

26th Annual

Natural Areas Association Conference

"Conservation Planning: From Sites to Systems"

Program Abstracts
Invited Speakers
Special Sessions
General Sessions



October 13 – 16, 1999
Tucson, Arizona

Hosts: Natural Areas Association ▪ The Wildlands Project ▪ Wild Earth

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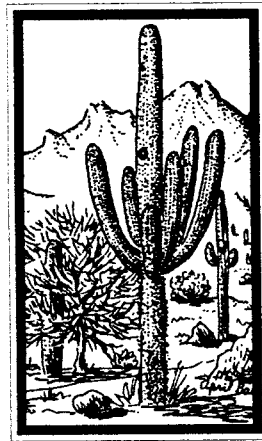
Invited Speakers

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Hosted by

Natural Areas Association

P.O. Box 1504, Bend, Oregon 97709

The Wildlands Project

1955 W. Grant Road #145, Tucson, Arizona 85745

Wild Earth

P.O. Box 455, Richmond, Vermont 05477

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SITE TO SYSTEM: THE INTEGRATION OF LAND, WATER, AND FISCAL RESOURCE DECISION-MAKING UNDER THE SONORAN DESERT CONSERVATION PLAN

Maeveen Behan, Assistant to the County Administrator

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The listing of the cactus ferruginous pygmy-owl in March of 1997 is Pima County's first real introduction to the force of Section 9 of the Endangered Species Act. In response to this listing, Pima County began to develop the Sonoran Desert Conservation Plan. The plan, because it is keyed to Section 10 of the ESA, allows the community to address four entrenched and related problems: 1) our standoff on issues of land use planning, population growth, and preservation; 2) deferring reconciliation of water use with water availability and related riparian ecosystem damage; 3) our resistance to long-term investment in infrastructure and quality of life expenditures that has led to exhaustion of our revenue base; and 4) the brinkmanship and contentiousness that has accompanied our resource decision-making.

Section 10 requires: 1) a science-based long-term commitment to conservation; 2) a level of riparian restoration that allows recovery of natural system functioning through policies that move the basin toward hydrological balance; 3) a defined revenue source for the conservation plan; and 4) a plan that balances environmental and economic needs.

No land use plan or conservation effort to date has required the community to remedy its land, water, and fiscal dilemmas in concert with each other. The big stick of Section 9 and the flexibility of Section 10 bring together these issues which past discussions have framed as opposing. The Section 10 process has given Pima County the opportunity to rechart its course in a much more thoughtful manner. Section 9's protection of the pygmy-owl—a tiny, six-inch, 2.5 ounce messenger—gave us notice of the need to do so.

CLIMATIC VARIABILITY IN THE AMERICAN SOUTHWEST: IS IT A FACTOR IN CONSERVATION AND RESTORATION ECOLOGY?

Julio L. Betancourt, Research Scientist

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The ability to predict climate beyond one or two seasons has not been demonstrated. Longer projections based on greenhouse effects and general circulation models (GCMs) should be viewed with skepticism. For example, to predict cool season precipitation in the American Southwest into the 21st century, at minimum GCMs would have to predict the long-term behavior of the upper-air westerlies and the tropical Pacific. Abundant rainfall happens during years (1905, 1915, 1919, 1926, 1941, 1958, 1983, 1993, 1997) and decades (1905–1930, 1976–1999) when the westerlies are displaced to the south and surface waters in the central Pacific are warm. Drought is associated with upper-air westerlies that are displaced to the north and a cool central Pacific (1904, 1917, 1926, 1943, 1950, 1954, 1956, 1974, 1989, 1996, and 1999; 1942–1972). This interannual and interdecadal variability modulates the behavior of key hydrological phenomena, including soil recharge, streamflow, and flood frequency and magnitude, as well as biological phenomena, including plant and animal demography (births and deaths) and disturbances such as wildfire and outbreaks of insects and pathogens. To anticipate (if not predict) the potential effects of future climate change, we must draw from empirical knowledge about climate variability and its consequences in the 20th century. Dominant themes in this talk will be the challenge of discriminating climatic from land use effects, and factoring in climate variability in conservation and restoration ecology.

A SONORAN DESERT NATURAL HISTORY SHORT COURSE

Tony Burgess, Assistant Professor

Department of Earth and Environmental Sciences, Colombia University/Biosphere 2,
32540 S. Biosphere Rd., P.O. Box 689, Oracle, Arizona 85623

The salient features of the Sonoran Desert Region derive from its latitude and its history of extensive continental crustal extension during the late Tertiary. I offer a brief orientation to the regional geography and biotic communities. The general biogeographic patterns are correlated with the limiting factors that control mortality and reproduction, especially drought, rainfall seasonality, frost, and fire. Many biotic dynamics consist of cascading lag effects initiated by climatic variance and exceptional weather events. I conclude with a survey of climatically comparable regions that may be sources of potentially invasive exotic species.

FOREST SERVICE CONSERVATION PLANNING AND POLITICS

Paul Johnson, Deputy Regional Forester

USDA Forest Service, Southwestern Region, 517 Gold Ave., S.W., Albuquerque, New Mexico 87102

On March 2, 1998, USDA Forest Service Chief Mike Dombeck announced a new Natural Resource Agenda that will guide the agency into the 21st century. The Natural Resource Agenda provides agency direction for the maintenance and restoration of ecosystem and watershed health on National Forest System lands. The Southwest Strategy provides framework for interagency and public collaborations and development of solutions to natural resource problems. This effort is essential since watersheds cross federal, state and private lands. The Natural Resource Agenda drives our work with the public to protect and restore riparian areas, develop recreation opportunities, and reduce fire danger at the interface between wildlands and urban areas. In our interagency management of watersheds and landscapes, our joint monitoring efforts will provide us with land management data. As new information is acquired, we will adjust our future management decisions to incorporate new knowledge. As we become more familiar with the political structure of other agencies, we will be able to develop common goals that provide the means to meet the multiple uses required of our nation's public lands.

NECTAR TRAILS/POLLEN PATHS ACROSS THE BORDER: CORRIDORS OF LIFE, CORRIDORS OF DEATH

Gary Paul Nabhan, Director of Conservation and Science

Arizona-Sonora Desert Museum, 2021 N. Kinney Road, Tucson, Arizona 85743

As habitat fragmentation has become more widely recognized as a prevailing cause of biological impoverishment in and around remaining natural areas, conservation biologists have invested ever greater effort in defining, protecting, or restoring corridors between natural areas. In the binational Southwest of North America, such corridors are especially important for keystone species such as migratory pollinators, seed dispersers, and predators which serve as mobile links among various biotic communities. Recently, however, there has been an unfortunate tendency to use the corridors presumably used by predatory “charismatic megafauna” as the defining element in planning corridor protection and restoration. There are empirical and philosophical flaws with this approach, namely 1) in the assumption that carnivores, pollinators, and dispersers use the same routes with the same fidelity; 2) that charismatic carnivores are the most effective umbrella species for corridor planning; and 3) that corridors provide connectivity and dispersal routes only for desirable native species, and not for invasives or for genetically modified organisms. The 5-year project, *Migratory Pollinators and Their Corridors* based at the Arizona-Sonora Desert Museum hopes to resolve some of these issues in corridor planning and protection. Finally, I argue that conservationists need to devote more efforts disrupting “corridors of death,” including corn belt monocultures of Bt corn, northern Mexican plantings of invasive buffel grass, and highway and airport proliferation in and near national parks.

RESOURCE EXTRACTION TO AMENITY-DRIVEN GROWTH: GOOD, THE BAD, AND THE UGLY

Ray Rasker, Director

Northwest Office, Sonoran Institute, 201 S. Wallace, Box 12, Suite B3C, Bozeman, Montana 59715

The U.S. and Canadian Rockies communities with high amenities, those surrounded by mountains, with nearby lakes, rivers and wilderness, are growing, in terms of real income, employment, and population. However, the causes of economic growth are diverse. They include 1) population growth; 2) an aging population, leading to an increase in retirement income; 3) the influx of urban refugees seeking a higher quality of life; 4) a decline in out-migration; the rapid rise in non-labor income, driven in part by the growth of the stock market; 5) increased property values in metropolitan areas, making housing comparatively more affordable in rural areas; 6) an increase in “footloose entrepreneurs,” made possible by a number of factors, including telecommunications technology and outsourcing of services; and 7) a rise in demand for tourism and recreation services. Because of changes in how products are manufactured in a modern economy, some people—such as engineers, software designers, business consultants, financial experts, and others—have chosen to live in a rural setting. Ten years ago this form of “footloose” employment was anecdotal, written about in magazines and newspapers as human interest stories as a glimpse of what the future might look like. Today they’re a major driving force in the economy, particularly in communities that have what it takes to attract and keep entrepreneurs. This form of amenity-driven growth offers greater opportunities than single-industry dependence of the past. It also brings with it a whole new set of problems.

HERPETOLOGICAL HIGH JINKS ON SOUTHWESTERN NATURAL AREAS

Cecil R. Schwalbe, Research Ecologist

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At one level, this talk is a whirlwind tour through many of the Southwest's natural areas and the reptiles and amphibians calling them home. On another level, its purpose is to demonstrate the increasing importance of natural areas as research sites, particularly for investigations focusing on rare and endangered species. The presentation reviews 25 years of herpetological research on a wide variety of animals—desert tortoises, leopard frogs, lizards wearing "snowshoes," barking frogs, garter snakes, rattlesnakes people catch and sell as pets, even sea turtles—in places such as our National Forests, most National Park lands in southern Arizona, San Bernardino and Buenos Aires National Wildlife Refuges, the Gulf of California, even military bombing ranges. Many of the targeted taxa are experiencing declines, but causes are not always clear cut. Natural areas continue to play a crucial role as hosts to investigations of effects of habitat alteration, invasive alien species, metapopulation disruption, and disease on the reptiles and amphibians in the Southwest. I will also discuss successes and failures of herpetological management programs that have evolved from research in the region.

CONTINENTAL CONSERVATION, OR "BOLD IS BEAUTIFUL"

Michael Soulé, Science Director

The Wildlands Project, P.O. Box 2010, Hotchkiss, Colorado 81419

Prominent biologists claim that we are midway into an unprecedented global extinction of species. The major driving forces behind the contemporary wave of habitat destruction and species loss are human population growth, technological innovation (e.g., mechanized forestry and fisheries), and the globalization of commerce. How have conservationists responded during this century in North America? There have been four major responses or "currents." Monumentalism was the first (around the turn of the Century). Then came Biological Conservation. Next was Island Biogeography. Finally, we have Rewilding. All four of these currents are relevant to the protection of biodiversity and wilderness.

Rewilding is a form of ecological restitution. It is one way of "healing the wounds." There is increasing evidence that many ecosystems are regulated from top-down by large carnivores, and that ecosystems may collapse without them, losing diversity and resilience. Long-term viability and ecological effectiveness of large carnivores necessitates space and landscape connectivity. Rewilding, therefore, requires a regional-to-continental network of reserves; the "system" is the regional network of protected areas (cores) bound together by landscape connectors, many of which function as both habitat and migration-dispersal corridors.

Other practical design and management guidelines include:

- 1) Maximize the size of the habitat remnants, including reserves (management effort and expense per hectare must be intensified in inverse relation to the size of the remnant)
- 2) Minimize edge effects (e.g., including those caused by roads)
- 3) Minimize the distance between remnant islands (nature reserves)
- 4) Maintain the optimum scale, intensity, and frequency of disturbance
- 5) Search out and destroy accidentally introduced alien species before they become invasive and destructive

The old strategy of praying for the arrival of a "good" Congress in Washington is bankrupt. What we need now is a compelling, ethically-based vision that inspires people to protect wildness, ecological diversity, and species richness. The Wildlands Project is one example of such a vision.

Special Session Presentations

All Conference Participants Are Invited

NAA PROGRAM ASSISTANCE COMMITTEE SPECIAL SESSION: REVIEW OF THE DRAFT STATE NATURAL AREAS HANDBOOK SURVEY

Session Chair: Ruark L. Cleary

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The Natural Areas Association Program Assistance Committee is charged with promoting Natural Areas programs in each of the fifty states. The NAA-PAC will implement this goal primarily by providing information and expertise to states that are: a) seeking to create a program to acquire, restore, and manage natural areas or, b) seeking means to enhance the effectiveness of an existing natural areas program. The initial project in this effort is a national survey of existing land conservation programs. The survey will look at both the “nuts and bolts” (appraisals, surveys, contracts, etc.) and the mission and goals of each program. A draft of the survey will be provided for review and comment at this session.

The follow-up to the survey will be a NAA “handbook” that will serve as a guide to creating or improving natural areas programs. The handbook will contain reviews of successful programs, model legislation, planning guidelines, references, program contacts, and other useful information. The Program Assistance Committee is requesting input from interested parties to identify the information that will best meet the needs of the handbook's intended audience.

NATURAL AREA TECHNIQUES FORUM SPECIAL SESSION

Session Chair: Randy R. Heidorn,

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The Natural Areas Association has initiated a strategy to address natural area protection and management problems. The NAA needs to know what those problems are. This session is designed to compile and prioritize issues, and begin the process of forming work groups to address the problems.

Call for Problems: The Response

Randy R. Heidorn

Chair, Management and Technology Development Committee, Natural Areas Association

This spring a questionnaire was sent to the membership of the NAA. Thirty-four problems were submitted by a total of 45 respondents. Those problems can be combined into categories including problems relating to native and exotic animals, exotic plants, community protection, visitor use, legal protection, pollution, prescribed burning, management technique problems and ecological inventory. Some of the issues described might be best handled by other NAA program, or special committees. The results of this survey will be presented to Forum participants in preparation for the facilitated discussion.

Planning to Solve the Problems

Facilitator: Peg Kohring

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Starting with the results of the Call for Problems, participants will develop and refine a list of natural area problems. Problems that might best be handled by NAA committees other than the Management and Technology Development Committee will be identified by the group and referred to them. The issues remaining on the list will be prioritized by participants.

