation's diversity of coastal habitats. The program focuses on management-related research that will enhance the understanding of estuarine environments, provide information necessary to enhance coastal and estuarine resource management decision making, and improve public awareness of estuaries and estuarine management issues. The primary goal of the NERRS Research Program is to support high quality environmental studies that significantly contribute to our understanding of both the existing and evolving functional ecology of the various ecosystems encompassed within NERRS sites. All NERRS research is designed to provide information of significant value to the development and implementation of management policy governing the U.S. coastal zone, for which OCRM/NOAA has management and regulatory responsibilities.

The NERRS Research Program has recently re-focused its research priorities so that the primary research objective for the next decade is the study of natural and anthropogenically-induced change in the ecology of estuarine and estuarine-like ecosystems. This system will ensure a continuous decade-long research agenda which, in turn, will provide the basis for long-term research and monitoring in the NERRS program. This system will also facilitate long-term interaction with other Federal and State agencies, as well as the academic research community. OCRM is currently working with the NERRS to develop a nationally-coordinated, long-term monitoring program at each site. Since this network of sites is well integrated with State management and regulatory agencies and the academic research communities around them, it is expected that this monitoring program will include a high level of expertise and will be responsive to State needs. Most NERRS sites also have on-site Research Coordinators and Education Coordinators to facilitate research and monitoring, and transfer of this information to the public.

The NMSP was established by the Marine Protection, Research, and Sanctuaries Act of 1972 to designate and manage nationally significant marine and Great Lakes areas. Through research and education, the NMSP seeks to increase the scientific understanding of our marine resources. The Program is administered by NOAA with the OCRM being responsible for managing all of the NMSP sites. Since 1972, 13 Sanctuaries have been designated and currently protect more than 12,000 square nautical miles of ocean. The locations of the current NMSP sites represent a number of distinct marine environments including nearshore, open water, and benthic ecosystems, in temperate and tropical areas. There are six NMSP sites in the Pacific, four in the Gulf of Mexico/Florida Keys, and three in the Atlantic. Specific sites are selected based on the needs to preserve or restore their conservational, recreational, historical, ecological and/or aesthetic values.

Examples of current and past OCRM efforts dealing with management-oriented research and monitoring in these programs will be presented. Results of initial efforts in synthesizing all research funded through these programs will be present along with suggestions for translation and transfer of this information to coastal zone managers.

BIODIVERSITY OF MARINE MACROBENTHOS IN THE NORTHERN GULF OF MAINE

Peter F. Larsen
Bigelow Laboratory for Ocean Sciences

The Gulf of Maine is zoogeographically complex due to present temperature regimes as well as historical, climatological and physiographic changes since the last glaciation. Early investigators recognized the resulting zoological richness and a significant portion of the collection and taxonomic description of North American marine fauna was centered in the northern Gulf of Maine. During the 20th century the Gulf of Maine has received relatively little attention from marine ecologists. Recent, limited quantitative surveys have again highlighted the high biological diversity of the region. A compilation of the results of 19th century qualitative collections and 20th century quantitative surveys leads to the conclusion that the northern Gulf of Maine contains the highest level of marine macrobenthic biodiversity in eastern North America north of the tropics. As this region contains some of the least anthropogenically impacted embayments in the United States, it is important to document existing biodiversity levels to serve as an ultimate benchmark of environmental quality.

NEW YORK BIGHT: A CASE STUDY OF MARINE HABITAT QUALITY AND MANAGEMENT

Dr. John B. Pearce
National Marine Fisheries Service

The New York Bight is a body of marine water heavily impacted by man for three centuries. Commencing with dumping of New York City sewerage and trash into the Hudson and East Rivers, in later decades, the Bight was a recipient for industrial wastes, sewerage, incineration debris, and other materials disposed of directly into the lower Hudson River, discharged through pipes, or dumped at sludge and dredge material disposal sites. Research and monitoring in the Bight has shown how sources, fates, and effects of contaminants have affected living marine resources and, more important, provide a basis for future management.

Results from past and ongoing research have provided an excellent case study on how science can serve in the legislative arena, for management of waters, and for planning the future in coastal zone management and resource.

USE OF REMOTE SENSING IN PROTECTING COASTAL AND ESTUARINE HABITATS

Dr. James P. Thomas
National Marine Fisheries Service

Coastal ecosystems, including those with Natural Areas (e.g., Reserves, Refuges, Parks, etc.), receive virtually all of the water flowing off the continental United States. As populations of humans increase so do waste loads and utilization of the landed surface. Changes in land use result in change in land cover, which affects water quality, and subsequently, coastal and estuarine habitats, and their living resources. These habitats also are affected by storms and other natural events.

Lack of understanding of the cumulative effects of land cover and changes in land cover on these habitats and their resources, has limited appropriate management of landscape activities. Additionally, in the U.S., as elsewhere in the world, human population in the coastal region is increasing at an ever quickening pace. Our ability to monitor resultant land cover and habitat change has not kept up, and management perforce has been more reactive than proactive.

To address these issues, NOAA under its Coastal Ocean Program has begun a new program, the CoastWatch Change Analysis Program, to monitor the coastal region of the U.S. on a one to five year repeating basis, depending on the rate and magnitude of change occurring. Our effort will emphasize a geographic approach including the use of geographic information systems (GIS), ground based data, and remotely sensed information. The goal is to develop a digital data base for land cover and habitat change in the coastal region of the U.S. that, when integrated with other data within a GIS, ultimately will enable the linkage of development in the coastal region to ecological and economic productivity of coastal and estuarine habitats and their living marine resources.

MONITORING AMPHIBIANS ON MT. MANSFIELD, VERMONT

Steve Trombulak and Jim Andrews
Department of Biology
Middlebury College

We have inventoried and monitored amphibians as part of the Vermont Monitoring Cooperative, a multi-disciplinary program in the working forest (timber and maple syrup) on Mt. Mansfield. We use five techniques: drift-fences, night-time road searches, censuses of breeding choruses, active searches, and counts of egg masses. These techniques are conducted over the area's 3000' elevational range to identify the impact of habitat quality on amphibians and to serve as a rapid measure of ecosystem health. Our work is integrated with other studies at this site, including those of air and water quality, plants, insects, and birds. This program is of interest because (1) amphibians are useful for rapid assessment of forest ecosystem health due to their dependence on both terrestrial and aquatic habitats and their sensitivity to changes in habitat quality; (2) the different ecologies of the species at this site allow the specific factors responsible for changes in population dynamics, both natural and anthropogenic, to be identified; and (3) inventories can be conducted rapidly, making it possible to establish baseline observations in new areas immediately prior to changes in land-use practices and to follow the response of these indicator species following habitat modification.

RESTIGOUCHE RIVER SYSTEM: RECREATION MANAGEMENT

J. Melvyn Fitton
New Brunswick Department of Natural Resources and Energy

The Restigouche River and its major tributaries, the Kedgwick, the Patapedia and the Upslquitch rivers form a unique recreational resource in northern New Brunswick, Canada.

It is a multi-jurisdictional river system involving the Federal Government, two Provincial Governments, two Native Band Councils and several municipalities. In addition, there are a variety of non-government organizations with a special interest in the recreation management of the system.

The Restigouche and its tributaries are world renowned as salmon rivers with the resulting angling activities contributing significantly to the local economy.

In the past ten years there has been a dramatic increase in canoeing, boating, camping and more recently the introduction of sea-doos. It is estimated that approximately 10,000 people participate annually in these activities.

The priority management issues being addressed are: waste disposal, sanitation, carrying capacity, fire management, user ethics, public education, enforcement, provision of recreation facilities and aesthetics.

A management plan will be developed with input from the various levels of government, native band councils and non-government organizations.

MANAGING WETLANDS FOR NONGAME WATERBIRDS

Douglas L. Helmers
Wetlands for the Americas

Wetland management has developed rapidly in recent years, and has gone beyond its historic focus of meeting the resource needs of waterfowl. Today an integrated approach to wetland management should combine the needs of waterfowl and nongame species. Managers and researchers recognize the importance of relationships between species life history requirements and seasonal habitat use. They also understand the importance of managing wetlands to mimic historical water regimes for maintaining long term productivity. Currently, public agencies and international programs (such as the North American Waterfowl Management Plan) are incorporating multi-species strategies into wetland acquisition, enhancement and restoration plans. To accomplish this goal, resource managers must be provided with specific biological requirements for developing and implementing these plans. The successful integration of wetland management strategies to benefit multiple species will be most effective if the chronology, habitat and life-history requirements of the species groups are known and understood. This paper will discuss these requirements and give recommendations on enhancing the management of wetland habitats for nongame waterbirds.

THE USE OF AN INDIVIDUAL-BASED MODEL TO EXAMINE LANDSCAPE PERMEABILITY

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Department of Wildlife
University of Maine

Determining the effects of landscape characteristics upon wildlife populations can be complex using state-variable models. For example, modelling the resistance of a landscape to animal movements (i.e., its permeability) requires extrapolating from well-known individual responses to approximate average population responses. Modelling average responses of populations can lead to misleading results. Models based upon the responses of individuals can be used to address population responses, and easily can include phenotypic variation. By aggregating the individual responses of thousands of animals, population responses can be inferred.

I used a simple, regenerative individual-based model to determine the permeability of Trail Creek Watershed, Montana to movements of grizzly bears (*Ursus arctos*), wolves (*Canis lupis*), and martens (*Martes americana*). The permeability of cover-types were assigned using a literature review. Movements of 2500 individuals were modelled for the landscape at three levels of timber harvest (i.e., current conditions with no harvest, harvests proposed for 1992, and proposed future harvests). Animals randomly placed into the watershed that dispersed beyond its boundaries were tallied, and compared statistically. The results have not been field-tested, but indicate that overall permeability changed little in response to timber harvest levels, whereas the general direction of dispersal was altered by harvest levels.

AN ECOLOGICAL APPROACH TO INTEGRATING WILDLIFE HABITATS IN URBAN DESIGN

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Department of Landscape Architecture
Pennsylvania State University

Robert P. Brooks
School of Forest Resources
Pennsylvania State University

The paper describes a research project in which multi-disciplinary wildlife conservation planning was applied to an existing urban environment for the purposes of regional landscape planning and urban design. The borough of Bellefonte, Pennsylvania, was the subject of the study. The objectives of the project included: the development of a methodology for urban wildlife habitat analysis; the use of avian species response guilds as habitat indicators; the analysis of existing urban landscape structure and habitats; the design of a regional conservation system based upon the establishment of core, buffer, and peripheral zones; and the creation of a regional wildlife habitat management plan which included recommendations for the protection, enhancement, and restoration of urban wildlife habitats.

The methodology and strategies employed in this study provide an innovative and systematic basis for considering biological diversity in urban land use planning and design. While these methods require further testing and elaboration, this study represents an important step in the hitherto neglected integration of conservation biology into the multi-disciplinary process of urban and regional planning. The working landscapes of urban America offer exciting and important opportunities for biological conservation, which if realized, could provide a higher quality of life for people and wildlife as well.

THE WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK: INTERNATIONAL COOPERATION IN NATURAL AREA PROTECTION

Dr. George Finney
Canadian Wildlife Service

The Western Hemisphere Shorebird Reserve Network (WHSRN) was established in 1986 and now has 21 member sites in seven countries throughout the Americas. The objective of the network is to catalyze conservation of geographically widely separated natural areas which are critical to the conservation of shorebirds during the various phases of their annual cycle. Objective criteria have been established which define those sites which may be considered as Hemispheric, International, Regional or Endangered species reserves. Approved sites are publicly dedicated as members of the reserve and the site managers undertake to ensure conservation of the areas. Linkage between sites is encouraged, through the formation of conservation agreements, exchanges of personnel or through other means. Conservation actions following the dedication vary widely given the huge range of challenges throughout the Americas. WHSRN attempts to help the site managers meet these challenges and there have been several notable successes which are noted in this paper. The success of WHSRN demonstrates that there is an important role for international tools in meeting the challenges of natural area conservation. The network also shows the value of informal and flexible instruments in conservation.

THE EFFICACY OF EDUCATION: REVERSING POPULATION DECLINES IN SEABIRDS

Kathleen A. Blanchard
Atlantic Center for the Environment

A management policy in which education and the cultural context play important roles has proved successful in the conservation of seabirds along Canada's North Shore of the Gulf of St. Lawrence. Direct exploitation and disturbance caused severe population declines among several species between 1955 and 1978, including 84% and 76% declines for Razorbill and Atlantic Puffin, respectively (Chapdelaine 1980). Exploitation stemmed from the indigenous human population's semi-subsistence relationship to seabirds; in 1981, 95% of households considered harvesting seabirds for food as acceptable (Blanchard in press).

This paper describes a fifteen-year project that developed and tested management strategies aimed at restoring depleted seabird populations while preserving the integrity of the culture. By means of an educational program suitable to the cultural context, the project helped reduce human predation and enhance annual productivity of breeding seabirds. It also measured significant improvements in the knowledge, attitudes, and hunting behavior of residents, thus demonstrating the efficacy of education in helping to solve conservation problems.

The author presents a conceptual framework for an education program that addresses a resource management problem and concludes with general recommendations for applying educational strategies to a range of conservation problems.

RAVENS IN MAINE

Bernd Heinrich

The common raven, *Corvus corax*, has historically been uncommon in Maine. Except for a few pairs along the coast, it was probably nearly absent until the early 1960s when coyotes arrived. In the last 30 years, however, ravens have become common. In my studies of ravens near Mt. Blue State Park since 1984, I have found nests separated by as little as 2 km. Inland, nests are always built on tall white pine trees or on cliffs, and the 3-6 young per nest are fledged in late May. Over 350 ravens have been captured and individually marked and released near Mt. Blue to study the birds' social biology and dispersal. These studies (summarized in my book *Ravens in Winter* and in over a dozen research publications) indicate that over 200 birds may feed at a single animal carcass put out into the forest. Radio-tracking and resightings indicate that most of these birds are "vagrants;" most wander over at least 2,000 km^2. The resident birds, however, breed every year at the same site, often rebuilding on the same tree and even the same limb. Ravens are unable to penetrate the hides of ungulates, and for that reason would not likely exist in the northern forests if it were not for large carnivores, and landfills. The current closure of landfills will likely adversely affect the ravens, unless a healthy ungulate population, along with its predators, remains.

IDENTIFYING AND PROTECTING WETLANDS IN VERMONT THROUGH SATELLITE IMAGERY, GIS AND GOVERNMENTAL INITIATIVES

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U.S. Environmental Protection Agency
and University of Vermont

Protocols were developed for identifying and statistically verifying Thematic Mapper (TM) derived land use/cover data for integration into a GIS (ARC/INFO) database for an approximately 1000 sq. mi. (260,000 hectare/650,000 acre) study area of north-western Vermont, adjacent to Lake Champlain. The wetlands of the 26 towns comprising this area had been identified as under the greatest threat in Vermont from direct and cumulative development impacts. The goals of this project are to better protect this region's hydrologic, habitat and biodiversity values. Primary collaborators include The Nature Conservancy (TNC), the State Heritage Programs, the U.S. Fish and Wildlife Service, the Vermont Department of Environmental Conservation, Regional Planning Authorities, and the University of Vermont. The utility of TM and GIS are being assessed as tools in the identification and protection of wetland and other land use/cover types, including quantitative measures of landscape pattern, riparian connectivity, and wildlife value; linkages with biodiversity surveys, natural areas evaluations, and wetland functional assessments; identifying potential wetland restoration, enhancement or creation sites; designating wetlands under local, state or federal authorities; refining TNC classification schemes; and prioritizing political entities, watersheds, and landscapes for study, planning and protection purposes.

LANDSCAPE ANALYSIS AND INVENTORY OF THE NAHMAKANTA MANAGEMENT UNIT

John P. Lortie and Joshua L. Royte
Woodlot Alternatives, Inc.

Sally C. Rooney and Janet S. McMahon

The Maine Bureau of Public Lands is developing a multiple use management plan for the Nahmakanta Management Unit. One of the first steps in the development of this plan was identifying places where rare, threatened, or endangered plants, animals, or natural communities exist, or may exist. This information will aid in developing proper land management strategies for the unit. We performed landscape analysis and field surveys during the winter, spring, and summer of 1992. Our landscape analysis consisted of reviewing aerial photos, timber harvesting records, spruce budworm spraying records, fire history, topographical maps, geologic maps, and mapped records of known rare features in and adjacent to the unit. We used this information to develop a list of sites with a moderate to high potential for containing rare species or exemplary natural communities. We then used this information to guide our aerial and ground surveys. Thirty eight sites were visited during the field season and a number of exemplary natural communities were found in addition to new stations for *Nymphaea tetragona, Dryopteris fragrans*, and *Schistostega pennata.*

MONITORING ECOTONES TO DETECT FOREST AND LANDSCAPE CHANGES

Thomas J. Stohlgren and Richard R. Bachand
National Park Service

We describe one approach to assess the potential effect of global climate change on the vegetation of the Colorado Rockies. Specifically, we describe a methodology to assess the biotic and abiotic controls on forest distributions and productivity at forest ecotones. A series of intensive, geo-referenced, long-term study transects (20m x 200+m) will relate forest stand characteristics (basal area, density, and seedling recruitment) to soil profile characteristics and microclimate (air and soil temperature, and photosynthetic active radiation) across community ecotones. We use a lodgepole pine (*Pinus contorta*) to spruce-fir (*Picea engelmannii-Abies lasiocarpa*) example from Bear Lake, Rocky Mountain National Park to demonstrate the methodology. Preliminary findings suggest complex interactions of aspect, mid-day air temperature and extent of soil profile development control forest distribution patterns. By replicating this technique on other forest ecotones across the landscape, we will develop a better understanding of species-environment relationships and identify which forest species are most sensitive to rapid climate changes.

HEMLOCK WOOLLY ADELGID IN SHENANDOAH NATIONAL PARK: LONG-TERM MONITORING STRATEGIES AND MANAGEMENT OF EASTERN HEMLOCK ECOSYSTEMS

J. Keith Watson and Jacob L. Bowman
Shenandoah National Park

The hemlock woolly adelgid, Adelges tsugae Annand was first detected in Shenandoah National Park (SNP) in 1988 in Thornton Hollow where eastern hemlock, Tsuga canadensis (L.) Carriere, mortality was evident. In 1987, Park staff began implementation of a long-term inventory and monitoring plot network to detect and document ecosystem scale alterations to SNP's forests in response to impending gypsy moth defoliation. Small modifications of existing monitoring protocols and reinventory frequency allowed Park managers to assess conditions of eastern hemlock forests in response to hemlock woolly adelgid infestation. Initial plots were established in 1990-1991 and reinventoried in 1992. Because remote sensing data suggested widespread crown health decline, parkwide ground surveys were initiated to document stand and tree condition following park established protocols and recently established protocols established by a multiagency working group in the Mid-Atlantic region of the eastern United States. Results of the vegetation monitoring indicate a significant change in crown health ratings of hemlock trees with a definite shift toward poor crown health and mortality. Dramatic changes in biodiversity are expected throughout the range of eastern hemlock and monitoring programs in SNP can lead to a better understanding and management of the hemlock woolly adelgid and eastern hemlock ecosystems.

DEVELOPMENT OF A NORTHERN FORESTS RESOURCE INVENTORY FOR BALANCED LAND-USE ALLOCATION

Michael L. Cline and Sally Stockwell
Maine Audubon Society

An inventory was conducted of resources present in the northern portions of Maine, New Hampshire, and Vermont that fall within the region referred to as the Northern Forest Lands Study area (approximately 18 million acres). Information was collected on the following categories: physical resources; ecological resources; recreational resources; timber resources; and development features. Most information was collected directly or developed from smaller existing state inventories, databases, or other recognized data sources. Many different sets of information comprised each resource category. A system was developed to score townships throughout the area according to the relative abundance of high-value resources present for each category. Maps were produced that identify for each resource category larger areas where high-value resources are concentrated. Applications for land-use planning and management, including developing a proposed working strategy for the Northern Forests, are discussed with emphasis on protecting traditional values and uses.

REPRESENTATION OF MAJOR ACADIAN FOREST TYPES IN HIGHLY PROTECTED AREAS

Eric Hundert
Environment Canada

Judy Loo-Dinkins
Forestry Canada

Most of the forested land in the Maritime provinces falls within Rowe's Acadian Forest Region. An array of forest types, differing in climax species composition, as well as successional stage, may be considered to be typical of the region. The adequacy of representation of the Acadian Forest within highly protected natural areas, including national parks, provincial parks, ecological reserves and Nature Trust areas was assessed in three steps. A list of major late successional or climax forest types was compiled using available forest type classification information for the region. For each major forest type, the area (ha) within highly protected natural areas was estimated. The degree of fragmentation was assessed based on number and size of the protected areas for each forest type. The adequacy of representation in protected areas was evaluated for each forest type based on total area and fragmentation.

LAYING THE FOUNDATION FOR BOTANICAL AREA STEWARDSHIP: A CASE STUDY IN INVENTORY METHODOLOGY ON THE SIX RIVERS NATIONAL FOREST, NORTHWEST, CALIFORNIA

Lisa D. Hoover and Thomas M. Jimerson
U.S. Forest Service

In response to a shift in public sentiment regarding the way the National Forests are managed, the U.S. Forest Service has been pressed to re-visit its priorities and take a closer look at how the agency is managing for biological diversity. One venue lending credence to this changing perspective is the establishment of Botanical Areas (BA). BAs are established to protect rare and/or distinct botanical features of an area as well as to provide for an appropriate level of public recreation opportunities.

Six Rivers National Forest in northwest California supports six BAs ranging in size from 1000-28,000 acres. Nested within a multiple-use landscape, these areas can be juxtaposed to both public lands allocated for timber production, recreation development, mining or grazing; and private lands, which are used at the discretion of the landowner.

Thorough inventory and mapping of the element occurrences should provide the basis for any projects planned in the areas and concurrently, substantiate analysis of the effects of on- and off-site activities. The methodology suggested by this paper incorporates the following: vegetation mapping to the plant association level, combining airphoto interpretation and ground-truthing, manuscripting for geographic information system (GIS) application, location validation using global positioning systems (GPS), and element tracking using a relational database (ORACLE).

Once collected, mapped and stored in GIS and ORACLE systems, the information can be used as a planning tool for development of these BAs consistent with the stewardship of the botanical values.

EXTREMELY LONG TIMBER ROTATIONS ON MANAGED LANDS: A WORKING SKETCH OF ECONOMIC AND PRACTICAL ASPECTS OF A POTENTIAL LANDSCAPE MANAGEMENT TOOL

Lloyd C. Irland
The Irland Group

Land management philosophies of private owners in the Northeast vary widely, from those focusing on short-rotation (30-years) culture of fiber in managed stands, often planted, to others managing on a conservation basis for large sawtimber and cutting pulpwood as a by-product only. A classic theme in this connection has been an idea that the public lands ought to grow large sawtimber, as private owners are less likely to do so.

Clearly, a managed forest landscape will be enriched in aesthetic, recreational, and habitat values if ways can be found to place selected stands and areas in management regimes emphasizing rotation ages much longer than present industrial practice. Maine forests have species that can grow for hundreds of years. Some of these will maintain high growth rates if given room to grow by intermediate cutting treatments. As old growth hard and softwoods literally disappear from world markets over the next 10-30 years, price premiums paid for large, clear logs may justify a re-examination of traditional financial analyses of forest management.

An initial exploration of the many practical administrative and financial issues will be offered. Selected mensurational and economic data will be offered for a few long-lived species that might be considered in these management regimes. While final quantitative results will not be possible, an initial characterization of the opportunities and obstacles will be given. It may be possible to identify under what circumstances extreme long-rotation regimes are likely to be feasible on a break-even basis, and to say some general things about what those regimes might be like. Comparative experiences from other regions will be consulted.

LAND AND RESOURCE MANAGEMENT PLAN DIRECTION FOR HABITAT DIVERSITY ON THE GREEN MOUNTAIN NATIONAL FOREST

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Green Mountain & Finger Lakes National Forests

The National Forest Management Act (1976) required each National Forest in the country to prepare a Land and Resource Management Plan (Forest Plan) to provide direction for protecting all "native and desirable non-native" vertebrates occurring on National Forests. The Forest Plan for the Green Mountain National Forest (GMNF) was completed in 1987 and heralded by conservation groups nationally as an excellent example of integration of objectives for protecting the natural environment while providing a sustained flow of goods and services.

Foundation for management direction in the Forest Plan is a set of specific vegetative composition objectives. These objectives are designed to fully utilize available vegetative tendencies, to expand limited communities, and to protect areas of vulnerability.

Nearly 90% of the 350,000 acres of the GMNF currently support northern hardwood forests. The Forest Plan gives directions for development of all age-class, or structure, conditions possible for northern hardwood forests -- including early successional, regenerating, pole, mature, old age, and all-age forest conditions.

The remaining 10% of the Forest is composed of several other vegetative types including conifer, oak, aspen, and wetlands. The Forest Plan contains goals for achieving certain acreages and conditions in these communities to assure a full compliment of vegetative and habitat relationships over the long-term. The Forest Plan also recognizes the needs of area sensitive species, focusing on those utilizing mature forest conditions.

Assumptions made during the development of the Forest Plan are currently being verified through on-going cooperative monitoring programs. Trends in Management Indicator Species populations are being analyzed in the contexts of both the GMNF and all of New England and are providing the impetus to tailor the Forest Plan to meet changing ecological needs. Critical to the successes of GMNF ecosystem management efforts is a complete network involving state of the art scientific, social, and economic expertise.

INFLUENCE OF HABITAT FRAGMENTATION ON A REGIONAL NATURE RESERVE DESIGN

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Ohio State University

This paper examines the habitat fragmentation in a 146 square-mile landscape in south-central Ohio and its implications to the regional biological diversity. This fragmentation analysis is part of an extensive nature reserve design study being conducted for The Nature Conservancy in an area known as the Edge of Appalachia, home to many rare and endangered plant and animal species and unique biological community assemblages.

Low-altitude aerial photography was used to classify and map land cover for the study area for both 1938 and 1988. Polygons of agricultural land, old fields, transitional forests, mature forests, and savannas along with hedgerow vectors were determined and imported into a geographic information system (GIS) database using digital scanning technology and heads-up digitizing. The type and degree of habitat fragmentation in both 1938 and 1988 were examined using simple GIS modeling techniques. These results, when enhanced by additional information in the database, provided important insights about the nature of the habitat fragmentation in this landscape. The inclusion of the historical data to the analysis provided important landscape dynamics information about the region. The influence of the results on land acquisition plans for the study area and the future management of the current nature reserve system will be discussed.

CONSERVATION OF INVERTEBRATES: THE PROBLEMS POSED BY BIODIVERSITY

Howard S. Ginsberg
National Park Service

The vast majority of species are invertebrates, but nearly all conservation programs emphasize vertebrates or vascular plants. Acadia National Park is the only national park with a comprehensive inventory of a large invertebrate group (nearly 6,500 insect species recorded); most parks have little or no information about their invertebrate faunas. Complete inventories and assessments of invertebrate faunas are not feasible because of the large numbers of unstudied species. General ecosystem preservation policies foster invertebrate conservation, but baseline data on invertebrate faunas are necessary to effectively manage this resource. These baseline data can be collected by 1) compiling and organizing information collected in the past at a park, 2) tracking collections from the park, 3) coordinating efforts among agencies, institutions, and conservation groups to compile information about regional invertebrate faunas, 4) removing disincentives to outside experts working in parks and tapping outside expertise to help conserve invertebrates, 5) performing research to improve and assess inventory techniques, 6) conducting inventories of selected taxa that can be used as indicators of the condition of entire invertebrate faunas and of other ecosystem components, and 7) fostering education of the public park staff about invertebrates.

THREE HUNDRED YEARS OF LANDSCAPE CHANGE ON CAPE COD AND THE NEARBY ISLANDS

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Massachusetts Audubon Society

Dr. William A. Patterson III
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Historical documents including photographs, maps and narrative descriptions are being combined with repeat photography and computer overlay mapping to analyze landscape change on Cape Cod, Nantucket, Martha's Vineyard and the Elizabeth Islands over the last three centuries. Natural disturbances such as storm events and frequent fires have influenced landscape change in the region for thousands of years. European settlement led to radical changes in the landscape over a relatively short time period, as illustrated vividly by historical documents. Ongoing studies by the National Park Service, Massachusetts Audubon Society and the University of Massachusetts Department of Forestry and Wildlife Management are using this historical record to provide a context for long term studies of succession and wildfire and the effects of those processes on fire-adapted plant communities. Historical photographs and contemporary repeat photography portray the extensive landscape changes at the end of the nineteenth century and the subsequent period of agricultural abandonment, reforestation and fire suppression. Parallel studies of vegetation response to fire and records of historical fire frequency suggest that fire suppression may influence the future extent of fire-adapted plant communities. The results of these studies will be used to develop management tools for conserving landscapes and vegetation communities.

EVOLUTION OF A WORKING LANDSCAPE: TWO CENTURIES OF CHANGING LAND USE IN CLARK COUNTY, OHIO, AND THE IMPLICATIONS FOR PROTECTING NATURAL DIVERSITY

Timothy A. Snyder
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In 1803, eastern Clark County, Ohio, was covered with an oak-hickory forest interspersed with prairies, barrens, and streamside wetlands. Over the next two centuries, that landscape was converted to farms and city. This study attempts to trace the evolution of this landscape by determining the sequence, location, and nature of changing land-use practices in two adjoining six-mile-square townships containing three state nature preserves. Maps showing the location and extent of vegetation communities in 1803 were developed from original survey notes and other records. By comparing them with present land use, changes in community diversity were evaluated. Tracking land use changes over time leads to a better understanding of their effect and suggests possible restoration strategies. Areas of potential ecological significance not presently protected are noted for future study.

HISTORIC WORKING LANDSCAPES: IS PRESERVATION COMPATIBLE WITH THE CONSERVATION OF BIOLOGICAL DIVERSITY? A CASE STUDY

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Pennsylvania State University

Working landscapes express important cultural historical values. Can historic working landscapes be preserved and managed in open space design which also values the conservation of biological diversity? This question faces all those engaged in the design and management of natural and historic landscapes.

This paper will examine a recent design for a new part of the Appalachian Trail which contains both important historic and ecological landscapes. The Cumberland Valley of Pennsylvania is the longest valley crossing along the 2,000 mile trail -- 13 miles of intensively cultivated prime farmland between two forested ridges. The National Park Service recently acquired 1500 acres in the Cumberland Valley for the Appalachian Trail Conference for a trail corridor. The planning and design of the Cumberland Valley Trail corridor includes: the protection, enhancement, and restoration of the biological diversity of the valley; the preservation of important historic agricultural or working landscapes; and the revelation of these ecological and historic landscapes to the trail users. The paper will present the project as a case study in the application of landscape design and management to the issues of biodiversity conservation, historic working landscape preservation, and land use planning on a sub-regional scale.

COMPREHENSIVE PLANNING FOR MAINE'S ESTUARIES: CURRENT PROGRAMS AND THE NEED FOR NEW TECHNIQUES

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University of Rhode Island

In view of the resources Maine's estuaries provide to the state, comprehensive management and conservation of estuaries is needed in the near term. Maine lacks experience in comprehensive estuary planning, but is building this capability. Maine communities have completed more than 500 local planning projects along the coast, most of them supported by the State Coastal Program. Many of these projects have been carried out through regional planning or comprehensive town planning with a land-use orientation, on a town-by-town scale. New techniques are needed to evaluate the combined effects of land uses and marine uses on estuarine ecosystems, and to manage estuarine resources on a watershed scale, beyond local boundaries. Recently, several estuary planning activities have begun in Maine, part of a new generation of waterbody planning efforts nationwide. This paper reviews five Maine planning programs and their prospects for comprehensive estuarine management: comprehensive town planning, the Wells National Estuarine Research Reserve, the Damariscotta River Estuary Project, the Casco Bay Estuary Project, and the Gulf of Maine Initiative. New planning techniques employed in these initiatives (such as citizen water quality monitoring and geographic information systems) are identified and assessed. Recommendations are provided for future initiatives.

MECHANISMS FOR MARINE NATURAL AREAS PROTECTION WITHIN THE GULF OF MAINE: U.S. AND CANADIAN APPROACHES

Melissa Waterman
Maine State Planning Office

The Gulf of Maine is a remarkable marine ecosystem. Recognized as one of the world's most biologically productive marine water bodies, the Gulf of Maine extends from Cape Sable, Nova Scotia, to Cape Cod, Massachusetts, and includes the Bay of Fundy and Georges Bank. As an area where ecological zones overlap, the Gulf hosts a number of species at the limits of their geographic range. As yet relatively unpolluted, the Gulf of Maine features many natural areas ideal for consideration as marine sanctuaries or parks.

This paper looks at the mechanisms available to the states, provinces, and two federal governments to protect significant natural areas within the Gulf of Maine. The paper examines the laws and programs in effect at several levels of government. It summarizes the findings of the recent United Nations Man and Biosphere studies of the Gulf for possible Biosphere Preserve designation. Finally, the paper concludes with an analysis of the opportunities available to the two countries to cooperatively designate a marine sanctuary or park within the Gulf of Maine.

ENVIRONMENTAL DATA MANAGEMENT IN THE GULF OF MAINE

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Massachusetts Coastal Zone Management

The Gulf of Maine Council on the Marine Environment established a Data and Information Management Committee (DIMC) to develop an environmental data management system. The proposed system will meet the needs of a diverse community of users (including managers, decision makers, researchers, educators and workers in the private sector) in the three states and two provinces making up the region. The DIMC conducted a user needs analysis and follow-up interviews to determine the requirements of potential user. Meeting functional requirements of these users presents a challenge because of the different platforms, businesses and levels of sophistication existing in the region. As designed, the system will act as a hub for distributed datasets identified as significant and will also contain resident data. Users will have access through Internet or dial-in ports. Tools will be acquired or developed (some in cooperation with private sector firms) to help users exploit the data; these might include applications for DBMS interoperability, report generating, image analysis, risk assessment and ocean circulation modelling. A prototype system is currently undergoing testing at the University of New Hampshire.

CONSERVING THE THREATENED COASTAL RESOURCE AGAINST ALL ODDS

Dr. Helen Pickering
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Poole Harbour, England, is one of the world's largest natural harbours. It is regarded of national significance for its ecology and landscape, both terrestrial and marine, reflected in its status as an Area of Outstanding Natural Beauty, Site of Special Scientific Interest and Heritage Coast. For the preservation of specific habitats, almost half of the harbour is covered by National Nature Reserves.

The harbour is also of national and regional significance for hydrocarbon resources, recreation, commercial port operations, fishing and strategic exercises. It is the epitome of the pressures faced by coastal zone management and the problems encountered by those attempting to preserve the disappearing natural coastline.

This paper will present a critical review of the national and local initiatives active within Poole Harbour for the mitigation of development pressures on the natural environment. Particular attention will be drawn to the problems caused by a diversity of statutory bodies, property rights and ineffective statutory provisions and to the regulatory and physical measures available to the coastal manager for impact mitigation.

COMBINING SONGBIRD AND FISHERIES HABITAT PROTECTION WITH SUSTAINABLE ECONOMIC DEVELOPMENT ON VIRGINIA'S EASTERN SHORE

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Virginia Council on the Environment

Sarah Mabey
Virginia Department of Conservation and Recreation

Bryan Watts
Department of Biology
College of William and Mary

Virginia's Eastern Shore of Chesapeake Bay and its seaside chain of barrier islands contain a unique mix of natural and cultural resources: exemplary habitat for 260+ species of land and shorebirds; a coastal corridor and staging area for neotropical songbirds and other migrants; pristine coastal marshes and waters supporting a $13 million/year seafood industry; family farms dating from the 1600s; and barrier islands designated a "World Biosphere Reserve" by the United Nations in recognition of their unparalleled biological value. However, severe fiscal stress and increasing development activity now confront this rural, agricultural area.

The state and county received a four-year, $700,000 Coastal Zone Management grant to co-develop a Special Area Management Plan. The Plan contains new, enforceable coastal habitat protection policies to be driven by existing scientific data for fisheries and new data for migratory songbirds. Various protection tools will implement the Plan: ARC/INFO GIS mapping of habitat data; local vegetation, zoning and stormwater ordinances; formal agreements among agencies and The Nature Conservancy; public access guidelines; no discharge zones; and conservation easements. To enhance support for the policies, sustainable economic development plans for nature tourism, specialty seafood production, and aquaculture will be developed. Economic multipliers will be calculated and tracked.

WHO IS MINDING THE OCEANS?

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Conservation Council of New Brunswick

To date, the scientific and policy domain of biodiversity discussions and studies have focused largely on terrestrial biodiversity. The slower development of sampling technologies suitable for marine environments and the greater emotional connection and response people have to terrestrial animals reflect the range of reasons given for the lack of attention to marine biodiversity. Regardless of the reasons and despite almost half a century of international and national efforts directed towards developing and implementing ocean management policies, there is growing evidence that marine biodiversity is in decline. This paper examines the concept of marine biodiversity and the scope of international involvement in ocean resource management. The author argues that the lack of integration and coordination between marine conservation and development policies on one hand and the development of resource management policies at higher levels of government on the other hand are two key reasons for the continued decline in ocean health and productivity.

MAINE'S BAITWORM FISHERIES: RESOURCES AT RISK?

Dr. Betsy Brown
Department of Biology
Colby College

Worms of the class Annelida have been used for centuries to serve human needs. Since the 19th century, fishermen in coastal towns of the northeastern United States have been digging baitworms from mudflats. Baitworm fishing began in Long Island, but more recently has been conducted primarily in Maine. Two groups of worms make up these multimillion dollar fisheries: (1) sandworms (= clamworms), *Nereis virens*, and (2) bloodworms (= beakworms), *Glycera dibranchiata*.

The sandworm and bloodworm fisheries were fairly constant until the early 1970s when catches decreased and some baitworm diggers went out of business. Concerns have been raised regarding the influence of the fisheries on baitworm population size distributions. Early work has suggested that while the fisheries have not affected these distributions, others will say that they have. Controversy exist on the ability of these species to recruit young into a particular mudflat. This talk revisits these issues and reevaluates management of these very important fisheries.

MICROHABITAT AND FIRE EFFECTS ON THE DEMOGRAPHY OF AN ENDANGERED PLANT OF FLORIDA SCRUB

Dr. Eric S. Menges and Jennifer L. McAnlis
Archbold Biological Station

Eryngium cuneifolium is an endangered endemic plant found only in rosemary-dominated Florida scrub, a periodically-burned, shrub-dominated habitat. Multivariate analyses using 22 microhabitat characteristics indicated significant effects on survival, and fecundity of 1287 individuals over a four-year period. Survival increased with distance to the nearest shrub and plants in larger open patches had greater survival rates. Neighboring *Ceratiola ericoides* and *Calamintha ashei* caused greater mortality to *E. cuneifolium* than other shrub species. Sand accretion increased growth and fecundity. With greater time since fire, woody shrubs increasingly dominate and open patches shrink, significantly reducing survival, growth and fecundity of *E. cuneifolium*. This herbaceous species has evolved and is dependent on an open, low-competition habitat maintained by a periodic disturbance regime. Underground competition or allelopathy from shrubs probably restricts *E. cuneifolium* to recently burned, open patches within the most xeric patches of Florida scrub. Periodic burning, once every few decades, can be used to manage for healthy populations of this scrub endemic.

PRELIMINARY RESULTS OF A SPRING BURN IN TWO OHIO FENS

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Prescribed burning is a common management technique used to control the invasion of woody species in prairies and savannahs. Although fire may not have been a regular occurrence in fens historically, as it was in prairies and savannahs, natural areas managers are now experimenting with prescribed burning to maintain sedge meadows and control natural succession in fens. The effects of a prescribed burn conducted in March 1991 were examined by sampling vegetation composition and abundance in burned and unburned areas of two west-central Ohio fens. The burns were confined to specific areas and transects were established in burned and unburned areas of similar community types. In 1991 and 1992, square-meter plots in each transect were sampled and percent cover was estimated for all plant species to determine the effect of the burn on woody species and herbaceous fen and prairie species. Initial results of the sampling suggest that burning increased total species richness and abundance. Although some woody species (*Potentilla fruticosa* and *Cornus* sp.) declined in abundance, one (*Rhamnus frangula*) increased. Most herbaceous and graminoid fen species increased in abundance while many weedy generalist species also increased. Further data are needed to determine the long-term effect of burning in fens.

FIRE AND NATURAL AREA STEWARDSHIP AT A U.S. ARMY TRAINING FACILITY IN VIRGINIA

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Virginia Department of Conservation and Recreation

Alan R. Dyck
U.S. Army, Fort Pickett

Fort Pickett is a 45,000-acre Army installation located in the southern Virginia piedmont. The primary mission of the base is training, including tactical, artillery, mechanized and small arms methods. A 13,000-acre controlled access area, which contains the ranges and target sites, has been subjected to frequent fires since the base opened in 1942. Annual prescribed burning has been used in this area for wildlife management, and to control the spread of random wildfires caused by incendiary ammunition. In 1992, the Virginia Division of Natural Heritage began a two-year inventory of significant biota and communities on the base. During the first year, Natural Heritage biologists determined that the regularly burned area provides requisite habitat for a rare bird, Bachman's Sparrow (*Aimophila aestivalis*), as well as for extensive pine and hardwood savanna communities. Such savannas were present historically in the piedmont, but have almost entirely disappeared because of post-settlement disturbance, including fire suppression. Initial results of the inventory demonstrate that long-term fire management of this area, together with the acreage, security and buffers afforded by a large military installation, have created and maintained an exemplary natural area compatible with intensive traditional use of the landscape.

DO WE NEED A STOCHASTIC MODEL FOR APPLYING FIRE TO LONGLEAF PINE COMMUNITIES?

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U.S.D.A. Forest Service

Fire is an important process in the longleaf pine (*Pinus palustris*) community, significantly influencing its structure and composition. Managers realizing its importance are striving to establish burning regimes that mimic natural fire. Based on research and historical data the prescription is to burn during the growing season every 3 to 5 years. While preferable to no fire or all dormant season burning, this model is less than ideal because on a landscape scale natural fire varied temporally and spatially. This paper discusses the effects on community composition, such as abundance and size of oaks and snag densities, which could result from removing this variation.

Rather than trying to recreate natural fire regimes burning can be applied to create desired effects. This method of handling variation is suitable for smaller areas while an alternative approach using stochastic models is likely more appropriate for larger sites like National Forests. These probabilistic models have been developed to predict the likely spread of wildfires. If they could be modified and improved using available information, they would provide managers of larger natural areas a tool for including variation in prescribed burning programs.

STRUCTURAL CHANGES IN TWO SOUTH FLORIDA UPLAND FOREST COMMUNITIES (PINE FLATWOODS AND HARDWOOD HAMMOCK) OVER AN 11-YEAR PERIOD: PROVIDING INFORMATION FOR LONG TERM MANAGEMENT

Jean M. McCollom and Michael J. Duever
National Audubon Society

From the point of view of managers, understanding how communities change over time is necessary to determine if observed changes are within the range of natural variability or could be the result of anthropogenic change. This study's objective was to understand woody plant community dynamics and its relationship to environmental conditions over time in "natural" communities.