Beginning to Solve the Problems

Facilitators: Randy R. Heidorn and Peg Kohring

Preliminary work groups will be formed on two to three highest priority issues. The work groups will develop specific program goals to address their assigned high priority issue. It is expected that the development of this goal may take longer than the available time slot. The goals will need to be turned into Randy Heidorn before the end of the Conference. The preliminary work groups, will be the beginning for ad hoc committees established to address chosen problems. These ad hoc committees will work closely with the Management and Technology Development Committee in their quest for solutions. It is envisioned that the effort will use of various NAA resources including the journal, newsletter, electronic media and annual conferences.

PLANT CONSERVATION ALLIANCE SPECIAL SESSION

PLANT CONSERVATION ALLIANCE—THE ROLE OF NATURAL AREAS A CALL TO ACTION

Session Chair: Angela G. Evenden

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The Natural Areas Association is a cooperating member of the Plant Conservation Alliance, a national consortium of private, federal and state partners which share a vision to conserve and protect our native plant heritage. The purpose of this session is to engage Natural Areas Association membership and committees and interested Wildlands Project members in active participation in furthering the vision of the Plant Conservation Alliance. It is also hoped that through discussions originating with this session that natural area conservation will become a more widely acknowledged component of native plant conservation strategies. Presentations will provide an overview of the purpose and organization of the Alliance, with focused discussions on established working groups for invasive non-native plants, pollinators and restoration. Following these presentations will be a panel and open group discussion on how the Natural Areas Association will enter a more active partnership with the Plant Conservation Alliance.

Audience: Anyone who wants to make a difference and be part of a national effort to increase the awareness of native plants and promote native plant conservation. It would be most beneficial if participants attended the entire session.

WHAT IS THE PLANT CONSERVATION ALLIANCE?

Peggy Olwell¹ and Larry Stritch²

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The Plant Conservation Alliance is a national consortium of 15 federal government member agencies and over 140 non-federal cooperators. These partners share the following vision: "For the enduring benefit of humans and our ecosystems, to conserve and protect our native plant heritage by ensuring, to the greatest extent possible, that native plants and communities are maintained on public and private lands." The Alliance provides the organization and structure to implement this vision. Goals of the Alliance include: helping establish common priorities and direction in plant conservation activities among cooperators; supporting collaborative efforts, including training programs; coordinating public education and outreach efforts; and developing networking tools for communication and coordination. Technical working groups established to help meet these goals include: Alien Plant, Data and Information Sharing, Medicinal Plants, Pollinators, Public Outreach, and Restoration.

ACCOMPLISHMENTS AND ASPIRATIONS OF THE ALIEN PLANT WORKING GROUP

Jil M. Swearingen

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The Plant Conservation Alliance's Alien Plant Working Group (APWG) has been in action since 1995. Participation in the working group is open to anyone interested in helping address the issue of invasive plants affecting natural areas. To date, the group has consisted of a relatively small force of participants, based in the Washington, D.C. area and has dedicated most of its energy to the development of a web page aimed at educating the general public, land managers, researchers, and others on the problem of invasive plants. The web page project, "Alien Plant Invaders of Natural Areas: Weeds Gone Wild" is on the U.S. National Park Service's web server, at: <http://www.nps.gov/plants/alien>.

"Weeds Gone Wild" is a unique and widely recognized, internet-based project providing information on the threat of invasive exotic plants and other organisms to the native flora, fauna and ecosystems of the United States. The site contains a national list of invasive plants, illustrated fact sheets with information on identification, native range, ecological impact, management, and suggested alternative plants, and links to relevant experts and web sites. All plants included on the site have been identified by reputable agencies and organizations, such as The Nature Conservancy, Exotic Pest Plant Councils, and federal agencies. A referenced national invasive plant database (USAWeeds) will be posted on the site in late 1999. This project is a cooperative effort, supported by federal, state, and local government agencies, non-governmental organizations, private industry, and hundreds of individuals around the country, who volunteer their time to the effort.

As a result of the January 1999 "Action Agenda" meeting of the Plant Conservation Alliance in Austin Texas, the working group's network was greatly expanded nationally and a wealth of ideas were generated on how to organize and take effective action against invasive plants. The APWG will continue its work on the web site and begin to reorganize nationally in order to initiate implementation of its action agenda.

RESTORATION WORKING GROUP OF THE PLANT CONSERVATION ALLIANCE

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The extent of disturbed natural landscapes encompasses significant areas across the country and is ever increasing. Ecological processes on these areas have been interrupted by a myriad of agents including active disturbance associated with land clearing, mining, and grazing; or more passive disturbance such as suppression of natural fire regimes. Out of this situation has arisen a need for more thoughtful and ecologically sensitive restoration management practices which include an emphasis on working with indigenous plant materials.

To address this need, the Restoration Working Group was initiated at the January 1999 gathering of plant conservationists in Austin, Texas. At this meeting over 40 people from throughout the country met to develop an action strategy for Restoration concerns. The resulting Action Agenda contains seven areas of emphasis: policy and guidelines; funding; research; native plant sources; prevention; public outreach; and information sharing and data management. The overall purpose of this effort is to facilitate an increase in the number of successful site restoration projects and to help ameliorate the number of areas needing restoration.

The Working Group is presently organizing themselves to accomplish the identified work. One of the desired outcomes of this group is to work more closely with Plant Conservation Alliance cooperators, such as the Natural Areas Association in pursuing shared interests in promoting good restoration practices. An important part of this work will be to better define the contribution that natural areas can make to the development and application of restoration practices.

PANEL AND GROUP DISCUSSION
HOW THE NATURAL AREAS ASSOCIATION CAN BECOME MORE EFFECTIVELY ENGAGED
AS A COOPERATOR WITH THE PLANT CONSERVATION ALLIANCE

Robert Bruenig,¹ Reid Schuller,² and Julie St. John³ (moderator)

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A steering committee has been recently formed to unite the interests of non-governmental organizations (NGO) under the Plant Conservation Alliance. The chair of this committee will report on developments of this new effort. It is hoped that non-governmental organizations working more closely together and in partnership with federal, state and local agencies can develop a stronger and unified voice for plant conservation. This committee is presently developing a strategy aimed at promoting and funding native plant conservation on public lands. Natural Areas Association (NAA) leadership will present ideas on how NAA programs and committees can interface with the Plant Conservation Alliance. A facilitated discussion aimed at identifying specific and tangible means of NAA involvement with the Alliance will follow the presentations. An important part of this discussion will be on identifying which elements of native plant conservation should be emphasized and the role of natural areas.

Abstracts for General Session Presentations

SPATIAL LAND ALLOCATION AND NATURAL HERITAGE CONSERVATION

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During the past decade, considerable attention has been given to conserving biological diversity and the pathways to accomplish this. The pathways include coarse- and fine-scale filters, genetic banking, ecosystem management, and land trusts, among other concepts. One pathway, the concentric zonation form of spatial land allocation, has received limited exposure as a biodiversity and natural heritage conservation planning tool. I suggest that the combination of partial land allocation with landscape inventory, ecology, and dynamics should serve as a foundation for biodiversity and natural heritage conservation planning and management. Additionally, I suggest that this type of planning may be undertaken for the entire land base of the United States, or another country, based upon the existing road system.

CONNECTING HEART AND MIND: EXPERIENTIAL EDUCATION IN THE SKY ISLANDS

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In the journal *Conservation Biology* in 1996, Reed Noss wrote an editorial called "The Naturalists are Dying Off." Concerned that conservation biologists increasingly are locked to computer terminals ("keyboard ecology") or tangled in obligations within academia or agency administration, Noss cautioned, "Scientific abstractions and fancy technologies are no substitutes for the wisdom that springs from knowing the world and its creatures in intimate, loving detail."

The Sky Islands of SE Arizona, SW New Mexico, and NW Sonora constitute an extraordinary archipelago of ecosystems in a complex mosaic of land ownership and management. Preservation of biodiversity is a focus of such disparate groups as The Wildlands Project, The Nature Conservancy, Southwest Center for Biological Diversity, Sonoran Institute, Malpai Borderlands Group, and high alphabet-diversity of agency acronyms from both sides of the international border.

Growing awareness of biodiversity parallels growing threats to ecological integrity: groundwater sucked from the reach of riparian tree roots or native fishes, grasslands degraded beyond reasonable expectation of recovery, mountainsides mangled for minerals, landscapes fragmented by highways and houses. Conservation here will need more than mapping ecosystems or measuring tree growth or manipulating livestock herds; it will require reconnecting people with the land. Experiential education, hands-on involvement in meaningful activities in natural and altered landscapes, is an important tool. Experiential education can create cores of commitment linked by corridors of concern. My slides and comments will celebrate such efforts to merge mind and heart.

NOVA SCOTIA WILD LANDS AND WILD OCEANS MAPPING WORKSHOP: INCORPORATING A MARINE COMPONENT INTO THE WILDLANDS CHARETTE

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In May of 1999, about 40 individuals participated in the Nova Scotia Wildlands Mapping Workshop. Maps were generated to lay the groundwork for a long-range science-based wilderness conservation plan aimed at maintaining and restoring terrestrial, freshwater, and marine ecosystems. Areas of ecological importance, richness of biological diversity, or other wildlands values were mapped. The terrestrial component identifies existing protected areas, gaps in representation of natural landscape types, and known areas of significant ecological value, all proposed as core reserves. Areas of important connectivity among core reserves were identified, including corridors along freshwater systems and the coast. Coastal and nearshore areas were proposed for protection to integrate the terrestrial and marine systems primarily around islands, headlands, and bays. Buffer areas were drawn around core protected areas and corridors. The wild ocean map has five major themes: 1) the pelagic (water column) component was divided into seven management units with distinctive characteristics of enduring oceanographic features, and with management objectives of maintaining ecological integrity and sustainable fisheries; 2) a series of marine protected areas (MPAs), selected with particular attention to the ocean floor (benthic zones), provide a higher level of protection; 3) within some of these protected areas, core zones were identified, which are proposed as "no-take" zones. Two large special zones were also identified: 4) a larval retention area proposed for special management because of its importance for larval settlement, and recruitment of juveniles; and 5) an area of fragile deepsea corals proposed as a "no-dragger zone."

SELECTING FOCAL-SPECIES FOR BIODIVERSITY CONSERVATION: EXAMPLES FROM THE EAST COAST—NOVA SCOTIA AND MAINE

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Focal-species warrant special biodiversity management attention because they are keystone, vulnerable, ecological indicator, flagship, or umbrella species or special populations. Frameworks for selecting focal-species and linking them to landscape level parameters are developed, tested and found to be useful for identifying conservation priorities. Potential mammal, reptile and amphibian, bird, and freshwater fish focal-species for biodiversity management in Nova Scotia and Maine are tentatively selected. Focal-species for Nova Scotia include: *Martes americana* (American marten), *Martes pennanti* (fisher), *Lynx lynx* (lynx), *Alces alces* (American moose), *Emydoidea blandingi* (Blanding's turtle), *Clemmys insculpta* (wood turtle), *Thamnophis sauritis septentrionalis* (northern ribbon snake), *Ambystoma laterale* (blue-spotted salamander), *Hemidactylium scotatum* (four-toed salamander), *Salmo salar* (Atlantic salmon), and *Salvelinus fontinalis* (brook trout). A preliminary assessment indicates that many of the same species represent focal-species in Maine, with the addition of species no longer existing in Nova Scotia such as *Canis lupis* (grey wolf), *Rangifer tarandus* (woodland caribou), and *Felis concolor* (mountain lion). Focal-species of birds tentatively identified in Maine include *Gavia immer* (common loon), *Pandion haliaetus* (osprey), *Haliaeetus leucocephalus* (bald eagle), *Aquila chrysaetos* (golden eagle) and *Falco peregrinus* (peregrine falcon). These focal-species and populations may be used to guide biodiversity management and protected area system design, including site selection, boundary delineation and monitoring at both species-population and landscape levels.

Note: The Maine focal-species study is in progress and is in collaboration with and funded by the Greater Laurentian Wildlands Project, 4 Laurel Hill Drive, South Burlington, Vermont 05403, (802) 864-4850, glwildland@sprynet.com.

PEOPLE, PRAIRIES, AND POPULATIONS: A UNIQUE FIRST-YEAR COURSE

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Ripon College is in the process of restoring a natural area, called the Caresco Prairie Conservancy (CPC). The CPC is used for a variety of teaching and research purposes. The most unique of these purposes is that the CPC serves as the focus for one of several seminars for first-year students. This particular seminar consists of three sections, one taught by a biology professor, one taught by a mathematics professor, and one by an English professor. The students are thus exposed to basic biology of prairie ecosystems, to mathematical modeling of ecosystem phenomena, and to environmental literature, both fiction and non-fiction. This paper will describe both the CPC itself and the workings of this seminar.

PRESERVING BIOLOGICAL DIVERSITY THROUGH LAND ACQUISITION AND MANAGEMENT: A LOCAL GOVERNMENT'S PERSPECTIVE

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The Brevard County Environmentally Endangered Lands (EEL) Program was established by public referendum in 1990. The vision of the EEL Program is to acquire, protect and maintain environmentally endangered lands guided by scientific principles for conservation of the county's rich biological diversity. Working with County staff, a volunteer Selection Committee composed of local scientists, naturalists, and a lawyer developed a strategy for acquisition that targeted ecosystems representative of the county's natural areas. Since then, more than 13,000 acres of relatively pristine lands have been acquired, protecting ecosystems that include scrub, pine flatwoods, maritime hammocks, beach dune, coastal strand, mesic and hydric hammocks, hardwood swamps, freshwater wetlands, and estuarine wetlands. Acquisition partners include the Florida Conservation and Recreational Lands Program, The Nature Conservancy, St. Johns River Water Management District, Florida Communities Trust, North American Wetlands Conservation Council and donations from private citizens and organizations. Management of the sanctuary network is the next critical step to preserving the landscapes. A Sanctuary Management Manual was developed by the Selection Committee and county staff to guide the County in management of the land. Management is based on Ten Principles of Conservation as a basis for integrating passive recreational use. Discussion will center on the acquisition and management strategies developed by the EEL Program to protect and enhance Brevard's biological diversity.