The slash pine community was burned prior to, but not during the study. Numbers increased rapidly for all species but pine. Basal area/hectare increased rapidly for all species and there was virtually no leveling off of recruitment and little mortality 14 years after fire. Early drydown after summer wet season caused decreased growth rates.

The hardwood hammock community progressed toward a more mature community throughout the study. All species decreased in number. Of temperate species, early successional species showed in number. Of temperate species, early successional species showed the only decrease in basal area/hectare. Lack of standing water during freezes was correlated with mortality of tropical species.

Species composition and rates of change threw doubt on our working assumption that without fire, flatwoods will rapidly succeed to hammocks.

Results were incorporated into a working model of native plant community dynamics, providing a summary of current knowledge relevant to natural area management.

MODIFIED PRESCRIBED BURNING TECHNIQUES FOR MANAGEMENT IN NATURAL AREAS IN URBAN NEW YORK

Robert Zaremba, Susan Antenen and Stephanie Gebauer
The Nature Conservancy - New York Chapter

In New York, fire has historically played an important role in many natural areas that are now surrounded by urban and suburban development. Reintroducing fire for ecological management to these sites presents a challenge to land managers who must balance the ecological needs of species and communities against fire and smoke safety concerns. For the past two years, fire management programs have been developing in the Albany Pine Bush within the city limits of Albany, New York and at the Hempstead Plains Preserve, 20 miles east of midtown Manhattan. Both sites support federally-listed endangered species believed to be dependent on periodic fires to maintain needed habitat. Modifications to standard prescribed burn techniques to address smoke and fire hazards will be discussed. Examples of burn plans and field activities are presented with preliminary results from monitoring projects for three burn seasons.

THE BIOLOGICAL AND SOCIO-POLITICAL PROSPECTS FOR LONG-TERM PRESERVATION OF THE CONCORD PINE BARRENS AND THE KARNER BLUE BUTTERFLY (*Lycaeides melissa samuelis*) IN CONCORD, NEW HAMPSHIRE

David VanLuven
The Nature Conservancy - New Hampshire Chapter

The Concord Pine Barrens is an island variant pitch pine/scrub oak barrens ecosystem located in Concord and Pembroke, New Hampshire. Approximately 5 to 10 percent of the original ecosystem remains today, and much of this remnant area is degraded. Despite its reduced size, the Concord Pine Barrens supports such a high diversity of species that The Nature Conservancy considers it one of New Hampshire's most significant ecosystems. The Barrens' diversity is highlighted by nearly 170 Lepidoptera species, 36 of which are rare. Of particular note is the Karner Blue butterfly (*Lycaeides melissa samuelis*), a sub-species which was Federally listed "Endangered" in December 1992. The Karner Blue has also been designated the New Hampshire State Butterfly and the Concord City Butterfly.

The Concord Pine Barrens is a challenging management puzzle from both the biological and socio-political perspectives. From the biological view, the ecosystem is poorly understood, highly fragmented, populated by rare species whose long-term viabilities are questionable, and in need of active restoration efforts. From the socio-political standpoint, the ecosystem is sub-divided among a variety of landowners, located in the heart of Concord's most rapidly developing commercial region, and dependent upon a disturbance mechanism (fire) which residents fear.

Selecting an effective long-term management strategy for the Concord Pine Barrens requires that both the biological and socio-political contexts of preservation be considered. Biologically, options range from complete ecosystem restoration to creation of an artificial Karner Blue butterfly "garden." The consequences of these strategies range from broad preservation to nearly complete ecosystem loss. For example, sustaining the Karner Blue butterfly necessitates the maintenance of grassy openings, not the restoration of the entire ecosystem. The scopes of management options are limited both by existing biological conditions, such as fragmentation and available buffer areas, and by the social, political, and economic climates of the region. Management strategies which go beyond Federal and State rare species protection regulations are more strongly confined by socio-political factors than those which do not.

This paper considers the biological and socio-political prospects for long-term preservation of the Concord Pine Barrens and the Karner Blue butterfly population within it. The ecosystem's components and the Karner Blue butterfly's biological requirements are derived from a comprehensive literature review. Remaining pine barrens parcels are delineated to identify lands with the potential for restoration. The socio-political context of management activities is based on an analyses of relevant Federal, State, and local laws, and on a case study of a recent development modified for Karner Blue butterfly preservation. Finally, various long-term management strategies are outlined based on their biological and socio-political feasibility.

DEVELOPMENT OF AN INTER-ORGANIZATIONAL PROGRAM TO RESTORE A FRAGMENTED ECOSYSTEM

Tom Chase
Martha's Vineyard Sandplain Restoration Project

The coastal sandplains are a globally rare ecosystem that once ranged from Long Island, New York, to the Cape Cod and Islands region of Massachusetts. Today, the largest and best preserved (or restorable) fragments of the sandplain communities are located on Martha's Vineyard Island. The Martha's Vineyard Sandplain Restoration Project, a coalition of six conservation groups, was formed to cooperatively restore and manage their separate landholdings for the benefit of many state-listed species. These conservation agencies -- private and public, local and international -- constitute a "working landscape" of parcels managed under different chartered goals (e.g., recreation, wood and game harvesting, preservation) and by staff with different skills and orientations. In addition, the Project is aided by advisors from other agencies, as well as volunteers and members, all of whom are motivated by yet other goals. Fundamental elements that make this cooperative effort work are 1) that all policies and guidelines are based on ecological principles, 2) though each agency has independent control over the management of their lands, no restoration project is eligible for inter-agency cooperation unless based on mutually agreed-upon guidelines, and 3) voting members are restricted to a small group of single representatives from each organization, though other members have a voice through managing separate task forces. Successes of this two year old project include: educational and campaigns which made popular the idea of restoring native communities through prescribed burning; fundraising and acquisition of burn equipment, a workshop to train volunteers, and implementation of prescribed fire; development of a cooperative interface between managers of conservation lands, private landowners, and landscapers. Current programs include: development of standardized monitoring techniques for restoration sites; island-wide mapping of the various sandplain communities using GIS; propagation of and guidelines for the reintroduction of native sandplain flora to restored sites. Future goals include: historic and recent paleoecological research of landscape changes and community distributions; and development of management plans intended to sustain the highest biodiversity amongst properties, rather than on individual parcels.

SYMPOSIA SESSION 10 -- Botanical Conservation in Working Landscapes

CONSERVING THE NORTH LANDING RIVER WETLAND ECOSYSTEM: A MODEL OF PUBLIC-PRIVATE COOPERATION

Caren A. Caljouw
Virginia Department of Conservation and Recreation

Steven Hobbs
The Nature Conservancy -- Virginia Chapter

A large and ever-growing natural area preserve system along the North Landing River protects one of Virginia's outstanding wetland ecosystems within the heavily populated cities of Virginia Beach and Chesapeake. The success of this protection effort represents a model of public-private cooperation, commitment, and innovation. Federal agencies and local government funded a natural heritage inventory and protection plan. Private landowners, as well as the City of Chesapeake, were willing to donate or sell key land holdings. The Commonwealth of Virginia and The Nature Conservancy jointly purchased a significant portion of the wetland, forming the core of a 6,200 acre refuge that will soon be expanded to more than 7,500 acres. Support for the project has come from a wide range of government agencies and private organizations. Management initiatives for the new preserve system continue in the spirit of public-private cooperation. A management plan was prepared by The Nature Conservancy and the Virginia Department of Conservation and Recreation. Management topics being addressed include enhanced public access, environmental education, control of invasive plant species, prescribed burning, rare species monitoring, and mitigation of off-site impacts by working with private landowners, grassroots environmental organizations, and the planning departments of both cities.

RARE PLANT OR WEED? ORONO SEDGE, MAINE'S ONLY ENDEMIC, UTILIZES HERBICIDED HABITAT

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University of Maine

Orono sedge, *Carex oronensis* Fernald (Cyperaceae), is Maine's only known endemic plant species. Although it is listed as Category 2 in the Federal Register (for questionable taxonomic status and distribution), currently none of the 53 known sites and 2818 individuals are protected. Habitat is unspecialized, including roadsides and old fields, and confined almost exclusively to the Penobscot River valley. The largest known population, containing more than half the world's total, occurs on a privately-owned Christmas tree plantation, in which commercial and conservation objectives appear to be compatible. A 1992 count of stems at this population, in which the mowing schedule was purposely delayed, showed that Orono sedge persists despite or because of intensive management. Between-row vegetation is mowed regularly and a pre-emergent herbicide is used to suppress weeds within the tree row. Regular disturbance appears to enhance Orono sedge habitat and permit potential increase of within-population density. Other "hidden populations" -- recognizable only if mowing is delayed to permit ripe development of ripe fruits which are required for identification -- are likely to be present in mowed areas within its known range.

THE ECOLOGY, REPRODUCTIVE BIOLOGY AND POPULATION GENETICS OF *OPHIOGLOSSUM VULGATUM* (OPHIOGLOSSACEAE) IN MASSACHUSETTS

Robert T. McMaster
Smith College

The Northeastern adder's-tongue fern, *Ophioglossum vulgatum* var. *pseudopodum* (Blake) Farw. (Ophioglossaceae) occurs in five known populations in Massachusetts and has been designated as a threatened species by the Massachusetts Natural Heritage Program. It is an early successional species, often colonizing disturbed sites such as pastures, power line rights-of-way, and abandoned beaver meadows.

In an attempt to elucidate the reasons for the apparent success of *Ophioglossum vulgatum* var. *pseudopodum* in some locations and its decline in others, the autecology, population biology and population genetics of all known Massachusetts populations were analyzed during the summer of 1992. The distribution of each population was mapped, associated vegetation sampled, and permanent plots established for long-term study. Isozyme electrophoresis was employed to assess variability within and between populations. The historical disturbance of the species in Massachusetts was examined based upon herbarium specimens.

Each of the known Massachusetts populations has a unique history of disturbance that may account for the suitability of the site. Four of the five populations are small. All specimens subjected to isozyme analysis were monomorphic for all loci examined.

The implications of the spatial and temporal distribution, population size, and low genetic variability of *O. vulgatum* var. *pseudopodum* are discussed. Management considerations for the preservation of this and other early successional species are suggested.

LARGE-SCALE POPULATION CHANGES OF THE ENDANGERED PLANT, *PEDICULARIS FURBISHIAE* IMPLY LARGE-SCALE CONSERVATION NEEDS

Dr. Susan C. Gawler
Maine Natural Heritage Program

Linda L. Gregory
Acadia National Park

Using census data from 1991 and 1989, with similar data from 1984 and 1980, we examine changes in overall population sizes of the riparian endemic Furbish's Lousewort (*Pedicularis furbishiae*). Censuses consisted of counting flowering stems (FS) within rivershore segments and mapping lengths of rivershore as "active (occupied)", "potential", or "unsuitable" habitat. Sixty-five percent of the 96 km of rivershore surveyed was unsuitable for *Pedicularis*, 25 km (26%) was active habitat, and 8 km (8.6%) was potential habitat. From 1984-1989, the number of FS increased by 37%, with individual segments (on average) decreasing in the upriver half of the area surveyed and increasing in the downriver half. Segments with increases typically received severe disturbance in 1984. The total population in 1989 was estimated at 18,000 plants. From 1989-1991, the total population decreased by more than half (56% FS decrease), or an estimated 10,000 plants, due almost entirely to unusually severe ice scour in 1991. Effects were most pronounced downriver, where virtually all segments drastically decreased in *Pedicularis*. The transience of individual populations supports the hypothesis that a metapopulation model may best describe the species' dynamics; conservation will thus need to include approaches at the metapopulation scale.

SEEDBANK REGENERATION IN A WESTERN LAKE ERIE WETLAND

James S. McCormac
Ohio Department of Natural Resources

The composition of plant communities within wetlands bordering the shore of western Lake Erie has changed dramatically since pre-settlement times. Introduction of non-native species has greatly reduced the diversity and abundance of native wetlands plants. A thoroughly studied marsh in this region is in East Harbor State Park. The flora of this area was initially reported in 1899. This wetland is currently dominated by non-native species, and native wetland species have declined by approximately 50% since the 1899 survey. A 1.5 acre site within the East Harbor wetland was selected for this study. The flora was sampled using a fixed interval transect method. Dominant species were reed canary-grass (*Phalaris arundinacea*), and giant reed (*Phragmites australis*). In March of 1992 the substrate was disturbed using a Case 850LGP bulldozer and Link-belt 2800LC excavator. The site was cleared of vegetation and the soil was overturned, exposing dormant seedbanks. Surveys throughout the 1992 growing season documented a dramatic shift in the composition of the plant community. Members of the Cyperaceae and Juncaceae families increased in both diversity and abundance, whereas alien species declined. Seven state-listed rare plan species have appeared on the site. The overall abundance and diversity of the native flora have increased.

ISOTRIA MEDEOLOIDES: MONITORING A FEDERALLY ENDANGERED ORCHID IN MAINE

Pati Vitt
Department of Ecology and Evolutionary Biology
University of Connecticut

Conservation of *Isotria medeoloides* in Maine has concentrated on the establishment of permanent plots at four sites in southern Maine. These sites have been actively monitored since 1986. I will be reporting on the demographic trends found at these four sites through 1991, including an overall decline of the number of individuals found; a decline in reproductive output; and a decline in plant size. In 1989 there was a dramatic decrease in the number of above ground individuals recorded at two sites; an increase in recruitment was found at these sites in 1991. The breeding system of this species was also investigated. It is primarily self-pollinating, and was found to be self-compatible. No differences in reproductive output, measured as total seed weight, were found between individuals which were crossed by hand pollination and those which were selfed by hand. Differences in reproductive output are closely related to the size of the individuals used in the investigation.

A FLORISTIC-BASED COMMUNITY CLASSIFICATION SYSTEM FOR VIRGINIA: APPLYING CONCEPTS AND METHODS OF THE BRAUN-BLANQUET APPROACH

Thomas J. Rawinski
Virginia Department of Conservation and Recreation

Community classification, inventory, and protection are matters of practical necessity in achieving biological conservation goals. The Virginia community classification system is based on the premise that total floristic compositions of communities better express their relationships to one another and environment than any other

characteristic. The system is hierarchical and does not require any prior formal or ad hoc definitions of landform, habitat, and physiographic region. It avoids the use of frequently misinterpreted terms and does not rely upon the concept of dominance. The system utilizes approximately 900 vascular plant taxa which are diagnostic of 43 community classes. Most of the diagnostic plants are regarded as "conditional character-species", a new concept which implies that a species' diagnostic utility is conditional on the absence of certain other species. The system was thoroughly field tested and refined. Stands of natural or semi-natural vegetation in the state, and some intensively managed vegetation types, now can be classified consistently to the level of class by independent workers. Thus, it establishes a common community nomenclature for use among public and private land managers and facilities work toward a more detailed association-level classification.

A STUDY OF MICROCLIMATES ASSOCIATED WITH POPULATIONS OF *MAGNOLIA MACROPHYLLA* AND *TSUGA CANADENSIS* AT LAKE KATHARINE STATE NATURE PRESERVE, JACKSON, OHIO

Philip M. Zito
Ohio Department of Natural Resources

The purpose of this research was to define the microclimates where two very different species of tree grow at Lake Katharine State Nature Preserve, and how these microclimates differ from the area immediately surrounding these species. One species, hemlock (*Tsuga canadensis*) seems to be restricted to cool habitats while the other, (*Magnolia macrophylla*), to warm habitats.

To define the microclimates at the study sites, a series of measurements were taken within and just outside of populations of bigleaf magnolia and hemlock. Relative humidity, soil temperature, minimum maximum temperature and temperature at the time of sampling were all recorded. Species composition was determined by recording all woody species found within a four meter transect running north and south through the center of each population until well outside of each population.

Habitats where hemlocks are found are cooler, more so during the warmer part of the day and to a lesser extent during the night. Relative humidity was generally higher and soil temperatures were cooler. Bigleaf magnolias are found on south facing slopes where temperatures are cooler during the day but warmer at night. Relative humidity is lower than in the surrounding areas.

The hypothesis that a small overall difference in temperature would result in one type of plant community being able to exist rather than another led me to ponder the potential effects of global warming or cooling on vegetation. Would a two or three degree change in average temperature result in a species being extirpated or increasing its population? Having a knowledge of microclimates associated with species of special interest may be helpful in explaining future changes in those species.

THE RESTORATION OF RARE AND ENDANGERED SEABIRDS TO HISTORIC NESTING SITES IN THE GULF OF MAINE

Stephen W. Kress
National Audubon Society

Seabird populations in the Gulf of Maine were devastated by 1900 due to excessive hunting for food and features. Many species recolonized former habitat after protective laws, effective enforcement and extensive acquisition secured island nesting habitats. Successful recolonizers include Herring Gulls, Great Black-backed Gulls, Common Eiders, Double-crested Cormorants and Black Guillemots. These species share most of the following characteristics: short-distance migrations, large clutches, early age at first-breeding and a weak tendency toward site fidelity. Seabirds which have not recovered former population size or range lack at least one, but usually several of the above characteristics. The traditional management tools of acquisition, posting and censusing are inadequate for restoring small, migratory species such as puffins and terns in the Gulf of Maine because gull populations crowd the smaller species from suitable nesting islands. This paper reviews active restoration methods such as gull control, translocation of young and social facilitation using models and playback of vocalizations for Atlantic Puffins, Common Murres, Leach's Storm-Petrel, and Common, Roseate and Arctic Terns. These techniques have successfully restored these species to several historic nesting sites.

STATUS AND CONSERVATION OF THE TIMBER RATTLESNAKE

Earl E. Possardt
U.S. Fish and Wildlife Service

Thomas F. Tyning
Massachusetts Audubon Society

The timber rattlesnake (*Crotalus h. horridus*) is an inhabitant of the eastern deciduous woodlands of North America. Its historic range included portions of 30 states and southern Ontario. It appears to have been extirpated in three states and Canada and its numbers greatly depleted in at least eleven other states. Throughout most of its range, populations are becoming fragmented and declining. The timber rattlesnake's low fecundity and its dependency on den sites for winter hibernation make it particularly vulnerable to overexploitation and habitat encroachment and degradation. Historically many timber rattlesnake populations were greatly reduced by human persecution and loss of habitat from deforestation and agricultural practices. More contemporary threats include collecting for the pet trade, organized rattlesnake hunts, continued persecution and accidental killing by humans, disturbance at den sites, and habitat loss from highway construction and residential and commercial developments. While many states provide legal protection against collecting or killing, enforcement efforts and judicial responses to violators have not been sufficient to stop illegal collecting nor do most state laws protect habitat. Unless legal measures are strengthened and enforced against collecting or killing; legal protection expanded to include habitat; and additional funds directed at management related population studies and habitat protection, the timber rattlesnake will face

continued severe population declines which will likely cause extirpation of the subspecies over significant portions of its range, particularly in the northeast and midwest. Education of the public and resource managers to alleviate unreasonable fears and foster a greater acceptance and appreciation for the timber rattlesnake is a fundamental requirement if a conservation program for this reptile is to succeed.

THE ATLANTIC COAST PIPING PLOVER RECOVERY PROGRAM

Anne Hecht
U.S. Fish and Wildlife Service

Piping plovers that breed and winter along the Atlantic Coast face pervasive and unrelenting threats from cumulative impacts of habitat loss and alteration, human disturbance, and predation. Coastal stabilization activities, including artificial dune construction, snowfences and planting of vegetation may degrade piping plover habitat by altering natural beach formation processes. A wide variety of strategies to reduce adverse effects of human disturbance and predation, including symbolic fences and signs around nesting areas; predator exclosures; restrictions on vehicle use, pets, and other high-impact recreational activities; and public education have been employed to date. These endeavors are generally very labor-intensive and most require annual implementation. Federal and state wildlife agencies have systematically identified nesting areas that are important to the recovery of this wide-ranging, sparsely distributed species. These areas are owned by a variety of federal and state agencies, county and municipal governments, and private organizations and individuals. Piping plover recovery on the Atlantic Coast will require working with landowners to institutionalize management activities that provide long-term protection for this species and its habitat.

THE NEW ENGLAND PLANT CONSERVATION PROGRAM (NEPCoP): A REGIONAL MODEL

William E. Brumback
New England Wild Flower Society

The New England Plant Conservation Program (NEPCoP) is a voluntary association of private organizations and government agencies in each of the six states of New England, working together to protect from extirpation and to promote the recovery of the endangered flora of the region. NEPCoP operates through State Task Forces, composed of appropriate organizational representatives and professionally qualified individuals in each New England state. It is overseen by a Regional Advisory Council which is responsible for setting conservation policy. This system combines conservation resources without duplication beyond artificial state boundaries, and is intended as a model for other regions.

Combining both in situ and ex situ conservation methods, members and volunteers survey populations of regionally rare species, provide recommendations on population management, and/or collect seeds for placement in a seedbank as a backup to catastrophe in the wild. Seed germination trails are conducted and the results are reported to the State Task Force. Any plants derived from this research are placed in a botanical garden for the education of the public or are made available for reintroduction or introduction should this be deemed necessary.

The NEPCoP system, its policies, and results to date are described.

THE ROLE OF KEYSTONE ECOSYSTEMS IN LANDSCAPES

Phillip Demaynadier and Malcolm Hunter
Wildlife Department
University of Maine

The term "keystone species" is prominent in the lexicon of conservation biology because maintaining populations of species that play key roles in ecosystems is a critical task for conservationists. We define keystone species as a species that has a greater role in maintaining ecosystem structure or function than one would predict based on its abundance or biomass. The keystone concept can be extended up in scale from the role of species in ecosystems to the role of ecosystems in landscapes, where a keystone ecosystem is one that has a disproportionate influence on landscape structure and function. Specific mechanisms by which keystone ecosystems influence landscapes are explained and examples of their identification provided. The conservation implications for the identification of keystone ecosystems within landscape mosaics are important. Recognition of keystone ecosystems suggests a landscape-level approach that assigns conservation value to ecosystems, not only based on the level of diversity they themselves contain, but also on the functional significance a given ecosystem may have in maintaining a viable landscape.

RECOVERY EFFORTS FOR THE ENDANGERED SMALL WHORLED POGONIA (*Isotria medeoloides*)

Susanna L. von Oettingen
U.S. Fish and Wildlife Service

The Federally endangered small whorled pogonia (*Isotria medeoloides*) is a rare but widely distributed orchid, currently known from 86 sites in 15 states and one Canadian province. In 1982, when the small whorled pogonia was first listed, only 17 extant sites were documented.

This small, light green orchid occurs on upland sites in mixed-deciduous or mixed-deciduous/coniferous forests that are generally in second- or third-growth successional stages. Common habitat characteristics include sparse to moderate ground cover, a relatively open understory canopy, and proximity to features that create long-persisting breaks in the forest canopy.

The U.S. Fish and Wildlife Service, State natural resources agencies and private conservation organizations have actively pursued the recovery of this orchid. Since 1982, recovery efforts have generated new site, life history, and population information and a greater public awareness of this endangered species. In addition, habitat protection efforts have been successful with approximately 45 percent of the known sites under some level of protection. Because of the increase in number of known occurrences and protection of many of these sites, the Fish and Wildlife Service is now considering the reclassification of the small whorled pogonia from endangered to threatened.

CONSERVATION OF LISTED MUSSELS IN VIRGINIA

Richard Neves
U.S. Fish and Wildlife Service

THE WILD ADIRONDACKS: A SINGULAR LEGACY, DIVERSE LANDSCAPE AND INSURMOUNTABLE OPPORTUNITY

David H. Gibson
Association for the Protection of the Adirondacks

Nine years after the Adirondack Park was created by New York law in 1892, The Association for the Protection of the Adirondacks was formed by large landowners concerned about their holdings, and depradations to private and state forests from over-logging, flooding, forest fires, and over-harvesting of game species. The Association opposed any change in a Section of Article VII of the State's Constitution, approved by voters in 1894, which called for the lands of the State "now constituting the Forest Preserve" . . . . to be "forever kept as wild forest lands . . . . nor shall the timber thereon be sold, removed or destroyed." Nearly a century later, the organization continues its strong defense of this Section.

The paper briefly reviews conservation history in the Adirondack Park, and the Adirondack Forest Preserve's institutional, recreational and ecological roles. Although preservation and biodiversity goals can be viewed as conflictual, the Forest Preserve contributes positively to these goals if viewed over time. Further opportunities to mutually benefit the Park's "working" private and public lands, and natural and human community diversity are explored.

WE MUST REPLACE THE "WORKING LANDSCAPE" WITH A SUSTAINING LANDSCAPE

Michael J. Kellett
RESTORE: The North Woods

In George Orwell's *1984*, the "working landscape" would be considered "doublethink," where the unpleasant reality is the opposite of the nice-sounding idea. The "working landscape" may work for common plant and animal species that do not mind fragmented fiber farms, but not for healthy and sustainable ecosystems. It may work for a few private interests, but not for the greater public interest in economic stability, good schools, clean water, and continued access to outdoor recreation. This system is not even working well for the landowners and industries that invented it -- they face declining forest health, aging mills, growing concern over clear-cutting and pesticides, stronger environmental regulations, and global economic competition. The time has come to replace the "working landscape" with a sustaining landscape. We must (1) recognize the Maine Woods as part of a larger Great North Woods ecoregion; (2) expand public landownership by acquiring important private lands from willing sellers; (3) restore the native diversity of species, ecosystems, and natural processes; (4) demand that government and industry behave in an ecologically and socially responsible manner; and (5) shift toward ecologically, socially, and economically sustainable human communities.

MANAGING FOR DIVERSITY IN A WORKING FOREST

Michael S. Coffman
Environmental Perspectives, Inc.

Most people are surprised when they learn that Biological Diversity can be enhanced by managing the forest for a variety of uses: timber, wildlife, recreation, water quality and others. In an increasing number of studies, managing the forest for these various uses equals or improves the "diversity index" no matter how it is measured. And timber management, often the villain in discussions on diversity, is the only way that this diversity can be accomplished economically. The romantic idea that Nature-Knows-Best is not necessarily true. Certainly, some areas should be preserved in set-asides for their unique value -- in a non-sensitive, willing buyer, willing seller arrangement. But the best hope for improving diversity is through forest management. Such management is best achieved through a mix of intensive and extensive types of management.

WILDLIFE IN A WORKING FOREST -- PERSPECTIVES FROM NORTHERN NEW ENGLAND

Carol R. Foss and Laura S. Deming
Audubon Society of New Hampshire

The Northern Forest Lands of New Hampshire and New York support a diverse assemblage of forest-dwelling wildlife which depend on a wide array of habitats, including hardwood, softwood and mixed forests of various age-classes and species compositions. Working forests, which comprise a major proportion of the region, constitute a crucially important land base for native wildlife and provide an extensive range of habitat conditions.

Silvicultural systems, both uneven and even aged, affect forest stand structure and composition, and thereby influence a stand's habitat suitability for various wildlife species. This paper discusses the dynamic relationships between forest practices currently used in northern New England, resulting habitat characteristics, and the distribution of native wildlife species in space and time.

NATURAL PREDATORS OF SPRUCE BUDWORM

Nancy B. Chandler
Merrymeeting Audubon Society

Natural predators of spruce budworm include birds, spiders, insects, and small mammals, particularly red squirrels. Avian predators have the greatest ability to limit populations of spruce budworm, but are most effective only at low levels or during a post epidemic population decline of spruce budworm.

The breeding populations of birds of the Family Parulidae increase almost three fold in mixed age spruce/fir/hardwood forests during spruce budworm epidemics. Spruce budworm larvae prefer the upper crowns of balsam fir, white, and occasionally red spruce. Significant spruce budworm avian predators include black capped chickadees, red breasted nuthatches, Cape May, bay-breasted, Tennessee, blackburnian, and Nashville warblers. These predators plus ground dwelling birds such as white throated sparrows, wood thrushes and

ovenbirds, plus spiders, ants, and red squirrels found at all forest levels, exert effective population control on low and declining populations of spruce budworm.

Forest management strategies which encourage a mix of species and size classes, with scattered 1/2 hectare openings and patches of regeneration, will provide habitat for spruce budworm predators. Mixed hardwood, fir and spruce forests have more than twice the resident bird population, and less tree damage after a spruce/fir epidemic, than a mature fir or spruce/fir forest.

FOREST INDUSTRY'S APPROACH TO ECOSYSTEM MANAGEMENT

Joe McGlincy
International Paper

Ecosystem management: a term that many within the forestry community do not understand or identify with. However, many forest management practices are designed at the landscape level even though they are often implemented at the stand level. Consideration is given to harvest unit size, shape, adjacency, sensitive sites and wildlife species. The result is a vegetation mosaic characterized by horizontal and vertical diversity, species distribution and protection of unique ecological sites. International Paper's forests can be divided into three broad categories of use. About 40 percent is intensively managed, predominantly even-aged conifer plantations. About 50 percent is extensively managed, including uneven-aged management of mixed species stands and naturally managed areas. About 10 percent are in some form of preservation or custodial care. This includes areas in the company's Unique Areas preservation program, cooperative management agreements with conservation organizations, and land unsuited for active management that is maintained in a custodial state. Regular interactions with policy makers and opinion leaders, environmental and conservation groups, and customers will be increasingly important as the forest industry moves into the 21st century.

PERSPECTIVE AND APPROACH TO ADMINISTERING LANDSCAPES - SEA COAST, BLUEBERRY BARRENS, FOREST

Christopher Leahy
Massachusetts Audubon Society

BIODIVERSITY IN THE REAL WORLD: CONSERVATION IN THE SETTING OF RURAL COMMUNITIES

Paul A. Doscher
Society for the Protection of New Hampshire Forests

Many of the natural areas which are important to protecting and enhancing biodiversity exist within the context of rural communities. One such town is Stoddard, New Hampshire, where land conservation efforts have been underway since the 1960s. Today, more than 1/2 of the land in Stoddard has been protected by private and public conservation efforts.

The areas protected range from lakeside, island, wetland and mountain top habitat, to large tracts of working forest and a remnant old growth hardwood stand containing some of the largest trees in the state. New Hampshire's largest donated conservation easement, Andorra Forest, is a key component of the landscape, along with the Forest Society's 3,400 acre Charles Peirce Forest and Wildlife Reservation.

The diversity of areas protected demonstrate how the mix of conservation easements and fee acquisition can both protect land from development while continuing a tradition of forest and wildlife management. Unique natural areas exist embedded within the working forest and recreational landscapes of Stoddard, demonstrating that protecting biodiversity can be compatible with the economic needs of rural communities whose livelihood is in large part dependent upon their use of natural resources.

THE EVOLUTION OF AN IDEAL: SCIENTIFIC FOREST MANAGEMENT IN BAXTER STATE PARK

Jensen Bissell
Baxter State Park

BSP logo

The Scientific Forest Management Area of Baxter State Park was donated via trust deed to the State of Maine by Percival P. Baxter and is administered by the Baxter State Park Authority. The Authority has adopted a long term approach to forest management encouraging the evolution of management from the concern of resources to the understanding and management of forest systems. Current efforts on the SFMA include the development of forest practices that recognize and provide for natural areas and associated "featured species" needs as a permanent part of the forest system. Within the confines of a "working landscape" such as the SFMA, management must attempt to define the characteristics of the forest mosaic, including the size and shape of management areas, habitat fragmentation, buffers, from the perspective of the forest system.

build miles of roads each year

PROTECTING AND MANAGING RARE BAT HABITAT IN A WORKING FOREST

Thomas R. Duffus
The Nature Conservancy -- Adirondack Chapter

In December 1992, The Nature Conservancy (TNC) and International Paper Timberlands Operating Company (IPTO) formed a unique partnership to acquire and manage 1900 acres of forest land in the Adirondacks of New York. The property, known as Hague Mountain, contains an abandoned graphite mine which harbors the largest winter bat hibernaculum in the northeastern United States. This site includes the federally endangered Indiana bat (*Myotis sodalis*) and the world's second largest population of the small-footed bat (*Myotis leibii*). TNC acquired a conservation easement over and under Hague Mountain and IPTO acquired the restricted fee title including the right to manage timber. Bat habitat protection and management and commercial forest management were approached as compatible land uses. Key to negotiating this partnership was defining and accommodating forest management activities and bat habitat requirements, discerning and reducing areas of potential conflict, and committing to legally binding agreements. Issues included: weighing the need to harvest timber against potential impacts on the habitat; liability; hindrance of timber revenues caused by restrictions; loss of stand density and crown cover; accommodating ecological needs of species for which little is known.

? about the effect of logging above ground on the underground bat habitat

EXOTIC PLANT MANAGEMENT IN A WORKING LANDSCAPE: CHALLENGES AND OPPORTUNITIES AT ACADIA NATIONAL PARK

Judith Hazen Connery
National Park Service

Acadia National Park protects and preserves outstanding scenic, natural, scientific, and cultural values for present and future generations. Acquisition of park lands through donation have resulted in a fragmented patchwork of public and private lands. This creates challenges in managing for the preservation of natural systems. Of 1,283 plant species and varieties found in Acadia National Park, almost one quarter (289) are non-native. Beginning in 1986, we attempted to identify and prioritize exotic species of concern to management. We conducted field and literature surveys to determine the parkwide distribution and feasibility of management for the 12 species of highest concern. Purple loosestrife (*Lythrum salicaria*) was judged the most threatening.

The purple loosestrife management plan was developed as part of a more comprehensive integrated pest management plan. It includes prevention of wetland disturbances; herbicide applications; education of park staff, neighbors and visitors; discouraging the sale of purple loosestrife by local nurseries; cooperation with state and other land management agencies to share information on loosestrife suppression and work toward noxious plant legislation; continued evaluation of management actions; and support of research on the ecology and management of purple loosestrife.

Only through cooperative, integrated management based on sound science can we successfully protect native systems from exotic species in complex working landscapes such as Acadia National Park.

SELECTION CRITERIA FOR FORESTED NATURAL AREAS IN NEW ENGLAND

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Selection criteria for natural areas depend upon proposed usage. In this paper, we discuss the selection of natural areas to be used for a broad range of ecological research/educational purposes. At least five factors are important: (1) Sufficient size to maintain or provide for natural disturbance cycles, stable population genetics, territorial requirements of native wildlife species, hydrologic integrity, and, in general, some degree of isolation from exterior influences; (2) adequate representation of typical and important community/site combinations; (3) known disturbance histories, to the extent possible, including natural events as well as historical agricultural/logging interactions; (4) acceptable current condition in terms of age/size/successional stage including not only pristine climax forest but forested tracts in earlier successional stages; and (5) administrative feasibility in terms of natural boundaries, locatability, ownership, and accessibility. The relative importance of these factors are discussed, and examples are presented from the U.S. Forest Service network of Research Natural Areas.

CONSERVING SPECIAL AREAS IN AN INDUSTRIAL FOREST

Carlton N. Owen
Champion International Corporation

Champion International Corporation, with 6.1 million forested acres, is one of the largest private landowners in the United States. The company has a long history of providing conservation donations and/or bargain sales with past contributions totalling more than 50,000 acres. This paper reviews not only the traditional efforts to protect special environmental or cultural sites in a commercial working landscape, but it also uses the company's record in like-kind exchanges, and a more recent program -- "Special Places in the Forest" -- to provide insight into conservation initiatives in the forest products industry. Additional information gives a perspective on opportunities and improvements possible for organizations seeking to partner with corporate landowners in protecting natural areas.

THE WATERBORO BARRENS: MANAGING A PYROGENIC PLANT COMMUNITY IN THE HEART OF MAINE'S VACATIONLAND

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The Waterboro barrens in southwestern Maine represent one of the best and largest remaining examples of pitch pine/scrub oak and pitch pine/heath vegetation in New England. Considered a northern variant of pine barrens that extend south to Long Island and New Jersey, the Waterboro barrens support plant and insect species that are rare elsewhere in New England. Comprising nearly 1,200 hectares, the barrens are in a rural part of Maine that has only recently come under increased development in the form of recreation home construction and gravel mining. The area has burned frequently in the past, both for blueberry production and by wild fire, most recently by one of the great 1947 fires that burned throughout Maine.

We reconstructed fire and vegetation history for the area using historical records and pollen and charcoal analyses of pond sediments. The record shows that vegetation of at least portions of the barrens was more mesic prior to European settlement 200 years ago. Charcoal is more abundant in post-settlement sediments than before, but there is evidence that fires burned through the area prior to the arrival of Europeans. Indirect gradient analysis of plant cover data from 44 releves subjectively located in representative plant communities suggests that species are organized into communities along gradients of available moisture and nutrients. A central core of communities including pitch pine/scrub oak, pitch pine/heath, open pitch pine and scrub oak are probably differentiable on the basis of interactions among disturbance (chiefly fire) and environmental factors. A conceptual model describing interactions between plant communities and disturbance regimes has been developed. Implications of the results of historical and vegetation analyses are discussed in light of management options for the barrens.

ISSUES IN MANAGING NATURAL AREAS IN THE PACIFIC NORTHWEST

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Washington Department of Natural Resources and
U.S.D.A. Forest Service

Twenty-five years of cooperation within the Pacific Northwest Interagency Natural Area Committee has provided information relating to natural area inventory, acquisition, and preserve design. Recent emphasis on stewardship and natural area management provides material for illustrating commonalities and differences between agencies and private organizations, based on organizational constraints, natural area size and location, and landscape setting.

A variety of management issues, including use of prescribed fire and exotic species control, are discussed in terms of their effects on adjacent or nearby lands. Emphasis is also placed on how adjacent land ownership patterns and management activities affect protection of ecological processes and features within natural areas. We argue that many negative influences result from dramatically different management objectives established on surrounding lands, which contribute to truncation or other alteration of ecological processes operating within natural areas. Future management of natural areas in working landscapes will be confronted with an increase in detrimental effects. Increased monitoring, research, restoration, and public participation will partially mitigate this trend, while helping to better align management of surrounding landscape with natural area values and protection. We believe that public outreach and education are a critical component to successful long-term protection of natural areas in working landscapes.

MAINE'S PUBLIC LANDS: AN INTEGRATED RESOURCE MANAGEMENT MODEL

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Maine Department of Conservation

The legislative mandate that established the Bureau of Public Lands (BPL) in 1973 directed the BPL to manage the state's publicly owned land under the principles of multiple use and to produce a sustained yield of products and services. For the managers of this 482,000 acre land base, these multiple use principles are applied according to a concept of dominant and secondary uses, based on an understanding that every acre cannot serve every use. Dominant and secondary uses are integrated into the management of the land by considering the level of sensitivity of each area and the degree of impact on the area of any proposed use. Within this hierarchy of dominant use, Maine's public lands are allocated to protect rare, threatened or endangered species and significant community types, enhance back-country recreation areas, sustain important wildlife habitat for game and non-game species, maintain scenic views and the general aesthetic appeal of the land and manage for high quality timber products on a sustained yield basis over long rotations.

To implement its mission of integrated resource management, the BPL engages in a planning process which solicits guidance from the general public. For each consolidated unit, a management plan describes the character and assigns appropriate uses of the land. These plans thus serve as the conceptual foundations for all future management activities. This paper will explore the policies which guide and the practices which typify integrated resource management of a land base that reflects the full range and diversity of the Maine landscape.

PROTECTING A REMNANT SOUTHERN NEW ENGLAND LANDSCAPE USING GIS IN HIGHWAY ALTERNATIVES ANALYSIS

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GIS (ARC/INFO) was used as a planning tool in the National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS) and §404 federal wetland permit reviews to assess and depict the impacts of about 12 miles of proposed new expressway through an eastern Connecticut landscape. A significant remnant fauna of mammals, birds, reptiles and amphibians was previously identified in this landscape. This projct is notable as a previous incarnation experienced the highly unusual outcome of being denied a Corps of Engineers wetland permit in 1989 because of direct, secondary, and cumulative impacts to wildlife, wetlands, and waters and the failure of the Connecticut Department of Transportation to rebut the regulatory presumption of a less damaging, practicable alternative, upgrade of existing Route 6. Detailed surveys of herpetofauna and wetland functions and values were conducted for the current proposal, together with assessment of breeding bird assemblages and wildlife habitat at representative sites. Data was also compiled to assess cumulative and secondary impacts. A range of expressway and upgrade alternatives are currently under regulatory review.

SCENIC LANDSCAPES: BALANCING NATURE AND CULTURE

Eleanor G. Ames
Maine Olmsted Alliance for Parks and Landscapes

For Frederick Law Olmsted, Sr., landscape architecture's great visionary and practitioner, scenery had a powerful effect on people. His great urban parks provided "passages of scenery" designed to provide restful and reflective experiences for all park users. At the scenic reservations of Yosemite and Niagara, Olmsted involved himself in proposing strategies for the protection and management of these great reservations and their spectacular scenery. Olmsted understood over a century ago the inherent conflicts between man and wilderness and explored the problem of access by the growing numbers of people to these natural areas. In his report of 1865, "Yosemite Valley and The Mariposa Big Trees", Olmsted warned of future problems if access to and management of the Valley was not well understood and planned for. He was concerned that without well designed access, the visitors would spoil the very thing they had come to see. Later, at Niagara, he addressed similiar concerns. In the 1920's at Acadia National Park, Frederick Law Olmsted, Jr., provided a range of scenic experiences for the park visitor in the design of the motor roads. As much of their design work demonstrates, the Olmsteds were able to find a balance between nature and culture. Today, have we lost that delicate balance in our scenic landscapes? How can and should we manage our landscapes which historically were set aside to be vast recreational areas for everyone? Perhaps by exploring history, we can find clues for the future.

WHAT CAN THE ARTIST OFFER TO CONSERVATION IN WORKING LANDSCAPES?

Stacy Levy
Sere Native Landscape Restoration

Neil Korostoff
Department of Landscape Architecture
Pennsylvania State University

Art is seldom considered as one of the human endeavors that provide meaning to conservation activities. While today's world relies upon the sciences as the avenue to knowledge and understanding of nature, historically art has played a fundamental role in interpreting the significance of the natural world to human culture. The author of this paper, a nationally recognized sculptor, has devoted her career to the artistic explication of the phenomena of nature to the general public.

This paper will describe the artist's approach to the revelation and interpretation of an important forested stream valley park. The Gorgas Valley, is a tributary valley of the Wissahickon Creek Gorge in the Fairmount Park system of Philadelphia, Pennsylvania. Protection since 1872, the forested valley has been the focus of management efforts to restore the beech/oak/hemlock forest native to the site. During the 18th and 19th centuries the Gorgas Valley contained intensive industrial and agricultural activities, remnants of which can still be found. The paper will include a description of a path and interpretative signs designed to reveal the working history of the Gorgas Valley, the impact of the industrial activities on the valley, and processes of restoration currently underway.