RIPARIAN VEGETATION INVENTORY AND MAPPING AT MOENKOPI WASH, HOPI INDIAN RESERVATION, USING COLOR-INFRARED, AERIAL PHOTOGRAPHY, SOFTCOPY PHOTOGRAMMETRY, DIGITAL ORTHOPHOTOS, MULTISPECTRAL AIRBORNE SCANNER DATA AND A GIS DATABASE

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The Hopi Tribe, Department of Natural Resources, in cooperation with the Arizona Water Protection Fund, is evaluating the extent and condition of riparian vegetation along Moenkopi Wash as part of the Talastima Wetland Rehabilitation Project. Given the large project area, which encompasses some 52 km of stream channel, and the difficult terrain surrounding the washes, it became apparent that remote sensing and digital image processing would be the only practical tool for inventorying riparian vegetation. We were fortunate to be able to acquire 15-channel multispectral airborne imagery in July 1998 from NASA/Stennis Space Center through the Commercial Remote Sensing Program/Verification & Validation Team. The ATLAS scanner collects data in 6-visible/near infrared, 2 short wave infrared, and 6 thermal infrared bands at a spatial resolution of 2.6 meters. A Learjet 23 simultaneously collected 161 frames of color infrared photography at a scale of 1:8400 using a Zeiss aerial mapping camera. A pilot project area was selected and digital orthophotos were produced to create an accurate basemap for the GIS database. The ATLAS multispectral data were georeferenced to the orthophoto base map. The Spence/Romme/Floyd-Hana/ Rowlands (SRFR) vegetation classification scheme was implemented because of its adaptation to the Colorado plateau flora. Using a hybridized manual/automated classification algorithm, vegetation acreage and dominant/codominant riparian vegetation communities were mapped with an accuracy of 90% correctly classified pixels. The resulting vegetation maps are stored in a GIS database and form the baseline vegetation inventory for the restoration project. Future digital imagery and photographic data acquisitions can be image matched directly to the orthophoto base to simplify the time series analysis of vegetation change, extent and composition. For areas outside the pilot project area, a known correction algorithm applied to the ATLAS imagery in conjunction with ground control points obtained from USGS 7.5' Digital Raster Graphics were used to georeference the imagery. This method enables accurate calculation of vegetation acreages, extent and composition. It should be noted that absolute georeferencing is on the order of 50 m spatial accuracy.

GILA MONSTER INTERSTATE WATERSHED COUNCIL

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This multi-agency effort was initiated by the Arizona Department of Environmental Quality, New Mexico Environment Department, and the Environmental Protection Agency in 1993 as a result of water pollution control regulations which the state governments were directed to implement. The purpose was to have local, community-based planning and implementation to address non-point-source pollution management, and to fulfill requirements under the Clean Water Act, in the Upper Gila River Watershed. The "Gila Monster" is made up of four local watershed councils: Safford/San Carlos/Duncan in Arizona, and San Francisco, Upper-Gila, and Lower-Gila in New Mexico. Activities within a local council are directed by a local advisory group made up of representatives from the public, cities, counties, interest groups, and industry. Public land management agencies provide technical support to the local groups. The four local councils have developed 10-year and comprehensive monitoring plans, and are developing site-specific projects and grant proposals. Efforts are currently underway to develop a comprehensive plan for the two-state watershed by combining the 10-year plans of the four local councils.

**BENEFITING FROM THE PAST:
LESSONS GAINED FROM EVALUATING THE RESULTS OF PAST RIPARIAN RESTORATION EFFORTS**

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The ecological decline of many riparian ecosystems in the southwestern U.S. and northern Mexico has made riparian conservation and restoration a focal issue for many federal, state, and private organizations. Nevertheless, progress toward checking the decline of riparian ecosystems has been marginal. This is due, in part, to the fact that the science of repairing damaged riverine systems is relatively young; we are still investigating fundamental questions on riparian ecosystem processes and impacts of human activities. In addition, the results of only a relatively small number of projects to improve the condition of damaged riparian areas have been evaluated for the benefit of future projects.

To begin filling this gap in riparian conservation literature and learn from the plethora of past efforts to improve damaged riparian areas, two investigations were completed over the past ten years to evaluate the results of riparian recovery projects from the arid southwestern U.S. and northern México. The first investigation evaluated a group of 27 riparian restoration projects (mostly revegetation efforts) in Arizona. The second investigation evaluated the results of riparian recovery efforts along the lower Colorado River, from Parker Dam to and including the river's delta.

This paper presents the findings of these evaluation investigations as well as provides examples of how current riparian conservation and restoration efforts have benefited from past experiences. Specifically, this paper will: 1) summarize the major lessons learned from evaluating past riparian restoration and conservation efforts; and 2) recommend courses of action for identifying areas of natural significance and strategies for maintaining their ecological condition.

**THE NATIONAL NATURAL LANDMARKS PROGRAM:
PARTNERSHIPS TO PROTECT NATURAL RESOURCES**

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The National Natural Landmarks Program was established in 1962 by Secretary of the Interior Stewart Udall. The Program seeks to identify, recognize, and encourage the protection of sites containing the best examples of our nation's natural history. To date, 587 sites have been designated as National Natural Landmarks (NNL's). While the Program is administered by the National Park Service (NPS), in most cases, NNL's are sites that the NPS does not need to own or manage. The NPS provides technical assistance to Landmark owners, monitors the condition of the Landmarks, and submits an annual report to Congress that describes damage or potential threats to Landmark resources. An important element of the Program is the long-term voluntary commitment of public and private landowners to protect the nationally significant resources. Federal agencies must consider the unique properties of a designated NNL in National Environmental Policy Act compliance, and there may be local or state planning implications. Landmarks in the southwestern states include caves, riparian areas, a cienega, areas of unique or disappearing vegetation associations, habitat for rare species, fossil sites, a volcanic neck, a caldera, lava flows, and meteor craters. The owners and managers of the southwestern NNL's are diverse, and include local, state, and federal governments; American Indian communities; private landowners; conservation organizations; and churches. The NNL sites are currently managed as wildlife refuges, national forests, national parks, commercial enterprises, state parks, nature centers and preserves, ranching operations, retreats, and research areas. All of these uses are compatible with the NNL designation.

HABITAT RESTORATION AND DEMOGRAPHY OF THE ENDANGERED ALLUVIAL SCRUB ENDEMIC SANTA ANA RIVER WOOLLY STAR (*ERIASTRUM DENSIFOLIUM* SSP. *SANCTORUM*)

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Eriastrum densifolium ssp. *sanctorum* (Santa Ana River woolly star) is restricted to <6 mi² near the City of Redlands along the upper Santa Ana River, San Bernardino County, California. Populations establish on sand terraces following major flood events and are replaced by succession over a period of several decades. Construction of the Seven Oaks Flood Control Dam will stop terrace deposition. The purposes of our study are to: 1) develop a stage-based matrix population model to predict patterns of population decline, and 2) test site manipulation techniques to restore declining habitat. Reproduction is by seed from subshrubs with an average life span (determined by growth rings of dead plants) that varies from 3.95 years in habitats <30 years post flood to 5.13 in habitats >70 years post flood. Older habitat soil has significantly ($P<0.05$) more organic material, silt and clay size soil particles and supports a denser population of alien weeds than younger terraces. Sand terraces <30 years post flood support 1%, 23%, 32%, 38%, 6% in stages 1 (youngest) to 5 (oldest) respectively whereas older terraces support <1%, 35%, 23%, 35%, and 6%. We conclude that patterns of seedling establishment and mortality of plants of all ages are correlated with time since sand deposition. Experimental plots simulating natural deposition of washed sand or exposure of subsurface sand are compared using stage-based population matrix models. The most cost-effective manipulation that supports seedling populations is removal of the upper soil horizon where organic and fine soil particles accumulate.

AVIAN MIGRATION MONITORING IN MEXICAN BIOSPHERE RESERVES

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Together with Mexican colleagues, we have been banding and monitoring wintering and migrant populations of hummingbirds and small passerine species. As flight distance-endurance is strongly correlated with body size, the small birds have problems finding energy and water resources in arid lands, particularly across the desert in northwestern Sonora. Natural areas not only provide stop-over habitat for resting and re-fueling, but assurance that monitoring sites will not be de-vegetated and “developed” in the middle of migration and long-term studies. We will report an analysis of annual capture numbers and bird conditions in la Reserva Biosfera Sierra del Pinacate for the past 7 years, and number decreases associated with plant succession in former burns in la Reserva Biosfera Sierra Manantlan, Jalisco.

BUILDING A DATABASE TO SUPPORT RESTORATION OF THE SALTON SEA

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The Salton Sea, located in southern California, is an important stop on the Pacific flyway for migratory birds, serves as breeding ground for around 100 species of birds, and supports a thriving lacustrine ecological community. Increasing salinity, overnutrification, unstable lake elevation, bird die-offs, fish die-offs, and other related threats trouble this vital ecological resource. In 1998 the University of Redlands received a U.S. Environmental Protection Agency grant to establish a GIS-based information center dealing with the Salton Sea. At virtually the same time, Secretary of the Interior, Bruce Babbitt created the Salton Sea Science Subcommittee to evaluate restoration alternatives for the sea. The Salton Sea Database Program quickly became linked to the subcommittee as an information center for examination of Salton Sea issues. A substantial digital library and bibliography on the Salton Sea are features of the database program. The purpose of the bibliographic database and digital library includes making information available not only to government decision-makers, but also to scientists, researchers, and the public. This paper addresses the technology and methods used to create, maintain, and facilitate use of the bibliographic database and digital library in the context of the process of evaluation of Salton Sea restoration alternatives.

FORESTED AREAS AND A SENSE OF PLACE: COMPARING THE PERCEPTIONS OF RURAL AND METROPOLITAN POPULATIONS

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salient

The study of how people connect themselves to their local environments is a relatively new field of research. Nonetheless, there is an emerging recognition among social scientists that, as people develop a sense of self, the places in which they reside serve as potent mediators in the process of understanding terms dealing with ecology, process arguments related to the environment, and thus relate ourselves to those advocating environmental issues including those associated with the use of natural areas. One viable approach to isolating the core values related to forested environments is to examine the discourse people use to describe the places in which they live, work, and play. This paper reports the findings of a USDA Forest Service-funded project comparing key themes people residing in metropolitan (Palatine, IL) and rural (Marquette, MI) settings use to describe their "sense of place," with special emphasis upon the role of forested areas in perception. Analysis of interview data and quantifiable responses to survey protocols suggests that, depending upon factors such as regional tenure, respondents foreground references to and report preferences for either social, economic, or natural resource values in describing their sense of place. Notably, in neither location is the role of trees or forests salient to the typical respondent; rather, natural areas serve as merely part of the backdrop for focusing on the social and economic functions which take place in more-or-less forested regions. Implications for communication strategies are outlined and comparisons with other sense of place studies are provided.

CALIFORNIA NATURAL AREAS AND PUBLIC-PRIVATE PARTNERSHIPS

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California has been developing conservation partnerships to protect natural areas on the ecoregional scale for several years. This year, a new initiative, aimed at developing a statewide public-private partnership has started. Information on both ecoregional projects and the statewide initiative will be presented. The poster will present maps showing a variety of conservation analysis useful in identifying priority areas and outline a developing computer program that can help local planners assess the broader context of their land use plans.

TRANS-BORDER PROTECTED AREAS: AN OPTION FOR THE SONORAN DESERT?

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A range of conditions, justifications, and paradigms have moved people and governments to explore trans-border protected areas. Some were established around *ad hoc* agreements based on individual commitments, and focused on immediate concerns. Others used international accords to commit resources to joint implementation of a protected area. Most initiatives were driven by public agencies and non-governmental organizations. Communities and private citizens have been less involved. Full stakeholder participation is paramount in deciding rights and access to resources and how conservation is implemented, thus harmonizing tension between protection and resource utilization. A formalized transborder protected area network would promote peace and friendship; integrate protection of natural resources; and preserve cultural values in the Sonoran Desert ecoregion of the U.S. and Mexico. Hurdles to this strategy include differences in funding capacities, language, agency structures, and degree of economic development. Successful experiences in transborder protected area management elsewhere have several common characteristics. They include: presence of a unifying theme, flagship species, and logo that build a sense of joint ownership; maintenance of national, state, and tribal governments' sovereignty; formal agreement ensuring institutional commitments; enthusiastic relationships among land managers, immigration personnel, and community leaders; information sharing among partners; a regular forum to discuss and advise on common conservation actions; and funding for stakeholder participation. Knowledge of experience in transborder protected area management elsewhere, coupled with the impressive history of collaboration in the Sonoran Desert suggests that this strategy has great promise here.

EFFECTS OF GRAZING ON FAUNA IN THE KISSIMMEE RIVER VALLEY, FLORIDA

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The impacts of cattle grazing on small mammals and herpetofauna on a section of drained Kissimmee River floodplain were studied using three approximately 3 ha fenced exclosures. Each exclosure was divided in half to create three sets of replicate grazed/ungrazed sample sites. Species richness and abundance of small mammals and herpetofauna were sampled using Sherman live traps and drift fences accompanied by pit-fall and funnel traps. Small mammals were tagged and measured for weight and standard length. Seven small mammal species and 15 herpetofauna species were identified. Baseline results indicated that cattle exclosures had healthy populations of *Cryptotis parva* (least shrew), *Reithrodontomys humulis* (harvest mouse), and *Sigmodon hispidus* (cotton rat). Preliminary results comparing grazed and non-grazed sites showed that moderate cattle grazing had a significant impact on abundance of small mammals, but little or no effect on herpetofauna. Grazing results were complicated due to extensive flooding from El Niño during the 97/98 winter that resulted in significant declines ($p < 0.001$) of least shrew and harvest mouse. Herpetofauna and cotton rats appeared to be less affected by flooding. Post-flooding abundance of cotton rats increased significantly on four previously ungrazed exclosures suggesting that grazing might impede small mammal populations from recovering following flooding. The decline in populations of least shrew and harvest mouse and the occurrence of rice rats (*Orozomys palustris*) during the flooding is an indication of the change in small mammal communities that might result from the impending Kissimmee River restoration.