DATA BASED ASSESSMENT OF REGIONAL LANDSCAPE VALUE

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David G. Pitt
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University of Minnesota

This paper focuses on an aesthetic value model that uses Forest Inventory and Assessment (FIA) inventory data to define the aesthetic value of a regional landscape. The model defines fourteen dimensions of attractiveness that include on-site and regional context variables. Interval measures associated with each dimension derive aesthetic values of unique sites and cumulative regional values. The model can be used with growth and harvest simulations to identify positive or negative changes to the visual character of a landscape over time. Using this methodology, forest managers can include consideration of aesthetic impacts in large scale planning projects with existing empirical data. The sensitivity of analysis allows isolation of impacts, a measure of their significance and can focus and monitor mitigation strategies. Additionally, there is potential for quantifying costs of mitigating aesthetic impacts in terms of forest production. The model and application are conceptual while validation efforts are in progress.

WILDERNESS VALUES IN WORKING LANDSCAPES

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University of Maine

Can we risk a future without wild nature? Wilderness has been defined as both a concept of the mind and a physical phenomenon of our environment. How do these two perspectives of wilderness relate to human culture and what implications do they have for managing wilderness areas in working landscapes? The answers may be rooted in our ability to capture the spirit of the land and develop a sense of its value. A synthesis of wilderness values, as expressed by ancient to comtemporary thinkers, reveals at least three that provide a rationale and direction for retaining a measure of wildness in working landscapes: (1) value of preserving the intrinsic form and function of wild nature, (2) value of preserving the opportunity to become aware of our place and ethical role in the rest of nature, and (3) value of preserving the opportunity to experience the restorative energy of relatively undisturbed natural areas. In the working landscape, the Allagash Wilderness Waterway in Maine exemplifies many of the problems and issues as well as solutions related to the management of wilderness areas to reflect these values.

"BALANCE" THE CHALLENGE FOR ECO-TOURISM AND PROTECTED AREAS

Ron Loughrey
New Brunswick Department of Natural Resources and Energy

New Brunswick, a Canadian Maritime Province, is rich in natural heritage and unique natural setting. The rugged coastal regions of the Bay of Fundy, the warm, sandy beaches and dunes of our east coast, the vast areas of forest, and unspoiled rural landsapes provides an ideal setting for outdoor adventure and nature appreciation. Tourism industry operators have found their focus from the initiative of several operators who have combined the outdoor adventure with the comforts and amenities of a quality country inn.

Inn operators throughout the Province now combined activities such as artists workshops, whale watching, nature observation, education, hiking and canoeing has activities making the Eco-tourism product sought after by many North American markets. As the demand for the eco-tourism product increases, the challenge has been and will continue to be, how to manage these very sensitive, valuable and unique aspects of our natural resources. Environment degradation by large numbers of tourists is the greatest threat to the appeal of the eco-tourism product. Exploitation of the natural product will reduce the life expectancy of the eco-tourism product, thereby greatly reducing the economic benefits created by a well managed, "balanced" product.

New Brunswick's Provincial Park System plays an important role in the growth of our Protected Areas Network. An aggressive interpretation program, accented with high quality recreational activities within the network places increasing demands and pressures on the natural resource. How these pressures are promoted and managed determine the quality and longevity of the Eco-tourism product throughout the Province. Preparing detailed management plans in partnership with the private sector and other government agencies have helped to develop the eco-tourism industry with some degree of "balance". What is that "balance" and what are the limitations pose the greatest challenge in developing a Protected Natural Areas Network.

SCENIC ASSESSMENT METHODS ALONG THE MAINE COAST

Terry DeWan
Terrance DeWan and Associates

SYMPOSIA SESSION 16 -- Conservation Partnerships and Community Involvement in Working Landscapes

LEARNING TO LOVE A LOUSEWORT: PERSPECTIVES ON COMMUNITY-BASED EDUCATION EFFORTS IN THE ST. JOHN RIVER VALLEY (MAINE/NEW BRUNSWICK)

Elliott Gimble
Atlantic Center for the Environment

Based on project experience in the upper St. John River Valley (Maine and New Brunswick), this paper identifies some effective elements of a community-based conservation education program and how they may be useful to resource managers in protecting biological diversity. The St. John Riverkeepers Project is one of a set of innovative, holistic environmental education programs focusing on rivers and riparian landscapes and designed to stimulate greater community involvement and conservation leadership. Activities include training for teachers and students in water quality and land monitoring, public outreach, and publications. Supported by the Maine Critical Areas Program, the U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency, this partnership has promoted public knowledge of and support for the region's rare and endangered plant species, such as the Furbish Lousewort, while emphasizing the greater ecosystem.

The Atlantic Center's mission is to improve the quality of life of communities within its region, taking into account the economic and cultural aspects of environmental issues and solutions. A division of the non-profit Quebec-Labrador Foundation, the Atlantic Center conducts environmental education and research projects relating to fisheries and wildlife, land stewardship, and rivers, and its international program maintains strong ties with conservation NGOs in Europe, Latin America, and the Caribbean.

BUILDING COMMUNITY SUPPORT FOR TORTUGUERO NATIONAL PARK, COSTA RICA

Jessica L. Brown
Atlantic Center for the Environment

The long-term security of a protected area depends, in large part, on its relationship with neighboring communities. In the face of limited financial resources and enforcement capacity, parks managers, particularly in developing countries, cannot rely solely on regulations, decrees and boundaries to ensure that critical natural areas are protected. At the same time, people in rural communities have much to gain from the effective stewardship of their natural resources, and are potential allies of protected areas. Parks managers must work in partnership with local communities to ensure that protected areas are effectively managed and live up to their potential to meet conservation and development objectives.

Located on Costa Rica's Atlantic Coast, Tortuguero National Park protects an area of high biological diversity, encompassing a great diversity of vegetation types and the habitat for 13 of the 16 endangered mammal species found in Costa Rica. As the core protected area of the recently established Llanuras de Tortuguero Regional Conservation Area, the 18,946-hectare park is the focal point of efforts to expand and

consolidate protected areas in northeastern Costa Rica. However, in common with other protected areas in Costa Rica and throughout the region, Tortuguero faces increasing pressures from land colonization, and expanding population, upstream agricultural development, commercial logging, and inappropriate tourism development. Its isolation and the fragility of its ecosystems make it particularly vulnerable to the combination of human activities, political pressures and economic problems which threaten it.

This paper examines the challenge of building local community support for Tortuguero National Park in the face of current threats to the park and plans for its expansion. It offers recommendations for strategies to build local support for Tortuguero National Park, including community participation, environmental education, promoting appropriate ecotourism and providing resource-use alternatives. These challenges and recommendations have application to protected areas in other regions of the world.

THE DEVELOPMENT OF COMMUNITY-BASED, SUSTAINABLE LAND-USE ACTIVITIES IN THE ECUADOR'S ANTISANA RESERVE

Abigail Rome
World Bank/International Finance Corporation

In Ecuador, as in much of the developing world, efforts to protect biological diversity must be closely tied to activities which generate income for local communities. With this in mind, Fundacion Antisana (FUNAN), a non-profit non-governmental organization established in 1991 to protect Mt. Antisana, Ecuador's fourth highest volcanic peak, is developing community-based, revenue generating projects which sustainably utilize the area's natural resources. Because the Antisana Reserve is the source of drinking water for over 1 million people in and around the capital city of Quito, a prime recreational site for the growing urban and tourist market, and home to endangered species such as the Andean condor and the spectacled bear, projects which protect water resources, natural habitat, and recreational assets are the focus of FUNAN's conservation program. Proposed activities include: establishment of fish (trout) culture operations, regulation and promotion of sport fishing, reforestation, organic agriculture, controlled sheep and cattle grazing, reintroduction of camelids, and ecotourism. FUNAN will provide technical assistance to surrounding landowners and communities to undertake these activities while simultaneously ensuring that all plant and animal life, as well as the soils and water upon which they depend, are conserved.

ACADIA NATIONAL PARK: A CASE STUDY IN COOPERATIVE MANAGEMENT OF BIOLOGICAL DIVERSITY

Bob Reynolds
Acadia National Park

This paper will not provide answers or a model to achieve goals, but rather will describe Acadia National Park efforts at maintaining natural systems within the context of land use on non-Federal lands in and around the park. The paper will describe in some detail cooperative efforts with other governmental and private organizations to achieve common goals, and the pitfalls and potential rewards of these cooperative efforts.

PRESERVATION OF BIOLOGICAL DIVERSITY IN THE BALCONES CANYONLANDS OF TEXAS

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The Nature Conservancy - Texas Chapter

Dean P. Keddy-Hector and David D. Diamond
Texas Department of Parks and Wildlife

The scale at which the impact of human activity is realized has often exceeded the spatial and temporal arena in which research has traditionally been conducted. Geographical information systems (GIS) provide a new set of tools that allow for expansion beyond site-specific experiments to regional analyses. Opportunities for habitat identification, protection, monitoring, and change detection at the landscape level have also created challenges in regional coordination of limited resources. To meet these challenges, The Nature Conservancy of Texas, the Texas Parks and Wildlife Department, and the Department of Defense have entered into a cooperative agreement that allows for the establishment of a GIS dedicated to improving the biodiversity information and decision making in Texas. A joint effort under this agreement is the delineation of Golden-cheeked Warbler breeding habitat throughout a 31 country area in central Texas. The endangered Golden-cheeked Warbler is the only endemic breeding bird of Texas. Its habitat consists of mixed Ashe juniper and oak woodlands. A discussion of the cooperative agreement, use of GIS for biodiversity protection, and preliminary results from Golden-cheeked Warbler habitat study will be presented.

PRESERVING DIVERSITY IN THE NORDIC FOREST LANDSCAPE

Mats Wikberg
Forest Engineer, Finland

Today, it is widely recognized that cultivated and tended forests cannot contain all the biological qualities and variations that are found in the natural forest. However, effective and efficient forestry operations can be successfully combined with highly demanding nature conservation goals.

In Scandinavia, the forest sector have in recent years gone through a significant change towards a more diversed approach regarding Forest management. In Sweden, the forest sector have announced a declaration of intent which is signed by forest owners, the forest industry, trade unions and church. The Declaration is designed to ensure that biodiversity is preserved in everyday forestry and that endangered species and unique habitats are protected. In addition the environmental goals of the Declaration have been recently adopted by the Swedish Parliamentary Committee on Forest Policy.

The Declaration recognizes that the achievement of nature conservation goals requires both detailed knowledge and committed participation from the thousands and thousands of Swedes that are in the management of the country's forests.

A series of workshops of the theme; "Richer forestry" have been a huge success throughout the Swedish and Norwegian forest sector and is in its initial stage in Finland.

Sweden is acting as a model for other nations in Scandinavia in not merely protecting its old-growth woodlands but actively expanding and managing new mixed woodlands thus ensuring that biodiversity is not only preserved but encouraged.

MINNESOTA'S BLUFFLANDS: LINKING PRIVATE AND PUBLIC STEWARDSHIP ACROSS THE LANDSCAPE

Ellen J. Snyder, Kathryn Bolin
and Harry Roberts
Minnesota Department of Natural Resources

Minnesota's blufflands harbor over 100 rare plants and animals -- one of the state's richest biological landscapes. Steep slopes, erosive soils, karst geology and scenic beauty result in a highly sensitive resource vulnerable to even minimal human impacts. Pressures are increasing on blufflands resources as they are rapidly being recognized for their recreational opportunities and residential development. With more than 90% of the blufflands in private ownership, landowners play a significant role in maintaining the blufflands unique natural areas.

Recognizing the necessity of resource protection and management beyond public boundaries, the Minnesota Department of Natural Resources (DNR) created the Blufflands Initiative. Funded by the Minnesota Legislature, the Initiative extends resource planning and management into the public arena by supporting and guiding citizen efforts to develop a vision for their blufflands community. Traditional boundaries within the DNR and between the DNR and local communities are breaking down as a result of this landscape approach to resource management. Residents are pursuing a diversity of resource protection tools including zoning, easements, conservancy districts, land stewardship and land trusts.

Cooperative biological inventories in this landscape have been initiated between the Blufflands Initiative, DNR Natural Heritage Program and DNR Division of State Parks and Recreation.

ISLAND SHEPHERDING: A SHEEP FIX FOR OPEN SPACE PRESERVATION?

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The challenges of open space preservation have created a growing interest in sheep as a tool for land management. Despite the ecologically devastating effects that New England's sheep caused in the last century, in some landscapes low intensity sheep grazing can increase biotic diversity and provide an attractive alternative to pesticides and mechanical cutting.

In conjunction with the Island Institute, during the summer of 1992 I conducted vegetative and soil surveys on six Maine islands in Penobscot and Muscongus Bays, three of which have year-round flocks of sheep. Their relatively shallow, acid soils typically support spruce-fir forests interspersed with bogs and heath meadows.

On each island I recorded plant species frequency and diversity and soil depth along sampling transects from the upper edge of the intertidal to the closure of the forest canopy. I performed cluster analyses on these data to determine if there are significant differences in the vegetative structure and soil depth in the supratidal between islands with sheep and those without. In addition, I used data from the three islands with sheep to elucidate the relationship between sheep density (relative to both open space and total area of the island) and the observed vegetative effects.

PIPING PLOVERS IN THE MARITIMES: PRESERVATION THROUGH PROTECTION AND PLEASE

Stephen Flemming and Gary Corbett
Canadian Parks Service

In the Maritimes, the endangered Piping Plover is threatened by human disturbance and habitat degradation. The Canadian Parks Service protects Piping Plover habitat, and also affords protection from human disturbance. Most Piping Plover breeding areas within National Parks are completely closed to the public. Other areas are monitored by summer staff and posted with information signs.

On provincial and private lands, a new initiative called the Piping Plover Guardian Program also reduces human disturbance. Volunteers post signs that request people to avoid the plover nesting area. The signs are reinforced by Piping Plover Guardians standing at the posted boundary and explaining to the general public why they should heed the signs.

Productivity within National Parks has improved since the implementation of protective measures. Fledging success was 1.3 chicks/pair (n=111 pairs, 1980-82, 1984-87), but has increased to 1.9 chicks/pair (n=208 pairs, 1988-92). Likewise, the Guardian program enhanced fledging success from 0.65 chicks/pair (n=44 pairs, 1991) to 1.44 chicks/pair (n=32 pairs, 1992).

We plan to expand the Piping Plover Guardian Program to additional sites in Atlantic Canada. Further, the Guardian Program will be used to reinforce the initiatives of the Canadian Parks Service. Protective measures and a "please campaign" are helping to conserve the Piping Plover in the Maritimes.

THE USE OF CRITICAL HABITAT ASSESSMENTS IN NATURAL RESOURCE MANAGEMENT PLANS

Rick Van de Poll
Antioch New England Graduate School

State and federal governmental agencies have established numerous protocols for the conservation of biologically significant areas in the United States since the passing of the Endangered Species Act in 1972. While most of these have focused on land acquisition and other permanent protection measures for known sites, very few attempts have been made to systematically inventory unknown sites, or provide protection mechanisms for sites that are a part of working landscapes. Working on a natural resource inventory and management plan for a 1000-acre privately held parcel in southern New Hampshire, this researcher has found that the use of 'critical habitat assessments' can provide an effective means for conservation management of these elements. Critical habitat is defined by the relative uniqueness and sensitivity of the element in the region, and the assessment criteria are shaped by the *land use objectives* as clarified through extensive communication with the landowners. Twenty-nine sites within six categories -- geological, wildlife, botanical, vernal pool, historical, and natural community -- are identified and discussed. Assessment methodologies using both quantitative and qualitative approaches are reviewed. Integration with a final management plan for the parcel is summarized through the 'management considerations' section of the critical habitat assessment report.

RECONSTRUCTING NATURAL COMMUNITIES IN OZARK STREAMS

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U.S. Fish and Wildlife Service

Robert B. Jacobson
U.S. Geological Survey

Conserving biotic communities in streams as natural areas often requires substantial restoration as a first step; yet knowledge of original presettlement faunas is meager. However, because biota of streams is highly controlled by physical habitat, if we are able to determine presettlement habitat conditions, then restoration of the community to natural conditions as possible. We are examining segments of streams, termed hydraulic habitat units, which possess distinctive physical and hydraulic characteristics as well as a unique genesis. Each habitat unit may be considered an ecosystem subcomponent because it possesses particular structural (invertebrate and fish communities) and functional (primary productivity and organic matter dynamics) attributes. We have used historical accounts and stratigraphic information for Ozark Plateau streams to document changes in the physical geometry of the stream channel due to both human induced and naturally occurring events, and to infer presettlement biotic conditions. By using natural hydraulic forces and geomorphic principles we have the potential to reconstruct original habitat elements and allow the reestablishment and maintenance of natural communities.

CONSERVATION STRATEGIES AND RESERVE DESIGNS FOR RARE PLANTS

Sara J. Oyler
Department of Wildlife
University of Maine

Conservation strategies and reserve designs were developed for the seven groups of plants corresponding to the seven forms of rarity described by Rabinowitz (1981). The design for habitat specialists, occurring in a wide geographic range in large local populations is several large reserves containing representative populations from across the geographic range. Those species with a similar geographic range and habitat specifically that exist in small local populations require many small reserves containing representative populations from across the geographic range. Habitat generalists occurring in a narrow geographic range in large local populations should be placed in one large reserve containing an entire large population with an escape corridor. Small local populations of habitat generalists with a narrow geographic range require a few small reserves containing entire populations with escape corridors. Large and small local populations of habitat specialists in a narrow geographic range require several reserves placed close together with connecting corridors. Any type of reserve design is sufficient for small local populations of habitat generalists occurring in a wide geographic range.

PRIVATE LANDOWNER VALUES AND STEWARDSHIP OF NATURAL COMMUNITIES AND RARE SPECIES IN AN EXURBAN LANDSCAPE

Sherri A. Buss
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University of Minnesota
and
Minnesota Department of Natural Resources

The focus of this research has been private landowner values and attitudes toward natural communities and rare species identified on their properties by the Minnesota County Biological Survey, conducted by the DNR's Natural Heritage Program.

The research used a case study methodology, and extensive interviews and on-site observations on private properties to explore landowner values and attitudes and identify property and management histories. The analysis explores the interview results, and relates landowner values and attitudes to the physical characteristics of the natural communities and rare species, as well as the characteristics of the landowner, such as their experience and management of the resource, knowledge of the environment and ecological concepts, and interest in future stewardship of the resource.

Results indicate that landowner values, attitudes, and interest in stewardship are most related to the type of natural community (or communities) on the property, the physical characteristics of the communities and rare resources, and some landowner characteristics, such as degree of experience with and management of the resources. Four general community types were included in the research -- dry woodlands, wetland forests, prairies, and open wetlands. The results suggest strategies for working with landowners to provide information on natural areas and rare species, as well as needs for additional protection strategies to preserve some types of natural areas that are likely to be altered on private properties.

This research was conducted for a Masters Thesis in Landscape Architecture at the University of Minnesota, in cooperation with the Minnesota Natural Heritage Program at the DNR.

CANEY MOUNTAIN NATURAL AREA AND THE EVOLUTION OF NATURAL AREA SYSTEMS

Richard H. Thom
Missouri Department of Conservation

The history of Missouri's Caney Mountain Natural Area reflects trends in natural areas conservation over time. The original natural area was designated in 1972, to represent a single natural community. It was selected without evaluating other glades to determine whether it was the best choice. After designation the area was left unmanaged for the next ten years while red cedar reduced its glade habitat. In 1979, a natural features inventory of Caney Mountain Wildlife Area revealed that far better examples of dolomite glades existed. In 1982, the Missouri Natural Areas Committee replaced the original natural area with the 170-acre Long Bald Natural Area, tripling the amount of dolomite glade and adding associated natural communities. The Conservation Department began ecological management to reduce cedar encroachment and to restore the glade natural community to Long Bald. The Department also established permanent vegetation monitoring plots and photo stations. Over the years the importance of surrounding old-growth forests,

savannas and streams was recognized along with the need to preserve ecological processes at a landscape level. In 1990, the Long Bald Natural Area was expanded to create a 1330-acre, landscape-scale Caney Mountain Natural Area.

PRELIMINARY EVALUATION OF PEATLANDS FOR PROTECTION AS NATURAL AREAS: A NUMERICAL METHOD

Dr. Ronald B. Davis
University of Maine

This method applies three criteria (rarity, exemplariness, and diversity) to six peatland characteristics (geomorphic/hydrologic type, other geological features, vegetation types, flora, size (area), and pristine condition). The first two criteria are applied on four geographic levels: international, national, state (or province), and local. For each peatland, criterion/characteristic scores are based on data from air photos, a low altitude overflight, and a field visit, and these scores are totaled to obtain a peatland evaluation grade. The method is useful for screening peatlands in counties, states, or larger regions. It may be used in preliminary consideration of a proposal for mining or some other destructive project at a peatland. Prior to application of the method, criterion/characteristic scores are calibrated against data representing the ranges of variation in peatland characteristics of the region. The method is demonstrated for the State of Maine, using data from 82 peatlands for calibration and for scaling of peatland evaluation grades into protection priority classes. Once a peatland has become a final candidate for protection of consumptive use, further ecological evaluation based on intensive field sampling is needed, covering additional variables such as hydrology and fauna.

COMPARISONS OF BIRD HABITAT BETWEEN OLD-GROWTH AND GYPSY MOTH-INFESTED FORESTS

Dale K. Thurber
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The exotic gypsy moth (*Lymantria dispar*) can cause high tree mortality, particularly among oaks, on vulnerable sites. As their range expands south and west, control efforts and damage become more costly. Impacts of defoliation on non-timber resources have not been well documented.

An outbreak of gypsy moths occurred during the fourth and fifth years of an 8-year bird habitat and population study in a second-growth forest in West Virginia. High canopy cover declined, whereas low canopy cover increased. Average percent live basal area decreased from 87% to 57%. Percent shrub cover increased by 40%, and 18 shrub species increased in cover. The most pronounced change was a 3-fold increase in snag basal area.