AN UPDATED PROTECTED AREAS GIS DATABASE FOR ECOREGIONS OF THE UNITED STATES

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A fundamental goal of conservation biology is to represent biodiversity in protected areas. However, do we really know how much or how representative the nation's protected areas are? To help assess the protection status of ecoregions of the U.S., we assembled a GIS (geographic information system) digital database of protected areas for the country at 1:100,000 map scale. Previous efforts involved smaller map scales (e.g., 1:2,000,000) which are useful for national and continental assessments, but are less appropriate at intermediate spatial scales. This first iteration of this mapping project emphasizes federal and state ownership; however, local government and private protected areas were included where electronic data were available. All areas over 200 ha were mapped as polygons, otherwise they were mapped as points. GAP and IUCN codes were compiled from existing sources or assigned to each protected area, and overall protection summary statistics calculated for each ecoregion as defined by World Wildlife Fund. Nation-wide only about 5% of all ecoregions were in strict level of protection (GAP codes 1 & 2, IUCN I-III), ranging from less than 1 percent for most ecoregions (particularly those along the eastern U.S.) to more than 30% for a few. Most protected areas were too small or did not meet broad representation goals at the ecoregional scale, and ecoregions that were considered "globally outstanding" by the World Wildlife Fund were poorly (<10%) represented. We provide a nation-wide framework for assessing conservation priorities at the ecoregion scale based on conservation reserve principles and representation goals.

ECOREGIONAL-BASED CONSERVATION PLANNING IN THE KLAMATH-SISKIYOU: A MARRIAGE OF CONSERVATION SCIENCE AND SUSTAINABLE ECONOMICS?

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The Klamath-Siskiyou ecoregion of northwest California and southwest Oregon is among the world's richest temperate conifer forests. The region abounds in rare plants and invertebrates with some of the highest conifer richness and mollusk endemism of any conifer forest in the temperate world. A history of unsustainable development and anthropogenically caused disturbances, however, threaten the region's unique character. The World Wildlife Fund together with five regional partners (Klamath-Siskiyou Alliance) and local constituents from around the region have developed an ecoregion-based conservation strategy that blends sustainable economics with sound conservation science principles. Like many other places in the west, this region has experienced economic growth in spite of the spotted owl listing and cut backs in federal timber. The region is now characterized by explosive growth in service industries, however, there are several significant obstacles to achieving the twin goals of sustainability and conservation, including below and above average education and poverty levels, respectively, and a false perception that extraction industries remain the primary economic base for the regional economy. The conservation strategy for the region calls for more than a four fold increase in protected areas (from 12 to 50%) in order to meet representation goals. Successful acceptance of this effort will therefore depend largely on local ownership of conservation planning and community visioning processes built on informing the public about opportunities to blend conservation with sustainability principles. We present an ecoregion-based conservation strategy that integrates conservation and sustainability with community outreach. Strategies for building public support and local ownership in conservation planning are presented as a case study for conservation at ecoregional scales with the intent of stimulating constructive dialogue among similar conservation efforts elsewhere.

CONSERVATION ASSESSMENTS USING ECOREGION VERSUS WATERSHED POLYGONS

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The spatial extent of different land use and land cover categories (e.g. cropland, forest, grassland) in relation to abiotic environmental variables (e.g. slope, soils, landform) is perhaps the best indicator of overall land health and environmental quality. Results derived from remote sensing land classifications are often used as assessment tools to help set regional land use and conservation priorities. Most often land cover-derived statistics have been attached to watershed polygons. Recently, some workers (e.g. Omernik and Bailey in the *Jour. Of Amer. Water Res. Assoc.*, 1997) have suggested that such assessments may lack validity because land cover corresponds with landform (e.g. ecoregion), whereas watersheds cut across multiple landforms. We used various combinations of metrics derived from a TM-based land cover classification attached to both watershed and ecoregion polygons to suggest conservation priorities for Missouri. We found significantly different spatial priorities result when ecoregions versus watersheds are assessed. Conservation assessments based on watersheds appear to be misleading or entirely spurious. We suggest abandoning the widely used method of attaching land cover statistics to watersheds to analyze conservation priorities. Ecoregions provide a more valid assessment tool, and even the ranking of a regular grid of hexagons, squares, or rectangles may provide easier interpreting of results versus the ranking of watershed polygons.

**BRITTLE PRICKLY-PEAR CACTUS (*OPUNTIA FRAGILIS*) IN THE SAN JUAN ISLANDS
AND PUGET SOUND REGION OF WASHINGTON STATE**

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A four-year-long study was completed to provide baseline information within the San Juan Archipelago and other areas within the Puget Sound region regarding this regionally rare species. A variety of sources of historical information on this species within the project area was investigated. Historically known sites were visited and potentially suitable habitats were field surveyed. Results indicate that the Brittle prickly-pear has declined sharply within the study region during the past 25 years. Conservation strategies have included nomination and ratification of San Juan County Code 16.60.740 (Species of Local Concern), providing information to the public regarding rarity and fragility of the species, and furnishing property owners with conservation guidelines. San Juan is the first county government in Washington State to address native plant conservation.

**REWILDING NORTH AMERICA:
CASE STUDIES OF THE WILDLANDS PROJECT'S APPROACH TO RESERVE DESIGN**

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The Wildlands Project advocates a "rewilding" approach to biodiversity and wilderness conservation. Rewilding represents the scientific argument for restoring large, interconnected wilderness areas with their full complement of native species. The rewilding argument states that large predators are often instrumental in maintaining the integrity of ecosystems and that maintaining these major ecological players requires extensive space and connectivity. TWP operates on the assumption that the reintroduction of top predators will facilitate the restoration of a natural balance to many ecosystems throughout the continent. The ecological argument for rewilding is supported by research on the roles of large animals, particularly top carnivores and other keystone species in many continental and marine systems. In this paper, I define the rewilding approach and review the research that has led to its development. I present and compare key components of three rewilding-oriented reserve design proposals: Sky Islands/Greater Gila Nature Reserve Network; Yukon Wildlands; and Maine Wildlands Reserve Network. Each takes a different approach to reserve design and rewilding, reflecting the biological, political, and socioeconomic conditions found in each region. Finally, I discuss the need to remain open to different approaches to reserve design and how TWP is addressing this need.

RESOURCE MANAGEMENT PLANNING FOR NATURAL AREAS IN RURAL SOUTHEAST VIRGINIA: A COOPERATIVE VENTURE

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The Zuni Pine Barrens Preserves are situated along the Blackwater River in Isle of Wight Co., VA. These preserves include Antioch Pines Natural Area Preserve (NAP), 400 acres, owned and managed by the Virginia Dept. of Conservation and Recreation - Division of Natural Heritage (DCR-DNH) and the adjacent Blackwater Ecological Preserve (BEP), 318 acres. BEP is owned by Old Dominion University (ODU) and managed by a consortium of conservation partners including ODU, DCR-DNH, The Nature Conservancy (TNC), the Virginia Dept. of Forestry, and International Paper Corp. (formerly Union Camp Corp.) - the landowner that originally gifted the land as a natural area. Both preserves are legally protected under Instruments of Dedication and are components of the State Natural Area Preserve System overseen by DCR-DNH. Blackwater Ecological Preserve supports the northernmost remaining occurrence of natural *Pinus palustris* (longleaf pine) communities, including numerous rare species associated with fire-maintained longleaf pine ecosystems. Antioch Pines NAP harbors several rare plant species and is thought to have historically supported longleaf pine communities as well. Management and restoration using prescribed fire is essential to long-term resource viability at the Zuni Pine Barrens Preserves. A comprehensive management plan was developed for these two preserves, coordinating their management in order to: (1) streamline fire management activities, (2) enhance habitat restoration efforts, and (3) improve implementation of routine preserve management decisions including public access, compatible uses, and research activities. A cooperative planning project, funded by TNC and DCR-DNH, included a contracted project coordinator to facilitate the process of data collection, coalescing of various agency recommendations, writing and revising various plan drafts. The process was guided by a Resource Management Planning Advisory Team consisting of individuals representing organizations listed above. The newly developed Resource and Fire Management Plans will greatly improve stewardship and long-term conservation efforts at the Zuni Pine Barrens Preserves.

ARTHROPOD COMMUNITIES IN PRESCRIBED BURN AREAS OF THE APALACHICOLA NATIONAL FOREST

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Insects of the wiregrass layer in longleaf pine-wiregrass communities in the Apalachicola National Forest (located in the Florida Panhandle) were studied under growing and dormant season prescribed burning regimes. Both dormant and growing season burn study plots were in high-quality longleaf-wiregrass forest that has been receiving regular prescribed burns for at least 20 years. Monthly insect collections were made using a D-Vac sampler, and insects were identified to family and counted. Collembola (springtails) was the numerically dominant arthropod order, while Diptera (flies) had the highest diversity in terms of number of families. Preliminary data show that for plots receiving growing season burns, there was a marked increase in numbers of insects of several families. Most of the observed increases occurred in the two months following the growing season burns. This increase was most striking in phytophagous insect families, particularly Chloropidae (Diptera, grass flies) Cecidomyiidae (Diptera, gall midges), Aleyrodidae (Hemiptera [bugs]), as well as the predacious Micryphantinae (Aranea [spiders]), and is presumably linked to rapid plant growth following summer burns. The most abundant insect group in both burn treatments was Collembola, with the species *Salina banksi* (Collembola: Entomobryiidae) being the most abundant insect. Our data support the position that growing season burning in Southeastern longleaf forests is not detrimental to insect communities.

A RESTORATION PROCEDURES MANUAL FOR PUBLIC LANDS IN FLORIDA

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The Nature Conservancy was contracted by the Florida Department of Environmental Protection to develop a "cookbook" for planning and implementing restoration projects on public lands. The target audience was state land managers, agency planners and technical staff. The manual gives step by step instructions on how to identify and rank suitable restoration projects within a region, details on the seven steps of planning (site selection, site assessment, alternatives development, plan writing, defining success, planning for the future and estimating costs), checklists and worksheets, and suggestions for implementation (funding, permitting, coordination and contracting). In addition, the manual is peppered with quotes, lists, gray box examples and supplemental materials from the current literature on ecological restoration. There is a fairly comprehensive list of sources of information valuable in planning restoration in Florida, as well as lists of agencies, public lands with potential projects, relevant state policies and copies of worksheets and checklists. The manual was produced in hard copy as a three-ring binder that can be easily updated, and is also being disseminated to agency personnel on cd-rom.

PEDIOCACTUS POPULATION GROWTH: PARTITIONING THE VARIANCE

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The probability of extinction of a rare species is dependent upon variation in the temporal and spatial environment, demographic variation, and the genetic variability of the populations. In the field, the rare species, *Pediocactus paradinei*, is being used to estimate these variance components based upon standard analysis of variance models. This species is the subject of a long-term project composed of permanent plots in northern Arizona, monitored since 1987. Replicate plots at the same site are used to estimate demographic variation in the plot population growth rate, while variation between sets of replicate plots is used to estimate the spatial component of environmental variation. The annual variation in population growth rate between plots is used to estimate the contribution of temporal environmental variation. Using these same experimental designs, the direct effect of genetic variability, in addition to environmental and demographic variability is being measured in laboratory populations of *Daphnia*. Genetic variability is used as a factor in the experimental design by using one or more distinct clones as the founders of the experimental populations. Populations made of more than one clone can be used to represent higher levels of genetic variability. These populations should be less subject to extinction than populations with lower genetic variability. The use of the analysis of variance designs will allow the estimation of the contribution of demographic, environmental and genetic variability to the probability of extinction of small populations. The experiments will also quantify the contributions of the interactions of these variance components.

CHANGES IN SEMI-DESERT GRASSLAND PLANT COMMUNITIES 10 YEARS FOLLOWING CESSATION OF GRAZING AND REINTRODUCTION OF FIRE

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Non-native invasive species can dominate a landscape, reduce native species diversity, and hinder restoration and conservation efforts. A goal of many land managers is to reduce populations of non-native species; reintroduction of fire is often believed to favor native plant species of plants over introduced non-native species. The Buenos Aires National Wildlife Refuge (BANWR) was established in southeastern Arizona in 1985 to manage for the recovery of the masked bobwhite quail (*Colinus virginianus ridgwayi*). Much of BANWR is dominated by *Eragrostis lehmanniana* Nees (Lehmann lovegrass), an undesirable introduced grass from South Africa. Management for restoration of native vegetation has included removal of cattle and reintroduction of frequent prescribed fires. The habitat recovery plan at BANWR includes long-term vegetation monitoring to determine plant community status after cessation of grazing and reintroduction of fire. We analyzed data collected in 1987, 1989, 1993, and 1997 on 38 permanent transects at BANWR using repeated-measures analysis of variance, and determined that basal cover of native species and non-native species have not changed substantially in ten years. Because no effect of year was evident we then used the most complete and current data set (i.e., 1997) to assess the influence of fire regime on basal cover of native species and non-native species. Neither fire frequency nor time since fire affected cover or species composition. This study suggests that resources currently allocated to prescribed burns at BANWR may be more useful if applied to research of other management options.

AN EVALUATION OF SUSTAINABLE AMERICAN INDIAN TOURISM

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American Indians have had to endure decades of economic deterioration due to inappropriate federal economic development strategies. The natural resources and tribal communities have suffered negative consequences as a result of many inappropriate developments, including agriculture, forestry, mining, and waste facility siting. As a result, American Indian reservations have been in dire need of socio-economic improvements, but not at the expense of their cultural and environmental traditions. Consequently, as tribes have gained greater political sovereignty and control over reservation social and natural systems, many tribal communities have started to promote different aspects of tourism as a source of economic renewal. While tourism has been cited as a potentially destructive activity to a region's cultural and natural resources, there has been an emerging concept of sustainable tourism. Understanding the factors and practicing the concepts that contribute to sustainable tourism has become an integral component in the management of some reservation-based tourism developments. Many reservations are incorporating sustainable tourism factors into their developments, giving them the ability to manage their resources according to their tribal beliefs and avoiding the poor management practices that were applied to their lands by the federal government. This paper examines sustainable tourism developments that have been established on reservations as a means of cultural, environmental, socio-economic and political sovereignty. The paper considers the factors of sustainable tourism and how they are essential to the sustainable development and management of American Indian reservations.

USING LOCAL MODELS TO ESTABLISH TARGETS FOR RESTORATION: EXAMPLES FROM FLORIDA SANDHILLS

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Assessment of restoration needs and success requires articulation of the characteristics of the target community. While the conceptual model of a community type may vary little over the geographic distribution of that community, allowing common identification of the community across its range, local environmental and biological conditions often alter the more specific community characteristics at a site. Additionally, where the historical management of sites has altered factors such as soil, elevation, hydrology, and species composition, the restoration trajectory may substantially differ in either recovery time or potential community composition. Local model sites are therefore necessary to provide quantitative and qualitative data for the setting of quantitative objectives for restoration. We have evaluated data on density of longleaf pine, and cover or density of overstory trees and understory perennial grasses, forbs, woody plants, litter and bare ground from three sandhill restoration monitoring efforts from central to northwest Florida. Ranges for these community components from local sites are used in quantification of objectives for sites under various restoration activities including prescribed fire, planting, herbicide application, and tree removal. Evaluation of restoration success is based on the trajectory of measurements in the restoration sites relative to the model sites, which are also monitored to detect short- and long-term trends in the variables and to re-evaluate the ranges in the objectives. Development of this method has provided both a means of evaluating the effects of management and important information about our overall community concept and the model sites selected.

ECOREGIONAL PLANNING IN THE NATURE CONSERVANCY: RESULTS AND LESSONS LEARNED FROM THE FIRST 3 YEARS (1996-1999)

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The Nature Conservancy intends to complete ecoregional plans for all contiguous U.S. ecoregions (63) as well as several in AK, HI, and internationally (Latin America and Asia-Pacific) by 2001. Through September 1999, approximately 18 plans have been completed. The product of each planning effort is a prioritized set of conservation sites designed to conserve all, native viable species and ecological communities. Preliminary results indicate that the percentage of land in each ecoregion covered by the portfolio of conservation sites ranges from a low of 3% in the Northern Tallgrass Prairie to 46% in the Hawaii High Islands. However, no plan to date has met its goals for capturing all targeted species and communities. Data will be provided separately for species and communities on the mean percentage of goals being met in these ecoregional plans. Although conservation sites span the range of land ownership, with a few exceptions nearly all plans have a substantial amount of public land ownership within the proposed conservation sites. The most commonly cited threats to biodiversity at conservation sites are residential development, poor grazing practices, exotic species invasions, loss/alteration of fire regime, and alteration of hydrologic regime. Summary data will also be provided on the conservation targets identified by each plan and the average cost (time and money) of these planning efforts. Ecoregional planning has significantly changed and improved the Conservancy's approach to reserve selection in a number of ways (e.g., larger conservation sites, better inclusion of ecological processes, better representation of all communities and ecosystems).

RECLAMATION OF CABIN BRANCH PYRITE MINE: WATER ON THE MEND?

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In the summer of 1995, the abandoned Cabin Branch Pyrite Mine located in Prince William Forest Park, a unit of the National Park Service in Triangle, Virginia, was reclaimed. Five acres of acid-producing pyrite tailings from this mine site were degrading terrestrial and aquatic habitats along Quantico Creek. One of the primary purposes for the reclamation effort was to bring the site into compliance with the Clean Water Act by reducing the discharge of metal-laden drainage into Quantico Creek. The primary purpose of this investigation is to determine the success of the reclamation using water quality parameters (chemical, physical, and biological) as indicators.

Five in-stream sites were selected for this two-year investigation. Water chemistry (pH, conductivity, dissolved oxygen) and dissolved/suspended metals (copper, lead, aluminum, zinc, arsenic, iron and sulfate) and physical parameters (flow and turbidity) were sampled monthly. Macroinvertebrate bioassessment and fish bioassessment were conducted three times yearly, using EPA Rapid Bioassessment Protocols. Data collection began in September 1997 and will end in October 1999.

All preliminary data indicate that the overall water quality is improving at this site. Results to date show that pH is being maintained between 6.5-7.5. All metals have diminished substantially with the largest reductions in aluminum and iron. Each impacted site shows increases in both macroinvertebrate and fish species richness and abundance. Further research is needed to determine if these data are representative of a long-term pattern and if wet weather flows will have a detrimental impact on stream quality.

INCLUDING AQUATIC COMMUNITIES IN ECOREGIONAL PLANNING: DEVELOPING AND USING ECOLOGICAL GROUPS TO STRATIFY THE ENVIRONMENT AND DEVELOP TARGETS FOR CONSERVATION PLANNING

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A paucity of data on aquatic species distributions and a lack of a standard way to identify and describe aquatic communities has resulted in aquatic targets not being adequately addressed in many broad-scale conservation planning efforts. To facilitate the incorporation of representative aquatic communities and system types into The Nature Conservancy's ecoregionally-based planning efforts, we have developed a new classification unit called Ecological Group. This unit, which fits into an existing hierarchy, is an aggregation of watersheds that contains similar sets of aquatic systems. Once delineated, a list of targets within Ecological Groups is developed and conservation goals and best remaining examples of each target are identified. Ecological Groups are delineated using hydrography, digital elevation models, surficial and bedrock geology, hydrologic regime characteristics, and zoogeography in a GIS. Examples of Ecological Groups developed for The Nature Conservancy's ecoregional planning efforts in the Prairie-Forest Border, Headwaters of the Rockies, and Interior Low Plateau will be presented.

**PROSPECTS FOR THE CLASSICAL BIOLOGICAL CONTROL OF GARLIC MUSTARD
(*ALLIARIA PETIOLATA*): AN ENVIRONMENTAL WEED IN NORTH AMERICAN FORESTS**

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Garlic mustard (*Alliaria petiolata*) is a biennial herb of European origin, which invades forest communities and displaces indigenous undergrowth flora. It was shown that the plant spread exponentially in the last few decades, and it is presently recorded in 28 states in the eastern United States, the Midwest, and southeastern Canada. Large, well established populations are difficult if not impossible to control with conventional methods, because of recruitment from the seed bank. Therefore, a classical biological control project was initiated in spring 1998. A literature review revealed 69 phytophagous insect species and 7 fungi to be associated with garlic mustard in Europe. During field surveys carried out in Switzerland, Germany, and Austria, 28 species were collected from garlic mustard, 20 of which were reared through. We selected five insect species as potential biological control agents due to records of their restricted host range: four *Ceutorhynchus* species (Coleoptera: Curculionidae), and one flea beetle (Coleoptera: Chysomelidae). Except for one seed-feeding weevil species, all other selected agents attack both phenostages, rosettes and bolting plants. This is thought to prevent garlic mustard from escaping attack and limit compensatory growth. Plants that are heavily attacked by several of these herbivores were observed to die prematurely. A preliminary test plant list was established and sent to some 150 interested parties in the US and Canada for comments. The revised list will be submitted to a TAB (Technical Advisory Group) during 1999, and host-specificity tests will start in the year 2000. In addition, studies are being carried out to compare plant parameters of European and North American garlic mustard populations, and to investigate factors regulating population growth. This should help to develop a successful integrated control strategy for this invader.

**TOWARDS AQUATIC SYSTEM FUNCTIONALITY IN RESERVE DESIGN: AN EVALUATION OF AQUATIC
REPRESENTATION GOALS WITHIN RESEARCH NATURAL AREAS OF WESTERN MONTANA**

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The Research Natural Area (RNA) program was established by the U.S. Forest Service in 1927 to identify and protect a representative array of terrestrial and aquatic ecosystems in the national forests. Although historical efforts have primarily focused on representation of different forest types, the recent emergence of the Forest Service's Natural Resource Agenda underscores the importance of RNAs and calls for a new approach to RNA designation which considers watershed maintenance and aquatic biointegrity. While several RNAs represent physical aquatic features in western Montana (lakes, ponds, rivers, streams, and wetlands), the biological significance of these sites is uncertain. In this presentation, we examine 25 RNAs with recognized aquatic features in order to evaluate the contributions of the current RNA network towards representation of functional aquatic ecosystems in western Montana. We use state and federal databases with ARCINFO 7.1 to score each RNA for its maintenance of native fisheries, amphibian communities, and sensitive aquatic and wetland flora, as well as inclusion of fourth and fifth-order watersheds. Results are evaluated by ranking each RNA and describing the biological effectiveness of the current physical representation strategy for reserve selection. Preliminary results have highlighted the inability of the current RNA network to represent functional aquatic systems and the need to expand this reserve network accordingly. We conclude with recommendations for 1) systematic expansion of existing RNAs in western Montana and 2) additional establishment criteria to enable representation of functional aquatic ecosystems.

IDENTIFICATION OF ECOLOGICAL NETWORKS IN FLORIDA AND THE SOUTHEAST UNITED STATES USING REGIONAL CONSERVATION PLANNING AND GEOGRAPHIC INFORMATION SYSTEMS

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An interdisciplinary planning team at the University of Florida has been working for the last four years to identify a statewide ecological network using a GIS decision support model. As part of the Florida Greenways Program, state government funded the analysis of potential statewide ecological connectivity to identify landscape linkages for the major existing and proposed conservation lands and other areas of primary ecological significance. An ecological network composed of both public and private lands could fulfill many conservation objectives including protection of biodiversity despite a burgeoning human population. Florida has made significant progress towards protecting such a system through its ambitious land protection program and increasing acceptance of a more integrated approach to ecological planning, and the identified ecological network will help focus future protection efforts. The University of Florida team has also continued with modeling of ecological networks in the entire southeastern United States for the Environmental Protection Agency. The objectives of this project are to protect ecological services and biological diversity by connecting and buffering remaining primary ecological areas utilizing major riparian ecosystems and other suitable landscape features. Early results indicate there are still good opportunities to protect a region-wide conservation reserve system.

PROPOSAL FOR A CONSERVATION AREA NETWORK IN THE SOUTHERN APPALACHIAN ECOREGION

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The Southern Appalachian region is one of the most biologically rich temperate ecoregions in the world. It retains much of its biological diversity despite a long history of human occupation and despite severe ecological abuse during periods of this history. The challenge for conservation planners in the region is to design a long term plan for the region that will protect remaining diversity to the greatest extent and lay the groundwork for recovery of species and ecological functions that are currently impaired. Our planning efforts have involved the identification of conservation elements including wildlands, old growth forest, biological hotspots, aquatic diversity areas, high priority areas for public acquisition, and wildlife movement corridors as essential elements of a protection and recovery strategy. A crucial part of this process also involves local grassroots groups and citizens in identifying these conservation resources, in setting conservation priorities, and in placing local conservation contexts within a landscape perspective. Local conservation information and priorities are integrated with conservation information and priorities from nearby areas to create landscape level conservation proposals. SAFC has created new GIS resources to facilitate work with grassroots groups and communities. Potential conservation areas have been identified throughout the region. GIS analysis and maps show the conservation opportunities and issues in and around these conservation areas. Conservation area proposals have been integrated on a landscape and regional basis into a proposal for a network of conservation areas throughout the Southern Appalachian ecoregion.

INTERPRETING NATURAL AREAS FOR EDUCATORS: USING NATURAL AREAS, THE LIVING LIBRARIES OF BIODIVERSITY, AS OUTDOOR CLASSROOMS

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Today's educators have a multitude of tools at hand with which to teach their students—everything from text books, videos, and computers as well as an international access to knowledge via the worldwide web and internet. The Forest Preservation District of Cook County maintains nearly 70,000 acres of open space in the metropolitan Chicago area, much of which is contained in the seven main natural communities and 47 subcommunities preserved as living libraries of biodiversity. These living libraries provide Camp Sagawau Environmental Education Center with the basis for assisting educators and their students with exploring and studying our natural communities through field trips and the outdoor classroom, affording both educator and student "real life" not virtual life experiences. Connections are drawn from a series of explorations and investigations throughout their visit to the natural area (living library) for parallels to the world's biodiversity. Field trips last from three to five hours and include four to five rotations of one-hour investigations, each highlighting an in-depth study of a particular aspect of the community being sampled. No more than 10 students participate in each rotation, giving a very low student-to-naturalist ratio. This allows for excellent student participation as well as low impact on the environment.

MONITORING THE STEWARDSHIP OF CONSERVATION LANDS: FLORIDA'S LAND MANAGEMENT REVIEWS

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Florida's Preservation 2000 program, having recently celebrated the purchase of 1 million acres for conservation, is recognized as one of the most successful land acquisition programs in the nation. But how well is the State managing these lands? This was the question many legislators were asking in 1997, when they passed a bill establishing "Land Management Review Teams." Land Management Reviews are now being conducted to determine whether public conservation lands are being managed for the purpose for which they were acquired and in accordance with an adopted land management plan. Each team consists of eight individuals representing state natural resource agencies, local governments, private interests, and conservation groups. For each property, the teams use a checklist to evaluate a broad range of issues: 1) protection of natural communities, listed species, and cultural resources; 2) resource management practices such as prescribed burning, control of non-native species, restoration of disturbed communities, and water quality monitoring; 3) public access to the property; 4) staffing and funding needs; and 5) whether existing and proposed uses are consistent with the purpose for acquisition. The reviews have proven valuable in several ways: 1) the exchange of useful information among land managers and knowledgeable individuals; 2) an increase in the quality of management plans being prepared; 3) a heightened awareness of the need for more staff and funding; and, 4) better management of the state's natural resources. Florida's Land Management Review Program has effectively brought attention to the management needs and successes on our conservation lands.

THE DIFFERENTIAL EFFECTS OF SPRING AND FALL FIRE ON PRAIRIE FORBS THAT BLOOM IN DIFFERENT SEASONS

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This study explores the effects of burn regime on the population dynamics of three species of prairie forbs, *Lithospermum canescens* (hoary puccoon), *Echinacea angustifolia* (purple coneflower) and *Aster sericeus* (silky aster), each of which blooms in a different season. Individual plants were mapped and measured before burning and in the first and second seasons after replicated fall, spring and no-burn treatments. Both burn treatments significantly reduced mean plant height of all three species relative to those in the no burn treatment. Spring burn significantly increased mean plant stem number in *Lithospermum* in the first season after the burn, and both burn treatments increased *Aster* stem number for two seasons after the burn. *Echinacea* stem number was unchanged. The species responded very differently in terms of sexual reproduction. Total number of flowering stems, mean number of flowers per stem, and seedling production were all affected by the treatments. *Lithospermum* was affected negatively by spring fire, having significantly lowered fruit production. Both *Echinacea* and *Aster* benefited from spring fire, with an increase in the total number of flowering heads produced. Fall fire had a positive effect on sexual reproduction in all of the species examined. Fire timing also differentially affected seedling establishment in all three species. Only fall burning enhanced seedling production in *Lithospermum*. Neither burn treatment affected the number of seedlings of *Echinacea* or *Aster* in the season immediately following the burn. However, both significantly increased the number of seedlings found in the second season post-burn. Management implications will be discussed.