The outbreak produced a combination of habitat elements found often in old-growth, but rarely in managed or second-growth forests -- specifically, numerous large snags, down trees, dense shrub growth under canopy openings, and the absence of abrupt edges. Populations of birds associated with snags and/or dense shrub cover, including Rufous-sided Towhees, Carolina Wrens, Rose-breasted Grosbeaks, Brown Creepers, Hooded Warblers, Black-and-white Warblers, and four woodpecker species, showed strong increases. This study underscores some potential ecosystem problems that result from forest management practices which include removal of wood.

UNDERSTANDING AND PROTECTING BIODIVERSITY AT THE LANDSCAPE LEVEL IN NOVA SCOTIA

A. Lynds and J.M. LeDuc
Nova Scotia Department of Natural Resources

Nova Scotia's landscapes have been developed and worked for over 300 years leaving only very small and isolated areas which can be considered virgin or untouched. Despite this history of use and development, over 40 percent of the province's land base is occupied by roadless areas (>200 ha.) where change is primarily due to natural processes. However these remaining roadless areas can be characterized as being small and fragmented with only a few incorporating large extensive wild areas. The Province of Nova Scotia is committed to establishing a network of protected areas which represents the landscape biodiversity of the province. To this end, the Nova Scotia Parks and Protected Areas Systems Planning Project has identified the distinctive landscapes of Nova Scotia and corresponding ecosystems by landscape type. This has led to an understanding of how biodiversity varies at the landscape level and has helped to address the question of what constitutes a representative protected area within the broad working landscapes of the province.

MAKING A START IN GUATEMALA: A REPORT ON THE CONSERVANCY'S CONSERVATION PARTNERSHIP

Mark DesMeules
The Nature Conservancy - Vermont Chapter

Guatemala is a country of unparalleled diversity. Whether it is culture, human history, geology, geography or biology, no Central American country compares.

This is an area of the globe where some of the world's greatest biological diversity abounds and, until recently, the least amount of conservation planning and action has taken place.

From the alpine heights of volcanoes down to the cloud forests of Sierra de las Minas, and further on to tropical coasts of the Pacific and Caribbean, biological diversity can only be described in superlatives.

We will be looking at conservation in Guatemala and focusing on the effort to assemble and protect a 250,000-acre cloud forest preserve. Our review will include the people of Guatemala, human ecology, Guatemalan geography and bioregions, and the details of how The Nature Conservancy, through its Guatemalan counterpart, Defenders of Nature, is helping the Guatemalan conservation movement. The perspective will be from a former Smithsonian Peace Corps Volunteer, Mark DesMeules, who worked in Guatemala on the early reforestation efforts in the Altiplano. Sixteen years later, Mark has returned to Guatemala as a Conservancy Director of Science and Stewardship to continue his conservation work there.

THE REDESIGNED FOREST: A NEW "YORK" PERSPECTIVE

Chad E. Covey and Robert L. Slavicek
New York Department of Environmental Conservation

New York has 457 State Forests encompassing over 700,000 acres. Purchased mostly in the 1930's, these old hill farms were reforested by the Civilian Conservation Corps. The forests are under the management of the Department of Environmental Conservation, Division of Lands and Forests.

Multiple use Unit Management Plans (UMP's) incorporating public input are presently being developed for these forests. Two plans, the completed Long Pond Unit and the draft Brookfield Unit, are unique in the State in their design to optimize biological diversity and compensate for past traditional forestry practices. Restoration Forestry, New Forestry, and Landscape Ecology techniques and applications have been incorporated into the plans. These include designs to preserve or create climax forest reserves, to maintain or create snag and coarse woody debris levels, to maintain closed canopy management areas, and to convert plantation monocultures to natural stands.

The authors represent both the field UMP development and the organization management perspectives in these efforts to design restorative influences on the composition, structure, and function of New York's public State Forest lands.

CONSERVATION OF BIOLOGICAL DIVERSITY ON THE WHITE MOUNTAIN NATIONAL FOREST

John Lanier and Steve Fay
White Mountain National Forest

Seeking the conservation of biological diversity on large, multiple-use forest areas is a demanding task. Constant attention must be paid to re-examination of fundamental principles underlying long term plans, case studies, or locally derived information, or experience, to routinely evaluate the approach taken. This field of study is subject to persistent change.

This paper seeks to briefly describe some principles which helped guide development of the Land and Resource Management Plan for the White Mountain National Forest. In particular, it will focus on wildlife habitat and the capability of this landscape to provide habitat based on an ecological classification. There will be a summary of monitoring results related to these two areas of interest.

The White Mountain National Forest is an approximately 800,000 acres in northern New Hampshire and Maine. It includes northern hardwood, spruce-fir, pine, oak forest and riparian habitat ranging from major valley bottoms to alpine ridges. The Forest Plan incorporates dispersed and developed recreation, wildlife, fisheries, water, timber and wilderness.

A BIRD'S-EYE VIEW OF MAINE'S INDUSTRIAL FOREST LANDSCAPE

John M. Hagan
Manomet Bird Observatory

Industrial-scaled forestry significantly alters the natural landscape by changing the age distribution of the forest, creating forest edge, and modifying the configuration of forested habitats. Many bird species are known to be sensitive to forest edge and configuration in other parts of the U.S. Whether this is true in Maine's industrial forest landscape is the focus of a study begun in 1992. The goal is to understand these possible effects, and recommend land management alternatives, if appropriate, without compromising the economic value of the forest. Data collected in the first year of study show that the varied landscape resulting from industrial forestry produces habitat suitable for a large diversity of bird species, including many Neotropical migrants, which are of special concern. At the same time, forest fragmentation is increasing and could compromise the welfare of some species if they prove to be sensitive to habitat isolation or forest-edge phenomena. Because many small harvests produce more forest edge than a single large harvest, the 1989 Maine Forest Practices Act, which strictly limits the size of any single clearcut, has accelerated the amount of forest-edge produced. Whether this may affect edge-sensitive species is not known at this time, but clearly empirical data are sorely needed to verify that the Act will not compromise populations of any species. The challenge ahead to the timber industry and conservationists will be to maintain a healthy age distribution of forest, *and* in a configuration that ensures perpetuation of forest interior organisms.

PROMOTING OSPREY NESTING SUCCESS IN THE WORKING FORESTS OF COOS COUNTY, NEW HAMPSHIRE

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Anne Tappan
New Hampshire Fish and Game Department

The breeding distribution of New Hampshire's threatened Osprey (*Pandion haliaetus*) population has long been limited primarily to the upper Androscoggin River watershed in northeastern Coos County. Osprey numbers in this part of the state dwindled during the 1960s and 1970s; only three active nests, none of which successfully fledged young, remained in 1981. Working with Boise Cascade and James River corporations, the NH Fish and Game Department and the Audubon Society of NH promoted a dramatic increase in Osprey reproductive success by 1) identifying nest locations on maps used in planning timber harvests, 2) establishing disturbance-free buffer zones around active nests, 3) retaining up to three potential nest trees within a 20-chain radius of nests, and 4) installing predator guards on nest trees.

Over the 12-year period from 1981 to 1992, 89% (56 of 63) of the known Osprey nesting attempts in Coos County occurred in trees on land owned or managed either by Boise Cascade or by James River. During this period total nests present increased from 11 to 30 nests/year, active nests rose from 3 to 16 nests/year and a three-year running average for productivity climbed from 0.59 to 1.14 young/active nest. Reproductive success was most improved at nests equipped with predator guards. Establishment of the Lake Umbagog National Wildlife Refuge and additional state acquisition of adjoining lands, both currently in progress, will provide further long-term habitat protection for much of this population.

PROTECTION AND BIODIVERSITY IMPORTANCE OF THE POLISH LANDSCAPE PARKS

Dr. Wojciech Jankowski
Institute of Environmental Protection, Poland

National parks constitute of 0.58% area of Poland, landscape parks and preserved landscape areas being the most important for conservation. The 79 landscape parks of 1.8-55.6 km^2 are protected by more restrictive regulations. Restrictions regarding exploitation of forest and cultivated areas, often causing conflicts with freeholders, aim mainly at maintaining natural biodiversity. They concern industry, mining, pesticides, fertilizers, manuring, farms, field afforestation, ploughing meadows and pastures, river regulation, drainage, destroying old river beds, small water bodies and wetlands, cultivating river valleys and lake shores, removing dead timber, building construction, tourist routes, speed limits, roads, dumping grounds.

The regulations and recommendations concern transforming mono-layer mono-species into multi-layer multi-species forests, their change towards original habitat, removing introduced species, natural renovation using local seed populations, increased clearing age, introducing admixture species, preserving and extending ecological corridors, renaturizing rivers and creating buffer zones along them, ecological agriculture, coordinating forest and agriculture management, purification of waste materials, preserving rare habitats and ancient monuments.

Lack of compensation for freeholders for the restrictions is disadvantageous, and the state and NGO rarely buy floristically valuable areas.

Within landscape parks new reserves are created and vegetation maps prepared.

The Ecological System of Conserved Areas has proposed that such areas in Poland should be linked by ecological corridors.

A PROTECTED AREAS POLICY FOR NEW BRUNSWICK

Martha L. Gorman
New Brunswick Department of Natural Resources and Energy

The Province of New Brunswick recently adopted a Protected Areas Policy which will integrate natural area conservation with forest management planning. The protection of the natural landscape of New Brunswick will be enhanced through the designation of conservation areas, the establishment of management objectives and coordination of planning activities for ecological reserves, natural area parks, watershed protection areas, wetlands and wildlife management areas, heritage rivers and multiple use areas. A systematic approach to the evaluation, classification and management of these protected areas is currently being developed by the Department of Natural Resources and Energy. It includes the development of system plans, scientific criteria and classification frameworks to evaluate candidate sites and identify natural elements which are not adequately represented in the Protected Areas Network. Almost half of the land base in New Brunswick is owned by the provincial government and the remainder consists of corporate and private land, federal land, agricultural or cleared land and park land. In order to ensure the conservation of natural areas in a working landscape, it will also be important to create partnerships among government agencies, corporations, public interest groups and private citizens.

MANAGING ADIRONDACK HIGH SUMMITS

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State University of New York

Kathleen D. Regan
Adirondack Nature Conservancy and Adirondack Land Trust

Ancient alpine communities occur on the twenty highest Adirondack summits in northern New York State and constitute living museums of post-glacial vegetation persisting on-site since the Younger Dryus period 11,000 years ago. Among the 110 species of vascular plants present, approximately twenty boreal species reach their southern distributional limits atop high Adirondack peaks. The summit landscape resembles islands of blanket bog underlain with fragile peaty histosols, which makes the summit ecosystem especially sensitive to trespass by the 12-15,000 recreationists annually arriving to enjoy the dramatic scenery unrivaled elsewhere in the Adirondack Park.

Beginning in 1967 we developed, tested, and implemented, a program of ecological restoration of the eroding trailsides and trampled summits by means of placement of permanent rocks and temporary grass on those sites damaged by overuse. Vigorous vegetational recovery is now underway but requires annual inspection by the citizen volunteers from the "Adirondack Fortysixers" hiking club which finances and conducts the ecological management program each summer.

Meanwhile, restoration is successful only where the visiting public is educated to appropriate stewardship for the rare alpine environment being protected. To that end the Adirondack Nature Conservancy and the Adirondack Mountain Club, with the cooperation of the NYS Department of Environmental Conservation, have inaugurated a program of citizen Summit Stewards to greet, inform, and educate hikers as they arrive on the several highest summits most endangered by activities unsuitable for alpine environments. For three summers now the efforts have proved to be an unqualified success, approved by both using public and state officials.

AN ASSESSMENT OF GOLF COURSES AS RESOURCE PRESERVATION AREAS

John L. Magistro
Environmental Scientist

Craig Schreiner
Golf Course Architecture from the Heartlands

Recently, there has been increased concern over the design, development and management of natural and altered ecosystems. Of particular interest is the construction and management of golf courses in urban and suburban landscapes. Golf industry critics suggest that golf course design and management practices do not appropriately address natural ecosystem processes, and the natural plant and animal communities associated

with golf course ecosystems. As development further fragments natural landscapes, golf courses will play a more significant role in preserving natural landscape features. Of particular interest are out-of-play areas which may support native vegetation communities, unique landscape features, and associated wildlife habitat. The present study was undertaken to examine the effect of golf course development on wetland resources. The objectives were to: (a) determine historic and current land use patterns and extent of wetland area associated with golf courses in western Pennsylvania; (b) determine land use changes and change in wetland area associated with each course; (c) compare the land use changes resulting from golf course activities with land use changes resulting from other types of development within the study area; (d) based on discussions with golf course architects, course superintendents and regulatory personnel, present guidelines for preserving wetland areas associated with golf courses.

APPLICATION OF THE LIMITS OF ACCEPTABLE CHANGE CONCEPT TO ECOSYSTEM MANAGEMENT OF NATURAL AREAS

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U.S.D.A. Forest Service

In the Northeast natural areas are contained within landscapes having a multitude of owners and land uses. Both ownership and land use are ecosystem components that are often neglected or considered secondary to biotic components because of the complexities surrounding ownership and land-use issues. Nevertheless, since a natural area is an open system, that is to say, adjacent lands affect the area through inputs, natural area managers must consider adjacent ownerships and land uses in making long-term management decisions. To participate in local landscape decisions and planning, the manager must learn to collaborate across jurisdictional lines. The adaptation of the Limits of Acceptable Change Concept from wilderness-recreation management is proposed as a process for long-term landscape decision making. The process brings together resource managers and specialists, landowners and interest groups, and planners and policy makers to establish long-term goals and objectives for the landscape, thresholds for incremental change, and a monitoring program to ensure goals and objectives are being achieved.

RESTORATION MANAGEMENT AT THE CACHE RIVER JOINT VENTURE PROJECT IN SOUTHERN ILLINOIS

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The Nature Conservancy -- Illinois Chapter

The U.S. Forest Service, U.S. Fish and Wildlife Service, Illinois Department of Conservation, Ducks Unlimited, and The Nature Conservancy are cooperating in a major restoration management effort on the Cache River in southern Illinois.

The long-term goal is to bring back the natural condition of a major part of the watershed, to restore both features and processes as they were prior to settlement.

Historical evidence and studies of the relatively natural remnants that still remain are used to develop models.

The development of the restoration plan involves collecting basic information on present character, identifying existing natural communities, documenting original character, and using that information to develop templates as guides for making management decisions.

Actual site restoration work includes planting to restore natural species compositions, putting streams back in natural channels, slowing water runoff, removing cultural features, restoring special habitats, and monitoring the successes and failures.

As a pilot project, data were collected from 64 natural area plots in 1992 to help prepare the restoration templates. Natural communities are being classified and described in detail based on the vegetation, soils, geology, hydrology, and fauna. The goal is not simply to put features back as museum pieces but to help make the Cache a better place for plants, animals, and people to live.

EFFECTIVE STEWARDSHIP OF SMALL NATURAL AREAS: NORTH AMERICA'S MOST OUTSTANDING EXAMPLES

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University of Alberta

Small natural areas, sites less than 1000 hectares, can contribute toward achieving a viable network of conservation lands by reducing the impacts of habitat fragmentation, by conserving biodiversity and by providing the catalyst to foster greater public support for land stewardship. However the degree of contribution may be largely dependent upon management approach. To gain a better understanding of how to effectively manage these fragile ecosystem fragments, North America's most outstanding examples of small natural area stewardship were analyzed using a case study approach. Common attributes of excellence will be discussed in relation to the current thinking on ecosystem management.

MANAGING CRITICALLY ENDANGERED SPECIES WITHIN SMALL HAWAIIAN ECOSYSTEMS

Robert W. Hobdy
Hawaii Department of Land and Natural Resources

Hawaii's remote and isolated position in the north-central Pacific has made it difficult for founder species to reach its shores. Once there, a diversity of habitats on several islands has fostered the development of a highly distinctive flora and fauna. Fully 90% of Hawaiian plants are endemic there, 98% of resident land birds and over 99% of its insects and molluscs.

Since the coming of Polynesians over 1500 years ago, and especially since the arrival of Europeans and others during the last 200 years, habitat alteration has occurred and is currently accelerating. Even relatively intact ecosystems are being invaded by aggressive weed species and mammalian and invertebrate pests. Many species have disappeared during the last century and many more are currently endangered.

Public awareness and concern for Hawaii's endangered biota have been increasing and management focus and funding have improved dramatically in the past five years, resulting in positive initiatives for ecosystems management.

Management strategies include animal control through fencing and eradication programs, weed control, endangered species propagation and reintroduction, monitoring and research. Interagency cooperation between State, Federal and private organizations and landowners has been very helpful in addressing problems on a broader scale.

While there have been encouraging signs in recent years, none-the-less, we are still losing ground. We have learned what works and there are limited successes, but there is a need for greater public will and more funding if we are to make meaningful progress.

MANAGING AN ENGLISH RURAL ESTATE: CONSERVATION IN A CROWDED COUNTRYSIDE

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The Beaulieu Estate is situated within the 'New Forest', on the south coast of England. The New Forest was declared a Royal Hunting Ground in 1079 by William I and is now a uniquely valuable natural resource -- environmentally, scientifically and culturally -- and has recently been granted National Park status. It also constitutes an important recreational resource for millions of visitors.

The Beaulieu Estate covers 8,000 acres, including agricultural land; woodland; a National Nature Reserve; Sites of Special Scientific Interest; two villages; a leisure complex attracting 500,000 visitors per year and a 300 berth marina on the Beaulieu River.

The Cistercian Abbey of Beaulieu was founded nearly 800 years ago. In 1538, King Henry VIII closed Beaulieu Abbey as part of the dissolution of the Monasteries: the Estate was sold to the Earl of Southampton and has been owned by his descendants ever since.

After 800 years of continuous occupation of the land, wildlife conservation on the estate must be planned and managed in a manner which is consistent with the continual development of Beaulieu as a working landscape. Despite being in private ownership, certain parts of the Estate, particularly the National Nature Reserve, must be managed according to strict government guidelines.

This illustrated paper will examine the efforts of a private owner to manage a working estate whilst enhancing the natural beauty of the area and conserving its wildlife.

NATURAL AREA MANAGEMENT AND EDUCATION IN THE WARNER PARKS

Brian Bowen
Warner Park Nature Center

The Warner Parks in Nashville, Tennessee, are a large urban park unit with more than 1,800 of its 2,665 areas listed in the Tennessee state register of Natural Areas. Established in 1927, the Warner Parks have a long history of multi-use recreation with recent attention given to natural area management. Efforts to eradicate and control exotic plant species have fostered an ecosystem management approach emphasizing reduction of edge effect, ecological restoration, and protection of native plant communities. A model for this approach designates "core areas" by identifying functioning ecosystem units. Management intricately links core areas, peripheral area, i.e. buffers, and property beyond the parks' boundaries. Management and education are integrated through the Warner Parks Nature Center and supported by Friends of Warner Parks. Educating the public about conservation biology management practices that are on-going in the park and other natural area issues utilize the Warner Parks as a valuable working landscape. This paper presents a case history and an assessment of present management and educational efforts in the Warner Parks.

old growth data.
1. min. size homo area capable of supporting
2. minimum % of max longevity reachable by dom. tree sp
3. evidence indicating the presence of a subsequent generation
4. no evidence of human dist.

THE NATURE OF OLD GROWTH IN THE NORTHEAST

Dr. Charles V. Cogbill
Vermont

Contrary to "ancient" forests elsewhere, the ecological values of the undisturbed northeastern forests are not their great age, superlative size, unique structure, aesthetic qualities, genetic stock, or rare species. In fact, the concept of "old growth" in the Northeast must be refined to reflect the subtle characters associated with evolutionarily young and environmentally stressed forests. Most of our regional knowledge of old forests is anecdotal and with all-pervasive human disturbances in the region, few if any, unequivocal examples exist. Recent intensive plot sampling of 52 old undisturbed stands, located from the Adirondacks to northern Maine, are used to document the characteristics of old-growth spruce and northern hardwood forests. These studies quantify the age structure, stand structure, dead wood, and dynamics of extant undisturbed remnants. These data have been combined with theories of forest development, site-specific histories, and presettlement surveys, to typify the nature of northeastern "old growth" spruce and northern hardwood forests. Ecologically the "old growth" condition is characterized by large-scale (stand) stability as reproduction equals mortality and growth equals decay. Even when developed without catastrophic disturbances, the small-scale (plots) are dynamic and have relatively high mortality. Several quantifiable criteria of northeastern "old growth" are evidence of lack of catastrophic disturbance, average individual longevity of about 200 years, evidence of replacement of tree generations, and accumulation of dead wood about equal to living biomass.

Def^n of old growth
- 4-5 ha min. area
- dom. trees > 50%, max. age
- minimal human impact or other catastrophic dist.
- late successional species

SURVEY OF OLD-GROWTH FOREST IN MASSACHUSETTS

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Massachusetts Audubon Society

A two year study was undertaken to identify and map old-growth forests in Massachusetts. Stands were mapped, and summary data were collected on their physical characteristics, composition, and structure from 0.1 ha plots. Thirteen stands greater than 5 ha have been located in the Berkshires, which collectively total about 142 ha. These stands are generally dominated by hemlock and mixed hardwoods, with the oldest individuals in excess of 250 years. Most are located on steep slopes (35-45°). Their inaccessibility, combined with the relative undesirability of hemlock for lumber, most likely account for the preservation of these old-growth remnants.

Twenty-five plots were marked and sampled to provide a baseline for tracking long-term changes in these stands. Data on the canopy and understory trees, deadwood, herbaceous layers, soils, and site characteristics were gathered. Only 1-4 plots were sampled per stand, and were located to include trees typical of the older canopy individuals found in the stand. Thus the data may not represent the overall character of each stand. The results of this work may be useful to other investigators interested in locating suitable sites for studying New England old-growth forests.