WHAT YOU SEE, IS WHAT YOU GET? THE ROLE OF A FOCAL SPECIES IN FLORIDA SCRUB CONSERVATION PLANNING

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What is a focal species? A focal species is one that is easily observed and is often recognized as a representative of a particular habitat type. These species are well known to the public and become cornerstones in issues of land acquisition and conservation. Understanding the role of focal species in conservation planning is complex due to the various perspectives of scientists, government officials, and the general public. The federally threatened focal species, Florida Scrub-jay, was used to demonstrate the role of a focal species in conservation planning within east central Florida. How can focal species assist in conservation planning efforts? Effective use of focal species must include public education, objectives that define the role of the focal species, persistent monitoring, and conservation goals for specific time periods. Can a focal species reduce the effectiveness of the conservation plan or limit the plan's long-term integrity? In many situations, focal species appear abundant in their respective habitat type, especially long-lived species such as the Florida Scrub-jay. Species visible in conservation landscapes are often judged by their presence, not their long-term population viability. Long-term monitoring and dynamic population models (i.e., meta-population dynamics) are needed to accurately represent a species from a long-term conservation perspective. It is important that all parties involved in conservation efforts understand that what you see is not always what you get.

CONTROL OF THE SPREAD OF THE INVASIVE PLANT *CYNANCHUM ROSSICUM* (SWALLOW-WORT)

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In recent decades, *Cynanchum rossicum* (swallow-wort) (Asclepiadaceae), a twining herbaceous perennial vine, has become increasingly invasive in central New York State and the Great Lakes basin. Native to central Europe, it has been present in eastern North America since before 1889. Population increases are problematic in limestone-derived soils of the Lower Great Lakes basin. Capable of forming dense monospecific stands in full sun, in shrubby areas and in the understory of successional woodlands, swallow-wort outcompetes other successional plants to the detriment of native flora. Once established, it can move into less disturbed natural areas. Knowledge of control is essential to provide a basis for conservation of biodiversity in areas where swallow-wort is spreading. We also need effective restoration techniques to discourage the establishment of other invasives and encourage the establishment of native species. Herbicide type, concentration and application method are investigated. Herbicide trials include foliar spraying and cut-stem applications of glyphosate and triclopyr. Preliminary results favor triclopyr 1% v/v foliar spray. Cover crops, an important weed management tool in agricultural systems, can also be effective in natural areas. Sowing native grass cover crops could provide effective exclusion of broadleaf weed species. Post-herbicide treatment seedings of *Elymus virginicus*, *E. villosus*, and *E. hystrix*, all native wild ryes, are evaluated. An ideal outcome would be a standard procedure, effective in all the light and moisture conditions tolerated by the plant, that could be easily used by both land managers and volunteers.

CONSERVATION AND ECOLOGY OF JAGUAR AND PUMA IN THREE PROTECTED AREAS OF ATLANTIC FOREST, PARANÁ STATE, BRAZIL

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Atlantic Forest is one of the most threatened ecosystems in the world. In our study, we selected three protected areas which are representative of the range of environments found in this ecosystem—from the sea-shore to the tops of mountains. Jaguar and puma presence was recorded in those areas, as was condition of the habitat. We also studied and compared the diets of Jaguar, puma, and local people. In all areas where we found jaguar and puma, one or more threats were present (deforestation, hunters, cattle ranching).

The dietary analysis showed us that people eat many species also used by jaguar and puma, with overlap higher between man and puma (0.41) than man and jaguar (0.27). These results deviated from those obtained by Jorgenson and Redford (1993) at six neotropical sites. The difference may be explained by different hunting methods used in the Atlantic Forest region.

Because man is altering habitat, defending livestock, and competing for food, long-term prospects for jaguar and puma survival in the Atlantic Forest are bleak. Jaguars are especially threatened because population sizes are smaller and ecological requirements are greater. In order to reverse this situation, we suggest an increase in law enforcement (both numbers and quality of personnel); improvements in livestock management that eliminate the need to remove “problem” jaguar and puma that take domestic livestock; and assurance of the long-term financial stability of protected areas within the Atlantic Forest region.

FIVE DECADES OF SUCCESSION AT A CATASTROPHICALLY DISTURBED SITE: OSAN AIR BASE, REPUBLIC OF SOUTH KOREA

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The scene of intense fighting in September 1950, the area which is now Osan Air Base, was completely denuded of natural vegetation. An aggressive reforestation program was implemented throughout much of the Republic of South Korea following the Korean Conflict. Plantations of two non-native species, pitch pine (*Pinus rigida*) and black locust (*Robinia pseudo-acacia*), were established to prevent soil erosion and to enhance soil fertility on the denuded slopes. Over the last 49 years, Osan Air Base has been extensively developed except for a few scattered and unimproved, hilly areas vegetated with remnants of those forest plantations. However, a gradual reversion to native forest communities is occurring as declining pine and locust overstories are being replaced naturally by four native oak species. Many native shrub and herbaceous species have become re-established, but various canopy and understory species are notably lacking.

A habitat delineation of Osan Air Base and a geographically separated property was conducted from April 27 through May 6, 1998. Unimproved upland and wetland areas of the base were surveyed. Natural Resource Management Units (NRMUs) were established on the basis of dominant plant species and structural characteristics. Descriptions of the plant communities also include associated species within each stratum and any unique or critical habitats for indigenous, endemic, or protected species. A successional model is proposed, protected species are identified, and a unique wading bird rookery is documented. Management prescriptions are provided for each NRMU, including the control of invasive species.

LANDSCAPE CONSERVATION AND TRANSBOUNDARY PROTECTED AREAS IN THE EASTERN CARPATHIANS

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Coordination of protected areas is challenging even under optimal conditions, but particular problems arise with a more complex scenario. An example is the East Carpathians of western Ukraine and adjacent Slovakia and Poland, where a strong conservation tradition and scientific competency is attenuated by conditions of difficult economic, social, and political change. This mountainous area, ca. 20,000 km², has a representative and well-arranged "archipelago" of protected areas. These "islands" of protection are ineffective if left isolated within a "sea" of unregulated land use, and are likewise ill-fated if they have no relevance to local populations. Unfortunately, conservation structures do not always coordinate effectively, and these protected areas are not necessarily the only landscape conservation possibilities for a changing Ukraine. Now is the critical moment for sound conservation planning at the landscape scale, while Ukraine still has the possibility to institute effective measures before further degradation occurs. My study of the conservation regimes of the areas and the "islands" of protected areas separated by fragmented landscapes and administrative and international boundaries emphasizes the current problems and possible optimization of the reserves and surroundings as well as potential complications to the area's conservation with future cultural and environmental change. The natural features of the region are viewed as inseparable complements to the local culture; one dependent on the other. Ideas will be suggested for integrative and landscape conservation measures to enhance the viability of the reserves in a way which also involves—even enhances—local culture.

MAINE WILDLANDS RESERVE NETWORK: A SCIENCE-INFORMED CONSERVATION PLAN

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Notwithstanding its predominantly wooded condition, Maine has been severely fragmented by logging and development. Pockets of truly wild habitat are too small, too isolated, and represent too few types of ecosystems to maintain native biodiversity in all its forms. Large carnivores, in particular, have been severely affected by indirect and direct human effects from habitat alteration and persecution. A recent study reports that 8 of the 25 forest community types in Maine are rare, with the remainder lacking exemplary representation. Further, the report concludes that fragmentation from logging and development are likely to continue.

Despite the rarity of many natural communities and species, and the projected increase in forest fragmentation and destruction, few state, federal, or private organizations are willing to propose large scale conservation measures. Indeed, only 2.8% of the Maine was identified by Maine Gap Analysis as currently having Category 1 or 2 (highest) protection.

Given this scenario, the Greater Laurentian Wildlands Project has been working to design an interconnected system of conservation lands capable of restoring and sustaining Maine's ecosystems over the long-term. The Maine Wildlands Reserve Network integrates information on special elements, representation, and focal species into a scientifically informed conservation plan. Large blocks of functionally connected habitat and the use of focal species planning provide the building blocks for this reserve design that will, when complete, help to guide and inspire long-term protected areas conservation throughout Maine.

THE ILLINOIS NATURAL AREAS INVENTORY

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An inventory of significant land and water features of Illinois was commissioned by the Illinois Department of Conservation in the 1970s. A team of scientists used a variety of information and methods to identify remnants of high-quality terrestrial communities, geologic features, and significant waters that occurred throughout the state. The Illinois Natural Areas Inventory Technical Report was completed in 1978 and established sets of criteria and standards necessary to qualify natural areas and features for the Inventory. A list of natural areas and significant features was identified and the Inventory was created.

The purpose of the Illinois Natural Areas Inventory is to act as a tool for the protection of the state's significant natural areas. Protection is accomplished primarily under the Illinois Natural Areas Preservation Act through the Illinois Nature Preserves System. The Inventory is maintained and updated by the Illinois Department of Natural Resources.

LARGE CARNIVORE RESTORATION IN THE SOUTHERN ROCKIES: CASE STUDIES ON HABITAT SUITABILITY AND RESERVE DESIGN

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Utilizing advanced computer mapping techniques, suitable habitat has been delineated for key large carnivore species that are either missing from or poorly represented in the Southern Rockies of Colorado, southern Wyoming and northern New Mexico. Our study has thus far focused primarily on the gray wolf, and has shown that over 20,000 square miles of habitat in the Colorado Rockies are highly suitable for wolves. This study will lay the groundwork for future detailed wolf recovery feasibility analyses and implementation of wolf recovery plans. In particular, our efforts provide wolf advocates with an unprecedented set of tools that are capable of both reshaping the debate over wolf recovery in the region, and helping land managers better decide how projects will effect future wolf recovery.

Other carnivore species of concern, including lynx, grizzly bear and wolverine, are being examined as well for their role towards comprehensive reserve design for the region. The benefits of having viable populations of such keystone/indicator species includes tangible gains for a suite of native forest species found in the Southern Rockies ecoregion. Indeed, the goal of rewilding the Southern Rockies cannot be achieved without the eventual presence of these carnivores.

USING MULTIPLE APPROACHES WHEN EVALUATING VEGETATION MONITORING DATA TO DEMONSTRATE WETLAND RESTORATION SUCCESS AT THE NATURE CONSERVANCY'S DISNEY WILDERNESS PRESERVE IN CENTRAL FLORIDA

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In 1993, four small wetlands at Disney Wilderness Preserve were hydrologically restored by filling ditches. Growing-season fire was also reinstated. Vegetation was sampled along gradients from wetlands to uplands for five summers after restoration. Herbaceous and woody vegetation were sampled separately. Differences between wetlands, including topography, degree of hydrologic change associated with restoration, different plant communities and fire history, made use of a single method for evaluating success difficult. Overall, an increase in wetland species abundance upslope was observed, but often it was necessary to evaluate the data at a species level to detect real change. At one bayhead, density and location of each wetland tree species over time showed a definite shift upslope that was not obvious in a wetland vs. upland comparison. Another bayhead showed recruitment of herbaceous wetland species upslope, but the presence of dense established upland shrubs, which could potentially be removed over time with growing season fires, made a wetland vs. upland comparison uninformative. Certain species, like *Gordonia lasianthus*, were very sensitive to hydrologic change and quickly shifted upslope, making them excellent indicators of hydrologic change. Other species, like *Lyonia lucida*, were so ubiquitous that they only muddled evaluation. Taking these species traits into account made detection of success easier. Because we are a mitigation site, we must show whether restoration is successful in a relatively short period of time. Short-term detection of long-term restoration change was maximized by using a variety of sampling strategies, species level data, and more than one approach to interpretation.

TRUSTEESHIP ON HUMANS IN THE BIOSPHERE

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Incompatible aims of different environmental groups have resulted in the declaration of “ecology wars” over withdrawal of industrialized humans from portions of the biosphere versus relying on biotechnology to solve ecological problems. This paper considers what could be done if environmentalists faced the ecology wars. The ruling International Coordinating Council (ICC) of the Man and the Biosphere Programme under UNESCO is almost unknown among internationally inclined environmentalists. So are the promising, deep ecological shifts this institution made in the late 1980s. Article 77 (1) C of the UN Charter describes how states can voluntarily withdraw from territories to benefit other peoples or species. A planned withdrawal from growing parts of industrialized earth is considered, with emphasis on restoration of human-impacted resources. The concept includes increasing the presence of human indigenous cultures on biosphere reserves, demolition of technological infrastructure, and restrictions on size of human communities. Under this scenario, intra- and interspecific environmental justice would have another chance.

POPULATION VIABILITY ANALYSES IN PLANTS: APPLICATIONS TO CONSERVATION AND MANAGEMENT

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A review of the nearly 100 plant population viability analyses (PVA; broadly defined) reveals that most consider a single species, only a few populations, and are based on data collected for fewer than 5 years. Since populations differ from each other and demography varies over time, most studies offer limited realism on which to base conservation and management decisions. Most PVAs use stage-based modeling and calculated finite rates of increase and population structure. Plants offer numerous challenges such as plant dormancy, seed dormancy, periodic recruitment, and clonal growth; all of which can be met by data collection, experiments, and suitable modeling techniques. Increasing numbers of plant PVAs are including more complicated but realistic approaches such as spatially-explicit models, integration of genetics and demography, meta-population modeling, and explicit consideration of demography in relation to disturbance. Although exact solutions are fraught with limitations, plant PVAs are best used to compare management regimes, populations, and microhabitats. Such approaches can be useful in identifying conservation sites and networks most likely to support viable populations, and in contrasting alternate management regimes. However, PVAs require data on all parts of a plant's life cycle (including seed dormancy and germination), ideally from multiple populations and for many years, and thus will be possible only for a subset of plant species of high conservation value.