SAMPLING GUIDELINES FOR OLD-GROWTH FORESTS IN THE MIDWEST

Stephen R. Shifley and Richard C. Schlesinger
U.S.D.A. Forest Service

Old-growth forests in the Midwest occur in tracts ranging from a few to a few hundred acres in size. As more resources are directed toward understanding the unique features of these old forests, there will be more opportunities to inventory the vegetation on these areas and to compare the observed composition and structure with other old-growth and second-growth forests. Such comparisons are meaningful only if the sampling procedures are sufficiently sensitive to detect differences that are of practical importance. Based on detailed inventories of five upland old-growth tracts in Missouri, Indiana, and Illinois we explore several practical and statistical issues relevant to inventorying old forests. This paper examines the relation between sampling intensity in old forests and precisions of estimates for (1) species richness/diversity, (2) various measures of stand density, and (3) coarse woody debris. Sample size guidelines are offered to aid in detecting tract differences of a specified magnitude. Effects of plot size are discussed, and some practical aspects of inventorying Midwest old-growth forests are addressed.

GENETIC VARIATION IN OLD-GROWTH RED SPRUCE

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Red spruce (*Picea rubens*, Sarg.) has been shown to have low genetic variation compared to most conifers. However, this result is based on sampling in second-growth forests, with a history of strong harvest pressures. We investigated the allozyme variation in six populations of old-growth red spruce, which have developed and matured free of such pressures, under the hypothesis that they are refuges of greater genetic variation.

Based on analysis of 14 loci, the combined old growth have a mean percent of polymorphic loci of 49% (95% criterion), compared to 32% for second growth, but virtually the same mean number of alleles per locus (1.7) and direct count heterozygosity (8.2%). Rare alleles were detected approximately ten times more frequently in the old-growth samples than in second growth. Old growth also showed high homozygosity (F_{IS} = 0.10).

Many protected populations of eastern old growth are small and isolated. This raises the issue of management to prevent loss of variation through inbreeding and genetic drift.

LICHEN DIVERSITY AND STAND CONTINUITY IN THE FORESTS OF NORTHERN NEW ENGLAND AND WESTERN NEW BRUNSWICK

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Division of Natural and Behavioral Sciences
University of Maine

The epiphytic lichen flora of a forest becomes richer over time, with a disproportionate number of rare species restricted to very old stands. Using the methods of Francis Rose in Britain, the continuity of spruce-fir, northern hardwoods and northern white cedar stands in northern New England and western New Brunswick are being assessed using indices of ecological continuity that are based on the number of selected lichen old-growth forest indicator species found at each site. Of particular interest is the suggestion that lichens in the Order Caliciales might play a central role. Commonly called the "stubble lichens" because of their small size, the species in this group are frequently overlooked, hence underreported: Of the thirty-five species that I reported for northern Maine (The Bryologist 91:2-17), twenty-three represented new records for the state; and nineteen of the thirty-three species recorded at Mount Carleton Provincial Park in New Brunswick are new records for the province. Many of these Caliciales species are known only from ancient forest sites, where they share their microhabitats with few other species.

ASSESSING POPULATION AND HABITAT VIABILITY OF SPECIES DEPENDENT ON OLD GROWTH FOREST IN THE GREATER FUNDY ECOSYSTEM

Stephen Flemming and Harry Beach
Canadian Parks Service

Research is now under way in the Greater Fundy Ecosystem (Fundy National Park and area, New Brunswick) to assess population and habitat viability of Pileated Woodpecker, Marten, and Northern Flying Squirrel, three species dependent on old growth forest.

Forest canopy and structure of roosting, nesting, and foraging habitat will be documented. These values will be translated into identifiable stand components at the landscape level. A habitat viability assessment will be made with the aid of a SPANS GIS system.

In Autumn 1993, we will run a preliminary population viability analysis (using VORTEX). Experienced woodpecker, marten, and squirrel biologists will assist us in identifying information deficiencies that could affect the validity of the initial simulation. This will serve to guide subsequent research on population dynamics, home range, and dispersal.

This research will provide a better understanding of the potential for Fundy National Park to maintain its faunal diversity in the face of landscape change. It will lay a factual base for the Canadian Parks Service to participate in land use planning in the Greater Fundy Ecosystem and Fundy Model Forest. In addition, it will help test assumptions underlying wildlife protection provisions of New Brunswick forest management planning.

SMALL-SCALE NATURAL DISTURBANCE REGIMES OF TEMPERATE RAINFORESTS IN SOUTHEAST ALASKA: IMPLICATIONS FOR MANAGEMENT

Robert A. Ott
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Sustaining biological diversity requires maintaining not only species, but also natural ecological processes across a landscape. Therefore, understanding natural disturbance regimes is important where maintenance of biological diversity is a management concern. The temperate, coniferous rainforests of southeast Alaska are characterized as having a high frequency, low-intensity disturbance regime. However, the degree of disturbance is highly variable across the landscape, and it can change quickly and at small scales, apparently in response to changes in topography, drainage patterns, and other factors. The amount of forest area in canopy gaps was estimated to be 4.0 to 12.6% for western hemlock-Sitka spruce forests, 23.1% for a western hemlock-Alaska yellow cedar forest, and 33.7% for a western hemlock-Sitka spruce-Alaska yellow cedar complex. Within hemlock-spruce forests, mean canopy gap area was 30 to 69 m^2 and median canopy gap area was 23 to 52 m^2. Within hemlock-spruce forests, the order of gapmaker types from most common to least common was: snapped, 54.5 to 94.7%; uprooted, 5.3 to 27.3%; dead standing, 0.0 to 15.7%; and leaning, 0.0 to 9.1%. Gapmakers tend to fall downslope and into existing canopy openings because those portions of trees crowns facing downslope or into a canopy opening grow larger. The importance of coarse woody debris as a rooting substrate for hemlock and spruce appears to increase as the moss groundcover increases. Variations in disturbance regimes appear to define, at least in part, the various plant associations. Variations in scale and intensity of natural disturbance regimes of southeast Alaskan forests suggest that forest management strategies will have to vary accordingly if these disturbance regimes are to be emulated across the landscape.

THE GRID-BLOCK-RADIUS SYSTEM: A STRATEGY FOR LANDSCAPE-SCALE MANAGEMENT

Gordon Kenyon and Arthur McKee
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One of the most difficult and contentious issues facing the land planner is that of reserves; their size, location, connectedness and their fraction of a working landscape. The process of succession also causes reserves of early-successional ecosystems to change into states other than that for which they were established. A dynamic method of management, called the grid-block-radius system (GBR), is described which utilizes a large-scale grid. This method provides great flexibility in allocating the amount and successional stages of reserves as well as distributing them in time and space. With GBR, adjacent cells of the grid have counter-rotating "cropping" or "cutting" radii whose rate of rotation is determined by the desired fraction of the landscape in "old-growth" reserves, the amount of time required to reach an "old-growth" state, and the nature of the other crops in the rotation. The geometric structure of GBR allows the location of the reserves to move through time and space in a manner which connects not only the entire landscape but also the gene pools of endangered and low-density species. GBR may also be useful in the management of reserves on the Continental shelf.

ANNAPURNA CONSERVATION AREA BIODIVERSITY CONSERVATION DATA PROJECT: A NEW INVENTORY EFFORT FOR NEPAL

Dorothy J. Allard
King Mahendra Trust for Nature Conservation and
The Nature Conservancy

The Annapurna Conservation Area (ACA) occupies 7000 square km. in north-central Nepal and is a project of The King Mahendra Trust for Nature Conservation. Ecologically diverse, its habitats range from glacier-filled valleys and snow-capped peaks over 8091 m. high, to lush subtropical valleys. Over 40,000 people reside in the villages of ACA, and trekking tourism brings in 40,000 more each year. The management strategy employed in ACA is unique in Nepal. Involvement of the local people in decision-making and in strategy implementation has been critical to the Trust's success. Now, a new effort is being undertaken aimed specifically at the conservation of biodiversity. Funded by The World Wildlife Fund with technical assistance from The Nature Conservancy, a team of Nepalese scientists has begun a one-year inventory to document the flora, fauna, and ecosystems of ACA. The Nature Conservancy's Biological and Conservation Data system (BCD) is being used on a trial basis to manage the information collected. These data will be used to assist in making management decisions. It is hoped that the project will provide a model for similar activities in the future in other parts of Nepal.

EVALUATION OF THE FLOODING REGIME OF THE PANTANAL WITH LOW RESOLUTION SATELLITE IMAGERY

Thomas Stone and Peter Schlesinger
Woods Hole Research Center

The largest freshwater wetland in the world, the Pantanal, is located along the upper Paraguay River and includes parts of Bolivia, Brazil and Paraguay. The region is poorly known yet is one of the largest breeding areas for waterfowl globally. Because the region is large and because the wetland area can change by tens of thousands of km^2 from the wet season to the dry season we have chosen to use a time series of low resolution imagery from the NOAA AVHRR satellites to map the extent of the flooding.

From the 1988 to 1991 satellite data that we have now, it appears that the flooded area of the upper Paraguay river system can vary by eight-fold. We have found a maximal flooded area in early July 1988 of about 40,000 km^2 and a minimal flooded area of about 5,000 km^2 in mid-September 1990. We found that the area of open water varies from about 17,000 km^2 to about 2,000 km^2.

Future work will include similar processing of additional NOAA satellite imagery and comparing these data with other maps and ancillary data. Also we anticipate focusing on additional specific regions defined during field work in the Pantanal in late January 1993.

EMERGING STEWARDSHIP OF NATURAL AREAS IN CENTRAL AND EASTERN EUROPE

Brent Mitchell and Jessica Brown
Atlantic Center for the Environment

At this point in history, Europe faces new threats to the quality of its rural landscape and natural areas, at the same time that it is creating new opportunities for transboundary cooperation. Recent political and economic changes in Central and Eastern Europe have resulted in growing pressures in the form of privatization of lands, industrial development, and increasing tourism and second-home development from the West. In Western Europe, integration into the European Community is accompanied by changes in transportation and agricultural policies which, along with the spread of urbanization and second home development, have major implications for land use in rural areas. While governments have traditionally been the lead actors in land use management in Europe, private organizations are poised to play an increasingly important role through advocacy, public education, negotiation and long-term stewardship of natural areas.

Despite our different systems, European and North American conservation professionals have much to learn from each other in the field of countryside stewardship. This paper will report on a field project (underway during February-September 1993) on the role non-governmental organizations (NGOs) are playing in the management of working landscapes in Western and Eastern Europe. This qualitative study will survey countryside stewardship practices in each country, against the background of national and European Community policies, and will focus on examples of innovative approaches to stewardship where NGOs are playing a leading role. It will explore the potential applicability in Europe of relatively new techniques being used by NGOs in the United States and Canada (such as voluntary agreements with private landowners and conservation easements), and vice versa. Geographic scope of the overall study will include organizations working in Germany, France, Switzerland, Austria, Czech Republic, Slovakia and Hungary. This paper will focus primarily on Central and Eastern Europe.

MANAGING NATURAL AREAS IN HAWAI'I: CHALLENGES AND SOLUTIONS

Betsy Harrison Gagné
Hawaii Natural Area Reserve Commission

All is not paradise in Hawai'i. Since humans arrived over 1500 years ago, the Hawaiian flora and fauna has faced increasing pressure and is not the most endangered in the United States. Over 90% of the native land species are endemic. More than half of the original bird species are gone; of the remaining 70 species, 30 are endangered. Nearly all Hawaiian species and their associated natural communities are threatened by disruptive non-native plants and animals, fragmentation, habitat modifications, or human impacts.

In 1970 the State Legislature created the Natural Area Reserves System. To date, nineteen reserves totalling over 110,000 acres have been dedicated, representing more than 78 (or 43%) of all recognized communities have been set aside.

The challenges of managing this program are large: initial stewardship efforts have focused on surveys, prioritized management plans and non-native species control. The Natural Area Partnership Program is a new state program providing 2:1 matching funding for protection efforts on private lands of natural area reserve quality. Although this bioregional partnership approach to enhance the effectiveness of all land management agencies, attention needs to focus on better integration of the non-biological aspects of conservation.

NATURAL DIVERSITY MANAGEMENT AND THE LIFE CYCLE OF AN ALASKAN BOREAL WHITE SPRUCE ECOSYSTEM: INSIGHTS FROM BONANZA CREEK LTER

Dr. Glenn Patrick Juday
Department of Forest Sciences
University of Alaska

Productive white spruce forest occupies about 2.7 million ha or about 5.8% of the total Alaska boreal forest of 46.2 million ha (total of productive and marginal forest). Research underway on the Bonanza Creek LTER is aimed at understanding the life history strategies of upland white spruce that produce these stands. White spruce, the potential terminal species in upland succession, is confined to reproduction from seed and is markedly less efficient and flexible in reproduction compared to its hardwood tree competitors. Reproduction of nearly pure stands of white spruce is effectively limited to the glide path of its seed, a probability density function around the parent tree generally limited to about 200 m except during exceptional seed crop years. White spruce reproductive requirements are contradictory to some degree: it requires intense stand-replacing fire but parent trees must survive nearby to allow seed production and dispersal. White spruce is a superior competitor against its hardwood associates later in its life cycle by producing refractory litter that inhibits element cycling and lowers soil temperatures.

Unlike the humid boreal environment of eastern and central North America, much of interior Alaska experiences a semi-arid climate and is characterized by complex topography and varied landforms in a largely unglaciated region. In interior Alaska it appears that white spruce reproductive effort is periodic and timed to place seeds into upland environments produced by stand-replacing fires. Burned sites support a favorable seedbed characterized by warmed soil, reduced organic layer thickness, and low vegetative competition. Upland, white spruce-dominated stands are made up of only one, two, or three cohorts representing seedlings that were successfully established in the limited period of time after stand-replacing disturbance characterized by elevated soil temperatures, elevated nutrient availability, high radiant energy, and acceptable levels of vegetative competition. A 102-tree sample of white spruce basal and breast height bole sections indicates that over 90% of the trees belong to a cohort that originated in the mid 1780s following a fire. The second cohort appears to have originated about 8 years after the first, probably from the next abundant white spruce seed crop. A complete sample of white spruce basal disks from 0.5 ha near Bonanza Creek also represents two cohorts. All white spruce seedlings originating following the 1983 Rosie Creek Fire belong to either the 1983 or 1987 seed crop. Compared with its hardwood tree competitors, white spruce experiences a longer life span allowing it to take advantage of successful recruitment timed to infrequent and stochastic environmental cues.

Natural areas managed to perpetuate the upland white spruce ecosystem require properly timed stand-replacing fires. Producing the required conditions in small, isolated reserves will be difficult.

THE UNIQUE GEOLOGY AND ECOLOGY OF THE NIAGARA ESCARPMENT -- A UNESCO WORLD BIOSPHERE RESERVE

Phil S.G. Kor, Steve Varga and Jarmo V. Jalava
Ontario Ministry of Natural Resources

The 725 km long Niagara Escarpment is the most prominent landform feature in southern Ontario. Its ridges and its deep valleys have been shaped by differential erosion acting on the cuesta's Paleozoic carbonate rocks. This cuesta sustains an ecological corridor noteworthy for its rare carbonate cliff, rim, talus and bedrock plain communities; its calciphiles; its 1000 year old Eastern White Cedar cliff forests; and its latitudinal trends from Tulip-tree deciduous forests to Jack Pine boreal forests. The outstanding scenic, biological and geological values of the Niagara Escarpment were recognized in the 1970s when the provincial government created a commission and a plan encompassing 1,370 square km, with nodal parks linked by natural corridors. In 1990 the area was declared a World Biosphere Reserve. Up to 1992, 46 life and earth science Areas of Natural and Scientific Interest (ANSIs) have been surveyed along the escarpment. These inventories found high concentrations of rare flora and fauna, numerous provincially rare vegetation communities, such significant geological features as relict shore caves and karst, and evidence of catastrophic subglacial floodwaters. The reports contribute to consistency in the overall management of the multi-agency parks system and serve as natural history guides for the general public.

THE FORESTRY SECTOR IN RIO GRANDE DO NORTE

Maria Anxiliadore Gariglio

The social and economic importance of forestry in Rio Grande do Norte is highly significative in genetration of jobs (6,400 direct and 53,000 indirect) and profits for rural producers (15% of monetary profit). Its participation in the energetic balance is really important as a source of primary energy for industries and domestic use.

The present availability of forestry resources is high in most parts of the State, except for the region of Natal (only 30% if the original cover is left). In other regions the forests cover 51% (2.5 millions ha) of the State.

The present consumption of forest products equals 1.4 million m^3/year for charcoal and firewood, and more than 0.15 m^3/year for poles and commercial wood.

The State forest ecosystem conservation is problematic and is not assured. The different vegetation associations protected by law are disappearing continuously, reducing native fauna.

In order to organize and control the use of forestry products, a diagnosis of the forestry sector was prepared and critical areas and themes were identified as a basis for a broad Forestry Development Plan for the State.

POSTERS

PRESERVING THE REMAINING NATURAL AREAS OF VIRGINIA'S LOWER PENINSULA: A REGIONAL CONSERVATION PROJECT

Kennedy Clark and Christopher Clampitt
Virginia Department of Conservation and Recreation

A multi-year conservation project began in 1989 for the Lower Peninsula of Virginia, a rapidly urbanizing region in the eastern part of the state. The purpose of the project was to create a concerted biodiversity conservation effort for the region among local, state, and federal governments and private interests. A three-year comprehensive natural areas inventory of the region was conducted by the Natural Heritage Program to systematically identify the region's best remaining natural areas. Subsequent to the inventory, a one-year conservation planning project conducted by the Natural Areas Program refined preserve designs and furnished protection and stewardship recommendations for each of the twenty-five natural areas documented by the inventory project. Information from the inventory and conservation planning projects is also being used to guide environmental review of proposed development projects in and near the natural areas. Upon completion of the conservation planning project, one natural area in each locality was selected as a demonstration site for earnest protection efforts. State and government agencies and a local land trust participated in these initial protection projects. Continued attempts to preserve the region's remaining natural areas through land protection and environmental review are meeting varied degrees of success.

PALEOECOLOGICAL APPLICATIONS FOR CONSERVATION BIOLOGY

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While the methods used by paleoecologists have expanded the potential dimensions and means of gathering data for ecological analysis, the contributions of paleoecology are not limited to ecological concepts. Applied paleoecology can answer many questions for conservation biology including: How and when did particular ecological features of a site develop? What mechanisms of natural disturbance maintained them? Will the unique features of a site continue to exist as climate changes? How will changes in fire frequency affect a site? What was the condition of a site prior to human influence?

Paleoecology provides a means to measure quantitatively past events that affected plants, expanding the time period and the study area beyond what is possible by traditional ecological methods.

Conservation biology can directly use the techniques of paleoecology to provide data upon which decisions concerning selection and management of preserves can be based. Paleoecology can provide critical information for assessing the conservation potential of a site, including its usefulness as a corridor for the future migration of rare taxa and whether it is prone to rapid vegetational and assemblage destruction. Management and prescribed burning plans can be developed based on knowledge of the origin and past maintenance of particular modern communities.

THE BALCONES CANYONLANDS CONSERVATION PLAN: PRESERVING HABITAT ISLANDS IN AN INCREASINGLY URBAN LANDSCAPE

David D. Diamond and Larry D. McKinney
Texas Department of Parks and Wildlife

Kim Ludeke
Natural Resources Information System

The Texas Hill Country is experiencing continuous, relatively rapid population growth. The region also contains many unique natural communities and endemic species, including federal listed threatened and endangered species. Protection of these unique natural features in the face of development pressure is a conservation challenge. The Balcones Canyonlands Conservation Plan is one attempt to provide for development while conserving endangered species within a functional, working landscape. This Habitat Conservation Plan seeks a regional Section 10(a) permit under the Endangered Species Act for the Austin/ Travis County area. The plan was developed by an executive committee including state agency, development, conservation, and private landowner representatives. Originally, seven listed species were targeted for protection, including five cave invertebrates and two birds. On-going research has revealed that several additional rare species, including invertebrates, salamanders, and plants may be present within the BCCP boundaries. The large number of individual species of concern highlights the need for a landscape-based approach toward preserve design. The current design is a blueprint that concentrates on conserving functional communities within which both listed and non-listed species are protected.

NATURAL AREAS CONSERVATION: PUBLIC EDUCATION

Robert H. Gray
Battelle Pacific Northwest Laboratory

Efforts to communicate with and involve the public in environmental decisions have increased nationwide. The U.S. Department of Energy's Hanford Site in southeastern Washington State was originally established to produce plutonium for the war effort and now, ironically, serves as a wildlife refuge and research natural area. Public outreach efforts at the Site have drawn on a broad spectrum of communications media. These have included technical articles (open literature and symposium publications, annual and topical reports); information brochures; video productions; interactive exhibits; presentations at scientific, technical, civic and other public meetings; and proactive interactions with the news media, and local, state, federal, and other agencies. In addition, representatives of local communities operate offsite sampling stations in Hanford's environmental monitoring network, and Native Americans are involved in studying cultural resources, fisheries, and other issues. All major environmental programs, such as the current multi-year effort to reconstruct past radiological doses to offsite human populations, are conducted with open public participation. this presentation describes Hanford's public outreach efforts, our successes and failures and lessons learned, and provides a model that could be used with other environmental initiatives such as natural areas conservation.