LA RUTA DE SONORA: TRANSBORDER RESPONSIBILITIES IN ECOTOURISM MANAGEMENT

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The Arizona-Sonora Borderlands region spans three nations (Mexico, United States, and Tohono O'odham Nation). It is defined by the beautiful and fragile Sonoran Desert and the rich and unique Upper Gulf of California. Within this region are public and protected lands that are managed by various U.S. and Mexican government agencies and several small communities that have a history of economic dependency upon the natural resources available in the area. The oceans and deserts have increasingly attracted visitors from the U.S. and Europe. Unfortunately, the infrastructure in the border communities of Mexico, the U.S., and the Tohono O'odham Nation to support this tourism growth is insufficient or is being developed with little or no regard to environmental soundness, cultural values, education opportunities and/or providing an economic benefit to residents in local communities. Following two years of research and meetings, *La Ruta de Sonora Ecotourism Association (La Ruta)* was legally inscribed in Arizona as a non-profit, community-based organization that promotes socially-responsible tourism in protected areas and other natural and cultural reserves in the Arizona-Sonora border region. *La Ruta's* fundamental objectives are to conserve nature and human heritage and provide opportunities for residents to generate new sources of income from business ventures and services. The natural resources, cultures, traditions, and customs of the region can become valuable as assets to support this emerging industry. *La Ruta* believes that by providing incentives and opportunities that require preserving and protecting these resources and values, an ethic of community based conservation and development can prevail.

CONTROLLING EXOTIC BUSH HONEYSUCKLES IN DRY-MESIC UPLAND FORESTS WITH PRESCRIBED BURNING

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Exotic *Lonicera tatarica* and *L. mackii* (bush honeysuckle) are commonly planted ornamental shrubs that easily invade many natural community types in Illinois. In forest communities, disturbances such as grazing and logging will create opportunities for bush honeysuckle to invade, mainly by seed dispersal from birds and small mammals. However, even in undisturbed forest communities, bush honeysuckle will establish easily along forest edges and to a lesser degree, forest interiors, resulting in lowering the native plant diversity by shading out the herbaceous understory and reducing hardwood regeneration. While labor-intensive hand-pulling and mechanical cutting coupled with herbicide treatments are proven methods for this exotic species, prescribed burning can now be added to this list of control measures in forest communities. The use of prescribed burns over two consecutive spring seasons in a dry-mesic upland forest dominated by mature white and black oaks, had the following results. In test areas burned with cooler back fires, 76% of all age classes of bush honeysuckle shrubs were totally killed after two burns. In treatment areas burned by head fires only, two burns resulted in killing 98% of the honeysuckle. Two years after the burn treatments, native wildflowers that were absent prior to the burns have slowly re-established. Mayapples, red trillium, false Solomon's seal, and Jack-in-the-pulpit have reappeared.

AN ECOSYSTEM APPROACH TO RIPARIAN RESTORATION

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The riparian ecosystem is a composite of aquatic biota, stream morphology and vegetative buffers that comprise unique biological systems. Many water quality values have been validated for riparian forest buffers, the primary value being the ability to filter nutrients from agricultural and urban sheet flow. With these facts in mind, the Virginia Department of Forestry has encouraged the reforestation of riparian areas in urban and agricultural landscapes. The ultimate goal of the effort is to improve water quality in the Chesapeake Bay watershed.

Many approaches have been developed to manage riparian restoration efforts for the unique variables involved. In agricultural landscapes fencing cattle out of streams and providing alternative water sources or limited stream access for cattle has been an initial step to recovery for streamside vegetative buffers. The premise is that without the livestock activity on the stream bank, vegetation will naturally regenerate into diverse healthy buffers. Seedlings have been planted at some sites and tree shelters are used to protect them. This approach has been successful in both urban and agricultural areas.

In some instances the streams have undergone severe degradation and alteration of morphology and will require extremely long recovery periods. The approach to riparian restoration for these streams requires a stabilization plan that can include the whole stream or just critical bank areas. Bioengineering techniques have been used in both rural and urban areas to accomplish the goal of healing the whole ecosystem.

Biological monitoring has been employed as well as monitoring the physical features of streams. A healthy stream system is the backbone of the riparian ecosystem. The forest buffer produces the food base for macroinvertebrates, which in turn are the food base for other biota in the stream. The trickle up effect is an improvement in water quality on a watershed level that transcends to the large watershed picture. Examples of the plans used in Virginia and the success that has been experienced are applicable to other areas of the continental United States.

***POLYGONUM PERFOLIATUM* L. (POLYGONACEAE), AN INVASIVE EXOTIC PLANT SPECIES, IN WASHINGTON COUNTY, OHIO**

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The spread of *Polygonum perfoliatum* (L.) in Pennsylvania, Maryland, Delaware, Virginia, New Jersey, West Virginia, and Ohio has been well documented. The Ohio population is in an industrial area and adjacent state highway right-of-way on the Ohio River floodplain in Washington County in southeastern Ohio. *Polygonum perfoliatum*, a native of East Asia, is an annual that has been known to grow more than six meters during a growing season. It clambers over the ground, structures, or adjacent vegetation which is usually killed because of the heavy shading. Recurved prickles along the petioles and weak stem enable it to reach several meters into trees. The numerous blue fruits that continue to ripen from early September until frost provide a huge reproductive potential. Prompt and effective action is required to prevent this site from becoming a seed reservoir from which the rest of the state would be invaded. Coordination between an industrial company and the Ohio Department of Transportation is a necessity. Herbicide treatments and competitive plantings will be carried out during spring and summer, 1999. Results will be reported.

**NEW TRAILS IN THE DESERT:
IMPACTS OF ILLEGAL IMMIGRATION ON ORGAN PIPE CACTUS WILDERNESS**

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In 1999, Organ Pipe Cactus National Monument, which shares approximately 30 miles of its southern boundary with Mexico, began work on its first Wilderness Management Plan in an era of unprecedented impact of cross-border traffic on Sonoran desert wilderness. Economic problems in Mexico and some Central American countries have caused an enormous increase in illegal immigration and drug trafficking on the U.S.-Mexico border. Increased border enforcement in southern California and southeastern Arizona has funneled illegal activity through the less-populated borderlands area of Organ Pipe Cactus N.M. and Cabeza Prieta National Wildlife Refuge, and other protected areas such as Coronado National Memorial in SE Arizona. Current statistics indicate that interdiction of illegal immigrants and drug smugglers in the U.S.-Mexico border area of Lukeville and Ajo, AZ has risen by at least 700% since 1995. This nontraditional and uncontrolled use of the backcountry makes it extremely difficult to manage wilderness resources. Many of the most remote natural and cultural landscapes of the monument, not generally accessed by traditional National Park Service visitors, are now negatively affected by illegal activities. Impacts include soil compaction from new trail systems and campsites in pristine areas, vegetation damage, wood-cutting, campfires, fence-cutting, garbage, off-road driving, abandoned vehicles, and vandalism and theft of historic structure materials, as well as associated effects to wilderness values from increased enforcement activities. Major challenges for developing a management plan for the 250,000-acre Organ Pipe Cactus Wilderness will be quantifying the intensity and distribution of the impacts of illegal activities, and seeking inter-agency and public support from both sides of the border to find creative resolutions to the problem. Possible responses will include ethnographic and sociological research, interdiction and enforcement, ecological restoration of affected areas, and passive education utilizing Spanish language signs explaining sensitive biotic communities in areas of concentrated use.

THE PRIVATE PROTECTED NATURAL AREAS IN ARGENTINA

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Argentina, located in the south cone of South America, has a surface area of 2,791,810 km². From south to north we find a range of subantarctic to tropical climates. Going from east to west, it presents 1) in the south: marine coast, the Patagonian steppe, and Andean temperate forests; 2) in the center: pampas grassland, *monte*; and 3) to the north: low elevation subtropical forests and Andean highlands. Overall, Argentina embraces eighteen continental ecoregions and four oceanic areas.

The federal system of Protected Natural Areas (PNA) is coordinated by the National Net of Technical Cooperation in PNAs. PNAs 14,692,262 hectares, including the national, provincial, municipal and private conservation units.

The protected natural areas of the private domain have been promoted by national non-governmental organizations (NGOs), such as the Fundación Vida Silvestre and Aves Argentinas/AOP, and other smaller ones such as the Asociación LIHUE. NGOs administer approximately 650,000 hectares, near 5% of the PNA total.

Private landowners have also begun a movement to convert land holdings to Private Wildlife Refuges (PWR). Within this movement, the most interesting initiatives are those that include important conservation targets, or those that cover big extensions of government and NGO PNAs. PWR Lago Escondido in the Patagonic Mountain Range of Río Negro Province is an outstanding example of a PWR; it includes both aspects: important conservation elements and critical geography.

LEAVING A TRACE: USING DIGITAL DATA DEVELOPMENT AND SPATIAL ANALYSIS TO CREATE A BASELINE FOR LONG-TERM SPECIES MONITORING

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The long-term monitoring of extremely long-lived woody plants such as the federally listed endangered species *Styrax texanus* (Texas snowbells) presents many problems. Two of the primary difficulties are keeping track of individuals through time, and presenting locations and individual monitoring information in a format easily understood by future workers. Tagging individuals is often unfeasible due to public access problems. Even when tags are used, they are often destroyed by animals or catastrophic events. Individuals are often extremely close together, thus eliminating the possibility of employing currently available, low cost GPS technology to distinguish between individuals. In the past a system of distances and bearings taken from a known reference point was used. However construction of hand-drawn maps from this data was often tedious and time-consuming. Using sub-meter GPS and GIS technology, maps can be easily produced, showing the location of each individual in relation to a permanent georeferenced point. Monitoring information for each individual can also be readily accessed through a GIS query. With the use of other data sources, hard copy maps and web pages can be easily produced showing relationships between individuals and their environment. Such a system makes the spatial and monitoring data readily available and understandable to managers, future researchers, and others who may need to locate or know the past history of individuals plants.

ASSESSING THE LANDSCAPE CONTEXT OF PROTECTED NATURAL AREAS

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Resource managers of protected natural areas are becoming more concerned with human activity occurring on adjacent lands and within the context of the associated bio-geographic region. The source of a wide variety of threats to natural resources is routinely attributed to human activities on adjacent lands. Habitat fragmentation; barriers to movement; the increased probability of introduced pests, pathogens and exotic species; introduction of pollution; and increased public access to the perimeter of the protected area are some of the issues of concern. The emerging national political issue of how to respond to urban sprawl is a reflection of these dynamics.

An analysis of adjacent lands has been conducted for the landscape setting of Great Smoky Mountains National Park Biosphere Reserve and World Heritage Site, one of the premier protected temperate forests in the world. It contains the largest stand of old growth forest of its kind on the continent. It is the most visited national park in the country with the greatest gateway community growth. The analysis was conducted via a geographic information system utilizing a robust series of databases assembled for a regional resource assessment conducted by the Southern Appalachian Man and the Biosphere Program.

Data themes incorporated in the analysis included: land use/cover, natural resource characterization and conditions assessment, pollution sources, resource utilization, and transportation. Also incorporated were human dimensions such as population dynamics, social condition, social order; economic dependencies; community characterization and potential for growth management; and political orientation. The potential for encroaching development to create an island effect for the protected area was evaluated.

Results of the analysis resulted in the identification of watersheds with the greatest degree of degradation, threats to key corridors linking the national park with adjacent national forests, and relative influence of gateway communities on the adjacent lands issue.

TRANSLOCATION AS A POTENTIAL TOOL FOR RECOVERY OF JAGUAR IN THE SOUTHWEST

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Given mixed results of recent large carnivore reintroductions in North America, conservationists are reluctant to consider translocation to help rebuild a population of *Panthera onca* (jaguar) in the Southwest. Nevertheless, as restoration of jaguar may be impossible without direct intervention, it is important to fully consider alternative translocation goals, methods, and potential outcomes along with ethical and philosophical issues before formulating an opinion. Key questions include: 1) Do jaguars belong in the region as a native species? 2) Can the region support them? 3) Since translocated jaguar may perish, is it worth the risk? 4) Would translocation add or detract from other jaguar conservation efforts? 5) Would rural people support it? Evidence suggests that the first two questions can be affirmatively answered, particularly if the entire borderlands area of Arizona, New Mexico, and Mexico is the recovery unit. Adequate prey base and cover appear to exist. However, security is problematic. Experimental release and study of a small number of jaguars could help assess the risk, and provide much needed information on habitat use and public acceptance of jaguars. The project might improve conditions for any wild jaguars currently in the region by drawing attention and support for a more focused, proactive restoration effort overall. If carefully planned (with full collaboration among interest groups, and safeguards against economic loss due to any livestock depredations), a translocation pilot project involving this charismatic cat could help usher in a new era of enlightenment between the people and nature in the Southwest.

PRONGHORN AND BIGHORN SHEEP AS INDICATORS OF DESERT GRASSLAND INTERGRITY IN SOUTHEASTERN ARIZONA

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Desert grasslands continue to decline in southeastern Arizona because of livestock overgrazing and fire suppression. Urban-exurban development, agricultural expansion, and the spread of exotic species threaten to further diminish them. While efforts are being made to restore grasslands locally, a regional recovery program is needed if desert grasslands are to remain a dominant habitat type. We propose that *Antilocapra americana* (pronghorn) and *Ovis canadensis* (bighorn sheep) serve as a primary management focus for basin and range grassland recovery. These native ungulates thrive in robust fire-dependent grasslands largely free of mesquite and other invading woody plants. They flourish where human impacts on the ecosystem involving livestock presence, recreation, and urban and agricultural development are carefully managed and controlled. A preliminary assessment of the region's grasslands (actual and recoverable) suggests a network of areas that could be managed to support self-sustaining metapopulations of pronghorn and bighorn sheep. As such, these grasslands would provide favorable habitat for a wide range of other grassland dependent species while allowing for ecologically sustainable levels of human use.

PREScribed FIRE ON PUBLIC LANDS: SUCCESS THROUGH PARTNERSHIPS

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Managing pyrogenic ecosystems such as flatwoods and scrub that are protected under the Environmentally Endangered Lands Program includes utilizing prescribed fire to insure long-term survival of these rapidly vanishing ecosystems. The use of such a potentially controversial resource management tool raises important questions: how can prescribed fire be implemented in natural areas that are surrounded by a growing urban population, and how can a program staffed with a few personnel possessing no major fire equipment conduct a prescribed fire? Discussion will focus on a step-by-step reenactment of one such successful prescribed fire conducted recently within the Micco Scrub Sanctuary in Brevard County. This will shed some light on the importance of working with other agencies that can combine equipment, personnel and know-how to conduct a prescribed fire that will solve each agencies' management concerns (fuel reduction, ecosystem maintenance, public safety).