CONSERVING THE NATURAL AREAS OF MAINE'S ISLANDS

Annette Naegel
Island Institute

Off the coast of Maine there are over 3000 islands and ledges creating an invaluable assemblage of ecological, cultural, and historic resources. These islands support significant wildlife populations as well as diverse human communities. Nearly one third of these islands are less than a few acres, one third have residences on them, and the remainder enjoy pristine natural habitats.

Recognizing the diversity among the islands was the premise for creating the non-profit organization, Island Institute. This conservation based organization is dedicated to seeking balance for the islands' future so that the diverse needs of the cultural and natural communities are met.

One way this goal is being accomplished is through inventorying and assessing the islands' ecological resources. By developing this framework, informed land use decisions are made.

The Island Institute has worked cooperatively with private landowners, conservation organizations, island communities and state agencies to develop long term management practices for the Maine islands on the basis of scientific natural resource assessments. This paper will describe several examples wherein this process benefitted the conservation of island resources.

Results of collaborative efforts include the voluntary protection of old growth hardwood stands, the preservation of seabird habitat, and the continued management of productive island forests.

USE OF WETLAND MITIGATION FUNDS FOR PRESERVATION OF HIGH QUALITY WETLAND SITES

Andrew M. White
John Carroll University

William L. Hudson
Ohio Department of Natural Resources

Pymatuning Wetland in Ashtabula County, Ohio, is a globally threatened (G-3) community of fen springs, marshes and shrub/swamp forests. It contains 20 Listed Ohio plants, one proposed Federal Endangered mollusk (*Pleurobema clava*) and may contain other Ohio Listed mollusks and fishes. Under private ownership, the wetlands were imperiled by existing gas, oil and gravel mining options.

We will describe a precedent-setting, cooperative program between ODNR-DNAP, The Cleveland Museum, TNC, a Private Developer and Concerned Citizens to utilize mitigation funds for purchase and management of this wetland and adjacent buffer.

Millions of dollars are spent annually to mitigate permitted wetland losses. Most are used to create mitigation wetlands of limited ecologic value. We will discuss a step-by-step case history of the Pymatuning preservation effort which will prove instructive to organizations wishing to utilize this funding source for natural areas protection.

Critical elements of the program include the consideration of exotics control and buffer management as enhancement; reimbursement of a private organization for land purchase; isolation of hydrology functions from flora and fauna values; involvement of private citizens; the program's attractiveness to developers; and use of quality indices to justify the preservation of unique wetlands to mitigate low quality wetland losses.

WATERSHED PROTECTION: EPA'S APPROACH

Janet D. Pawlukiewicz
U.S. Environmental Protection Agency

There is a growing consensus that today's water pollution and habitat degradation problems can best be solved by following a basin-wide approach that takes into account the dynamic ecological, social, political and economic relationships at play in individual watersheds. The U.S. Environmental Protection Agency (EPA) calls this the Watershed Protection Approach. The approach incorporates risk-based problem identification, broad stakeholder involvement, and integrated action tailored to address threats to human health, ecological communities, and desirable uses of the water.

This session will focus on EPA's efforts to align its programs to support watershed management. Formal watershed-based partnerships are integral to such programs as the National Estuary Program, the Clean Lakes Program, the Great Lake Waters Quality Initiative, the Gulf of Mexico Program and the Chesapeake Bay Program. In addition, EPA provides regulatory, technical, and financial assistance for nonpoint source pollution abatement, water quality assessment and monitoring, water quality criteria and standards, wetlands protection, effluent discharge permits, wellhead protection, underground injection control, comprehensive state ground water protection, and drinking water protection.

PRESERVING BIOLOGICAL DIVERSITY IN THE ADIRONDACKS' CHAMPLAIN VALLEY: A GIS APPROACH

Michael L. Pressman
Department of Landscape Architecture and Regional Planning
University of Pennsylvania

The Champlain Valley of Essex County (NY) has been called the gateway to the Adirondacks. This landscape, lying within the 6 million acre Adirondack Park, is comprised of rolling farmland interspersed with forested hillsides, quaint but economically depressed hamlets, historic structures, residential homes, and the forested Adirondack foothills. The Champlain Valley is quite distinct, however, from the rest of the Adirondacks. Productive farmlands, an extremely high percentage of private land, its location on Lake Champlain, and its proximity to the cities of Plattsburgh (NY) and Burlington (VT) make this region unique.

A GIS approach, relying heavily on satellite imagery, will identify those lands needed to help preserve biological diversity in this working landscape. Keystone and indicator species will be identified. Habitat requirements for these species will form the basis for the identification of land in need of protection. Additional effort will target those rare and sensitive species and communities whose preservation would not be ensured through the keystone and indicator method. A connected habitat system of nodes and corridors will be identified. Finally, both regulatory and non-regulatory strategies to achieve habitat protection will be investigated and analyzed.

CONSERVING WETLAND COMMUNITIES IN MERRIMACK RIVER BASIN IN NEW HAMPSHIRE

Mark Kern
U.S. Environmental Protection Agency

Current Activities. Since cumulative wetland losses impact our outstanding wetlands as well as our less valuable wetlands, there is a need to establish priorities within the Merrimack basin. EPA is helping prevent valuable wetland losses before they occur by gathering information, setting priorities and assisting local officials to protect some of these valuable wetlands. This paper provides an overview of EPA's current non-regulatory activities in the basin as well as possible future directions. Our current work can be broken down into the following categories:

1. Mapping wetlands and adjacent land use
2. Identifying priority wetlands with the aid of a computer model
3. Working with the New Hampshire Natural Heritage Program
4. Giving these maps and other information to local officials and regional planning agencies
5. Protecting important wetlands

Future Directions. First, we will continue to work with local officials to protect and watch over important wetland systems. Thus, we expect to focus much of our future work on implementation. Second, we would like to begin tracking specific wetland losses from New Hampshire and Corps permit on a GIS system. In time this would provide us with an understanding of cumulative losses to wetland systems that received a permit. Third, we plan to consider not only wetland values, but risks to wetlands and streams. For example, a stream system near a major highway interchange surrounded by erodible soils would likely be at greater risk than some other sites. Both value and risk should help us determine the urgency for protection. Finally, we plan to work with the Heritage Program to complete more site specific work on exemplary communities.

ECOLOGICAL RESTORATION OF A FLORIDA STATE PARK IN AN AGRICULTURAL LANDSCAPE

James A. Stevenson
Florida Department of Natural Resources

Falling Waters State Geological Site, located in the panhandle of northwest Florida, is a 155 acre island of longleaf pine and wiregrass surrounded by lands managed for agriculture and silviculture. The first prescribed burn to be conducted in a Florida State Park, occurred at Falling Waters in 1970. Lightning season prescribed fires have restored the uplands by suppressing oaks and increasing the native grasses. Seepage slopes and stream-side vegetation are also being restored with lightening-season fires. Exotic trees and shrubs are controlled with herbicide and fire. A system of sinkholes and caves are protected by restricting visitors to elevated boardwalks. Other projects include girdling pines and oaks to open the canopy and create snags and increasing the gopher tortoise population.

THE MYCORRHIZAL FACTOR IN PRAIRIE RESTORATION: RESPONSE OF THREE LITTLE BLUESTEM POPULATIONS TO MYCORRHIZAL FUNGAL INOCULUM FROM A SINGLE SOURCE

Roger C. Anderson and Karl J. Roberts
Department of Biology
Illinois University

In prairie restoration, the use of seeds from non-local sources has been of concern to restorationists. In this study, the specificity between mycorrhizal fungi and little bluestem obtained from three localities was examined. Seed for this experiment was obtained from three sources (1) a commercial source in Kansas, (2) Sand Ridge State Forest (SRSF), Mason County, Illinois, the site from which the experimental soil was obtained, and (3) Sand Prairie Scrub Oak Nature Preserve (SPSO), 32 km southwest of SRSF. Plants were grown in three substrates (1) autoclaved soil, (2) autoclaved soil to which a mycorrhizal fungal-free sieving of non-autoclaved soil was added, and (3) non-autoclaved soil. All plants grown in non-autoclaved soil were colonized by mycorrhizal fungi, whereas none of those grown in the other substrates were colonized. Plants grown from Sandridge seed produced more biomass than those grown from Kansas seed ($\bar{X} \pm$ SE, Sandridge = 0.54 $\pm$ 0.04g, SPSO = 0.49 $\pm$ 0.03g, Kansas = 0.37 $\pm$ 0.03g). For plants from all sources, those grown in non-autoclaved soil (0.27 $\pm$0.02 g) produced less biomass than plants grown in autoclaved (0.58 $\pm$ 0.03g), or autoclaved plus sievings (0.59 $\pm$ 0.03g). The results provide no indication of a host-endophyte specificity.

WETLAND AND STREAM PRESERVATION AND RESTORATION IN METROPOLITAN PORTLAND, OREGON

Anthony L. Laska and Michael C. Houck
The Wetlands Conservancy

The Pacific Northwest is a magnet for persons seeking open space, natural areas and world-class outdoor recreational opportunities. Development pressure in the Portland metropolitan is responding to a projected population increase of one-third within the next 20 years. The state-mandated Urban Growth Boundary calls for infill which can impact remaining urban natural areas. In this "working landscape", The Wetlands Conservancy, a nonprofit 12-year old land trust, together with its Urban Streams Council, preserves and protects Oregon wetland and riparian habitat through education, research, first-hand field experience and wetland acquisition. TWC owns approximately 60 acres on which we sponsor work parties and host tours. We participate in and sponsor public forums on wetland topics, submit public testimony and give illustrated presentations. Experienced volunteer professionals direct our property management work. In response to increasing public needs, we are organizing a program to provide direct *pro bono* field consultation to those whose questions and problems call for professional assistance. Our Urban Streams Council has embarked on watershed-oriented restoration efforts in partnership with Youth Conservation Corps, state, local and federal agencies and educational institutions. Work in target streams serves as a demonstration project for program expansion.

UPDATE ON THE ASSESSMENT OF INVASIVE WEED PROBLEMS ON NATURE CONSERVANCY PRESERVES NATIONWIDE

John M. Randall
The Nature Conservancy
University of California

Invasive week problems on preserves managed by The Nature Conservancy were assessed with site visits and a national survey. Ninety-three of 122 (76%) stewards contacted replied, reporting week problems on 235 preserves in 46 states. Over 240 species were cited as problems and many of them outcompete native species and/or significantly alter communities they invade. Problem species include a moss, ferns, gymnosperms and flowering plants of a wide variety of life forms ranging from annual herbs to perennial herbs, floating, emergent and submersed aquatics, vines, shrubs, understory trees and canopy trees. *Tamarix spp., Centaurea spp., Phragmites communis, Ailanthus altissima, Robinia pseudoacacia, Alliaria petiolata* and *Lythrum salicaria* were among the most widespread and serious problems reported. A database linking the species reported, preserves where they are problems, threats they pose at the site, and control methods used against them was developed from the survey replies. The database will be updated at 2-year intervals and will facilitate the transfer of information on weed biology and control between stewards.

UPDATE ON THE ASSESSMENT OF INVASIVE WEED PROBLEMS ON NATURE CONSERVANCY PRESERVES NATIONWIDE

Paul Reeberg
National Park Service

The Western Region of the National Park Service has developed the Fire Monitoring Handbook, which is a standard protocol for the monitoring and documentation of prescribed fire behavior and effects. There are four levels of monitoring:

Level One:	Fire Reconnaissance
Level Two:	Fire Conditions/Behavior
Level Three:	Immediate Postfire Effects
Level Four:	Long-term Change

The handbook provides a formal system to document that the burning conditions and fire behavior remain within prescribed ranges, that burn objectives have been achieved, and that long-term trends are followed. This information assists managers in the refinement of prescriptions when objectives are not met or long-term undesirable trends occur, and to identify areas for research.

In support of the implementation of the handbook, data forms, software, and training courses have been developed. The program begins its fourth year, with a database that is 77% complete.

ALIEN FOREST INSECTS AND DISEASES IN EASTERN NATIONAL PARK SERVICE UNITS: IMPACTS AND INTERVENTIONS

Keith R. Langdon and Kristine D. Johnson
National Park Service

Alien forest insects and diseases present a difficult challenge to managers of natural areas and to the National Park Service mandate of preserving native biodiversity. Alien organisms have a severe and long-lasting impact on forest ecosystems because the host trees lack genetic resistance and natural predators and parasites are seldom effective in control. National Park Service policy allows for control of alien forest pests by various methods, but impacts on non-target organisms are an overriding concern.

Great Smoky Mountains National Park is a 209,000 hectare International Biosphere Reserve renowned for its number of tree species and for the largest expanse of old growth forest east of the Mississippi. This paper examines some significant alien insects and fungal diseases that attack eastern U.S. forests. Specific impacts at Great Smoky Mountains National Park are noted, along with management strategies and monitoring systems. National Park Service areas work closely with other agencies and private landowners in addressing these problems, and several successful programs have been established to exchange information and cooperate in monitoring and control of several major pest species, such as: balsam wooly adelgid, gypsy moth, Dutch elm disease, dogwood anthracnose, hemlock woolly adelgid and butternut canker.

IMPACTS OF ANTHROPOGENIC CONTAMINANTS ON VEGETATION AND GROUND-WATER CHEMISTRY IN A NORTHERN ILLINOIS FEN

V.A. Nuzzo
Native Landscapes

S.V. Panno, K. Cartwright, and I.G. Krapac
Illinois State Geological Survey

B.R. Hensel
Science and Technology Management Inc.

Residential development within the watershed of a fen-wetland complex has resulted in encroachment of groundwater borne anthropogenic contaminants into three high quality fens. Groundwater samples were collected from peat and marl, and from sand and gravel aquifers, and analyzed for inorganic constituents. Density, percent cover, and height were recorded for narrow-leaf cattail (*Typha angustifolia* L.) and hardstem bulrush (*Scirpus acutus* Muhl.) in $1m^2$ quadrats coincident with groundwater samples. Community data were collected within $0.25m^2$ quadrats located stratified random within each fen.

Contaminant plumes originating from septic systems of houses adjacent to the fens are enriched in Na, Cl, NO_3, and TDS, and have higher specific conductance and alkalinity values, than uncontaminated areas of the fens. Cattail density increases significantly as Na, Cl, CL/SO^4, NO^3 and TDS concentrations increase. Bulrush density is independent of water chemistry levels, but decreases significantly with increasing cattail density. Contamination appears to favor cattail invasion, which subsequently leads to displacement of bulrush. Fen vegetation has been almost completely replaced by cattail within the affected area. Local hydrogeologic conditions and artificial drainage channels may limit movement of contaminated groundwater through the fens, and thereby protect portions of the fens.

ANALYSIS OF RESIDENTIAL DEVELOPMENT AND EFFECTS ON NATURAL AREA MANAGEMENT

Carol G. Andersen and Wayne C. Zipperer
U.S.D.A. Forest Service

The urbanization of rural landscapes for recreational homes adjacent to natural areas may seriously influence the ecological integrity of these areas. To determine the effects of the development on a natural area, we conducted a land-use analysis of Jackson, New Hampshire, a rural community adjacent to the Presidential Range of the White Mountain National Forest. The analysis was conducted by interpreting aerial photographs from 1954, 1966, 1978, and 1987, and using GIS. Over this 33 year duration, commercial and residential development increased by 265%. Development initially occurred within the level topography of the riparian habitat. By 1988, development extended up the mountainsides and outward to the National Forest boundary. Suitability analysis of physical features indicated that development may directly and indirectly influence water quality, habitat quality, natural resource management practices, and visual resources of the working landscape.

50-YEAR VEGETATION CHANGES ON THE TIONESTA SCENIC AND NATURAL AREAS

Russell S. Walters
U.S.D.A. Forest Service

The Tionesta Area was purchased in 1936 to preserve an example of the virgin hemlock-beech climax forest. This 4,131 acre tract is an uncut remnant of a forest type that once covered 6 million acres of the Allegheny Plateau in Pennsylvania and New York. Changes in understory vegetation observed over the past 50 years are primarily the result of browsing by a large herd of white-tailed deer and by strong winds resulting in extensive areas of blowdown. The frequency rates of ferns and beech have remained constant over the years while those of striped maple, red maple, eastern hemlock, and birch have increased. Red maple, eastern hemlock, and birch populations have fluctuated widely during the last 20 years, as cohorts germinated and died. Beech comprises over 70% of the advance reproduction taller than 1 ft.; beech, birch, and striped maple make up more than 97%. White-tailed deer browsing eliminated hobblebrush before 1952 and no doubt contributed to the loss from the understory of sugar maple and white ash.

PRESCRIBED BURNING IN THE URBAN INTERFACE FLORIDA CASE STUDIES

Walter M. Thomson
Florida Department of Natural Resources

Florida's natural landscape has been severely fragmented through a myriad of human impacts, most recently urban development. A majority of the vegetation types dominating these ecosystems are fire adapted and require periodic fires for their perpetuation. The continued use of prescribed fire as a management tool has and will continue to offer new challenges to the land manager in states with burgeoning human populations. This presentation offers techniques in planning, public education, smoke management, site preparation, ignition procedure and other methods that have perpetuated the use of prescribed fire as a management tool in Florida.

SUCCESSION FOLLOWING THE 1974 WATERFALLS CANYON FIRE, GRAND TETON NATIONAL PARK, WYOMING

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Permanent plots were established in a chronosequence of coniferous forest stands differing in time since fire and fire severity. Vegetation changes and breeding birds were sampled during five different years between 1975 and 1992. Despite faster growth rates of *Pinus contorta, Picea engelmannii* has been the most successful pioneer tree species in both the moderately and severely burned sites. In the moderately burned plots, *Abies lasiocarpa* is only slightly less important than *P. engelmannii* because more individuals of *A. lasiocarpa* survived the fire. In the severely burned site, *P. contorta* is second in density to *P. engelmannii.* Plant and bird species richness has increased in the moderately and severely burned areas. Plant species richness increased 50-100% due to the addition of intermediate and late-successional species. Woodpeckers declined in abundance, especially black-backed and northern three-toed woodpeckers. The permanent plots that we studied, established by Grand Teton National Park, are important in understanding succession in the region.

HISTORICAL VARIATION IN FIRE AND TREE SPECIES RECRUITMENT ASSOCIATED WITH THE CHARCOAL IRON INDUSTRY (1780-1900) IN PENNSYLVANIA

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Composition and structure were studied in mature mixed-oak valley floor forests and in similar forests extensively logged between 1936-1946 in central Pennsylvania. These data were analyzed in relation to presettlement forest composition and historical fire records to investigate temporal variation in *Quercus* recruitment versus accelerated succession of more shade tolerant species following logging. Presettlement valley floor forests in the study area were dominated by *Quercus alba* and *Pinus strobus.* Recurring logging and fire between 1780-1900 associated with charcoal iron furnace activity increased *Quercus* and decreased *Pinus* dominance in second-growth forests established during that period. Specific areas used for charcoal hearths still exhibit arrested succession to this date, possibly due to toxic levels of micronutrient. Between 1908-1989 the total area burned by wildfire throughout Pennsylvania decreased by > 99% (from >400,000 ha to < 3,500 ha per year). The decreased influence of logging and fire this century facilitated recruitment of later successional *Acer* and *Prunus* species in *Quercus* forest understories. Logging of forests in this condition rapidly accelerated the rate of obtaining canopy dominance for these later successional species. The biodiversity consequence of process is the conversion of species rich, mixed-oak forests to near monocultures of maple or cherry.

HABITAT MANIPULATION OF THE FEDERALLY ENDANGERED SMALL WHORLED POGONIA, *Isotria Medeoloides*

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Small Whorled Pogonia, *Isotria medeoloides*, is one of the rarest orchids in North America. Populations throughout its range have exhibited recent decline, possibly due to shading with forest succession. For two sites in southern Maine where hundreds of individual plants have been marked and monitored for at least six years, we removed 35% basal area of trees and 35% herbaceous/shrub cover over a portion of the monitored population. We anticipate that added light at the forest floor will lead to an increase in number of emergent stems, leaf whorl diameter, flowering, and fruiting; we hope the apparent decline in the population will be reversed. In a related experiment, we have prepared an 8x20 m artificial treefall gap at each site near the selective cut and within the known populations to encourage recruitment or re-emergence from dormancy.

A BOTANICAL SURVEY OF THE BOWL RESEARCH NATURAL AREA

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The Bowl Research Natural Area is a 206 hectare old-growth forest in the White Mountain National Forest of New Hampshire. Elevations range from approximately 580 meters along Wonalancet Brook to 1215 meters at the summit of Mt. Whiteface. Vascular vegetation in four Ecological Land Types (ELTs) of the Bowl was characterized in quantitative plots and during qualitative meander surveys. Several microhabitats within the ELTs, including sidehill seeps, ledges, canopy openings, and a well-travelled trail were also inventoried. The vegetation structure and species composition for each ELT and microhabitat are described.

A total of 93 species were recorded, including the state-protected plants *Dicentra canadensis*, and *Cypripedium* sp. Eight species found in seeps were observed nowhere else in the Bowl. As expected, the greatest number of species were observed at relatively low elevations in ELT 6 (Predominantly Softwoods on Steep Upper Mountain Side Slopes with Deep Bouldery Colluvium), where the greatest variety of microhabitats occurred.

HABITAT CHARACTERISTICS OF *Trollius Laxus* Ssp. *Laxus* (SPREADING GLOBEFLOWER) IN A CENTRAL NEW YORK CONIFER SWAMP

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Trollius laxus ssp. *laxus* (spreading globeflower) is a rare species of calcareous fens and conifer swamps of the Northeast. Loss of habitat due to development is the greatest threat to *T. laxus*. Even with protection from development, habitat succession may further threaten this species. Literature mentions that populations of *T. laxus* decline as shade increases, but no studies have substantiated this suggestion. Our study was done