CONSERVATION OF A RARE FLORIDA ENDEMIC SPECIES: *ZIZIPHUS CELATA*

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Ziziphus celata Judd & Hall (Florida Jujube, Scrub Ziziphus) is a federally listed Endangered plant endemic to the Lake Wales Ridge in Polk and Highlands Counties, Florida. Once thought to be extinct, *Z. celata* was discovered in the wild in 1987, and listed as Endangered in 1989. Five populations have been located since 1987. One population is protected on public conservation lands, and four occur on private properties. Threats to this species' survival include loss of appropriate habitat, limited sexual reproduction in the field, and limited genetic diversity. The conservation of *Z. celata* has been multidisciplinary, including land acquisition, management of populations (including the use of prescribed fire), field surveys and monitoring, establishment of an off-site conservation collection, genetic research, and breeding system research.

The conservation of *Z. celata* demonstrates the importance of using different approaches, pooling resources, and building an information base. Since 1987, many private and public partners have contributed to what we know about *Z. celata*. Eleven genotypes have been identified through analysis of allozyme electrophoresis and other genetic data. A single genotype occurs at four of the known sites, with the other seven genotypes occurring at the remaining site. Breeding system research indicates that *Z. celata* is an obligate outcrosser, but not every genotype is compatible. The species is adapted to fire, but we are still learning more about this response. Each year we are able to develop, and implement, a better conservation plan by incorporating many types of research.

INTEGRATED NATURAL AREA MANAGEMENT ON AN URBAN EDGE: SOUTH BOULDER CREEK STATE NATURAL AREA, BOULDER, COLORADO

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The South Boulder Creek State Natural Area in Boulder, Colorado, is a 1200-acre site on an urban edge. The area contains wetlands of state-wide significance, rare tallgrass prairie remnants, native riparian communities, rare species habitat, and important agricultural land, and provides quality visitor experiences. Challenges created by numerous and sometimes conflicting management objectives necessitate a conservation planning process that uses an interdisciplinary team approach and public involvement. Implementation involves coordination among City of Boulder Open Space staff, agricultural lessees, Colorado State Natural Areas Program staff, and other community members. Research and monitoring results provide the basis for continuing or adjusting management practices in the natural area.

Relatively large blocks of open space in the natural area provide habitat for several species with federal, threatened status. These include *Zapus hudsonius preblei* (Preble's meadow jumping mouse), *Haliaeetus leucocephalus* (bald eagle), and *Spiranthes diluvialis* (Ute ladies'-tresses orchid). Other locally or regionally rare species include *Dolichonyx oryzivorus* (Bobolink), *Buteo regalis* (ferruginous hawk), *Athene cunicularia* (burrowing owl), *Spiza americana* (Dickcissel), *Amorpha nana* (dwarf leadplant), and *Apios americana* (groundnut). Natural processes have been altered significantly during the last 150 years by agriculture, urban development, and non-native species. Current agricultural practices and prescribed burning substitute for missing natural disturbances like native ungulate grazing, flooding, and natural occurrences of fire.

This display provides an overview of integrated management activities that are designed to preserve native species and communities, maintain or mimic natural processes, support the continuation of agriculture, and provide recreational opportunity.

LARGE-SCALE CONSERVATION PLANNING IN THE CENTRAL APPALACHIANS

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There is a growing recognition that conservation plans need to encompass large areas—on the order of 10^4 to 10^5 km²—in order to effectively conserve biological diversity over the long term. Regional conservation planning is not likely to be initiated by governments, because there are few precedents for regional legislative or planning efforts that extend beyond political boundaries. The Appalachian Restoration Campaign is an NGO that has initiated GIS-supported, large-scale strategy, throughout the Central Appalachian mountains and plateaus. Our strategy, which we call the Central Appalachian Assessment, is threefold. First, a regional assessment of existing ecological conditions is conducted and conservation priorities are established using both coarse and fine filter approaches. Our coarse filter analysis involves multiple criteria, each of which are being added as a layer in our GIS. For example, we are conducting surveys and habitat suitability analyses for a keystone carnivore, the eastern cougar. We are also examining patterns of land use and land cover. Our fine filter analysis examined the distribution of all element occurrences of rare, threatened, and endangered species throughout the Central Appalachians. Second, we evaluate the sufficiency of existing mechanisms designed to protect biological diversity. Third, we develop a long-term conservation plan in which we identify potential core areas and corridors. This plan will attempt to restore and maintain a full complement of native flora and fauna while supporting compatible human uses. We hope our work will be used to set conservation agendas, influence land-use decisions, and guide acquisition and restoration efforts throughout the Central Appalachians in the next Century.

Project of Redwood
focus = cougar
Partnerships
consensus building
community implementation

**MANAGEMENT OF AN INVASIVE AFRICAN GRASS, *PENNISETUM CILIARE* (L.) LINK,
ON ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA**

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Buffelgrass is a large bunchgrass native to Africa, the Middle East, India, Pakistan, and Indonesia. It was brought to the U.S. in the late 1930s and established in Texas and Arizona. Buffelgrass was first recorded on Organ Pipe Cactus National Monument in the mid-1980s and by 1995 it had been found on 20-25 square miles of the Monument. This species excludes and competes with native Sonoran Desert species, eventually killing them. Millions of acres in Arizona and Sonora, Mexico, have been converted to monotypic stands of buffelgrass. To prevent a type conversion on the Monument, an eradication project was undertaken using mostly volunteer labor. Between 1996 and 1999, an estimated 100 tons of buffelgrass was removed mechanically. The project has been successful in the short term. The development of the project will be outlined and results from monitoring plots will be presented.

BIOGEOGRAPHY OF RED BROME IN THE SONORAN DESERT

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Invasions by exotic plants can alter ecosystem structure and function and biological invasions have caused the extinction of more species than any other human-caused aspect of global change. *Bromus rubens* (red brome) is a Mediterranean winter annual grass that was introduced to California from Mexico in the early 1800s. Red brome was seeded in southern Arizona in the first decade of the 20th century and soon became common in this area. Through a search of herbarium records in the western U.S. and original botanical sources, such as U.S. Geological Survey botanical reports and agricultural experiment station publications, we trace the spread of red brome from California and recruitment foci in Arizona to describe the biogeography of this exotic species in the Sonoran Desert. Red brome has been able to invade undisturbed areas in the Mojave Desert, the Great Basin, and the Sonoran Desert. Abundance of this species is linked to winter precipitation, and may be enhanced by increased atmospheric concentrations of carbon dioxide and by increased occurrence of the El Niño Southern Oscillation.

BURROWING MAMMALS FACILITATE NATURALIZATION OF *LACTUCA SERRIOLA*, AN ALIEN RUDERAL PLANT

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Alien ruderal plants are abundant and widespread in California. Despite their ecological importance, mechanisms of naturalization have been poorly understood. Over the past decade, an alien ruderal, *Lactuca serriola* ("prickly lettuce"), slowly invaded the prairie vegetation at the Carrizo Plain Natural Area (San Luis Obispo County, CA). In 1998, the *Lactuca* population at the Carrizo Plain skyrocketed such that plant densities in an old cultivated field on the "Selby Ranch" averaged 10.54 (SE = 1.51) individuals per square meter. The California prairie ecosystem is riddled with small patches of disturbed soil created by burrowing mammals.

These disturbed soil patches are much like miniature cultivated farm fields. Therefore, a study was undertaken at the "Washburn Ranch" and "Swain Ranch" to determine whether *Lactuca* naturalization was facilitated by the natural soil cultivation done by endangered giant kangaroo rats (*Dipodomys ingens*). *Lactuca* plants growing on kangaroo rat burrow mounds occurred in greater density ($P = 0.01$), were taller ($P < 0.001$) and had more stems ($P < 0.001$) than plants growing in less disturbed adjacent microsites. It seems clear that the abundance of natural soil disturbances created by native burrowing mammals inadvertently helped facilitate the naturalization of *Lactuca* at the Carrizo Plain. Moreover, it is likely that in the past, the naturalizations of numerous other alien ruderals in California were also aided by native burrowers.

NEW YORK ADVANCES WILDERNESS AREA MANAGEMENT: HIGH PEAKS UNIT CASE STUDY

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With the completion of a unit management plan for the 193,000 acre High Peaks Wilderness Area of the six million-acre Adirondack Park, New York State has forged an historic agreement addressing the needs of many users groups while achieving improved natural area protection. The High Peaks is home to many of New York's most precious natural resources, including scenic, open space and biologic resources, like old growth forests, a peregrine falcon nest and alpine tundra. All of New York's remaining alpine tundra is located in the Adirondacks on only 19 peaks totaling only 40 acres of vegetation, and 18 of these summits occur in this unit. The alpine tundra community supports the largest accumulation of rare flora in New York State; many of these plants are threatened with extirpation due to trampling by visitors and some have already been lost from the summits.

Located in the populous Northeast U.S., the High Peaks Wilderness is within a days drive of over 70 million people in the U.S. and Canada. The level of use in the High Peaks has been a concern to managers since its designation as wilderness in 1972, yet visitation has continued to increase, growing from 57,000 in 1983 to 150,000 in 1998. During the summer of 1998 more than 18,000 visitors reached the summits of five peaks. In response, resource managers have devised extraordinary measures to protect these natural areas. One such measure places "summit stewards" on the five most visited peaks to instill an appreciation of the alpine tundra and help direct visitors to stay off of the vegetation. The implementation of a management plan for the High Peaks marks the beginning of a coordinated, systematic approach to address an array of resource issues. The Plan calls for controlling the level of use indirectly through limiting the design capacity of trail head parking facilities, using designated campsites and systematically monitoring resource conditions as a basis for adjusting the manager's responses.

CIENEGA CREEK STREAM RESTORATION PROJECT

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A 1.4 mile reach of Cienega Creek, Pima County, Arizona was disturbed by farming activities in the 1970s. Modifications include three dams, one levee and a road crossing/canal system that diverts water away from three miles of Cienega Creek into a small tributary. This disturbance of the creek has effected riparian development and habitat for a multitude of special status species including *Poeciliopsis occidentalis* (Gila top-minnow), *Gila intermedia* (Gila Chub), *Empidonax traillii* (south western willow flycatcher), *Thamnophis eques* (Mexican garter snake), and *Rana chiricahuensis* (Chiricahua leopard frog). The hydrologic and ecologic processes of this stream segment were restored using principles stable natural channel morphology. Key aspects of the design were to maintain the proper pattern, dimension and profile of the segment being restored. Structures were removed, the diversion canal blocked, road crossing moved and reconstructed, and a new stream segment constructed. Revegetation and two grade control structures were used to stabilize areas at risk of erosion. Monitoring has begun and will be used to gage the level of physical and biological change resulting from stream restoration efforts.

THE SONOITA VALLEY PLANNING PARTNERSHIP

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The Sonoita Valley is a unique, scenic area of rolling desert grasslands and woodlands in a high desert basin in southeastern Arizona. Located along a scenic highway within an hour of the rapidly growing Tucson metropolitan area, the Sonoita Valley includes the public lands of the Empire-Cienega Resource Conservation Area administered by the Bureau of Land Management and intermixed state and private lands surrounded by National Forest Lands administered by the Coronado National Forest. In 1995, BLM's Tucson Field Office decided to take a new, collaborative approach to complete long-term land use planning within the Empire-Cienega Resource Conservation Area. This approach lead to the formation of the Sonoita Valley Planning Partnership (SVPP), an informal, voluntary association of public and private participants who share a common interest in the future of public land resources in the Sonoita Valley. The SVPP has met monthly since 1995 and is open to any interested participants. Facilitated discussions have focused on issues relating to recreation, livestock grazing, mining, wildlife, vegetation, water quality and quantity, and cultural resources. Through these discussions, participants have agreed on the primary goals of maintenance of healthy riparian areas and native grassland systems and associated water as well as vegetation, wildlife, and cultural resources. Well maintained resources in turn support a broad range of recreation opportunities, livestock grazing, and other public land uses. The SVPP has developed strategies for resolving issues and achieving objectives which are designed to be incorporated into planning efforts currently underway in the Valley. BLM's Tucson Field Office, as a participant in the planning partnership, has incorporated the goals and objectives as the foundation for the Empire-Cienega Integrated Management Plan. A draft plan, which also incorporates the alternative management strategies is scheduled to be completed in late summer-early fall 1999.

INVASION OF THE ALIENS: SCIENCE OR PSEUDOSCIENCE?

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The theory of harmful "alien invasions" has become a pillar of wildland management. Examination of the origins of "natural" communities, ongoing natural movements and the plasticity of natural successional trajectories demonstrates that the concepts of "nativeness" and "alienness" on which invader theory rests are non-operational constructs dependent on arbitrary spatial and temporal scales, useless in the construction of a testable scientific theory. Following an edenic mythos of coevolved equilibrium communities, nativists inappropriately attempt to impose an idealized European parkland on natural areas. Field work finds most introductions ecologically integrated, stands of "invaders" disturbance indicators only, with high levels of diversity and many beneficial effects, phenomena invisible to nativists due to confirmatory bias. Anti-invader literature is a deeply contaminated information-pool, with low standards of evidence, unsupported causal attributions, circular reasoning, selective and anecdotal data-mining, and other pseudoscientific characteristics. Field work among nativists found high resistance to contradictory evidence, faulty ingroup/outgroup categorizations, self-sealing arguments, defensive projection, conformation with the frustration-aggression-displacement theory of prejudice, and strong parallels with the psychologies of xenophobia, racism, and other attributional conspiracy theories. This is confirmed by the origins of the anti-exotics movement in the 1930s in National Socialist Germany. Through media sensationalism invader hysteria is promoted by the herbicide industry and their regulatory allies. In furthering their economic interests dangerous and ill-advised extermination projects become widespread. Wildland managers must decisively reject exotic-invader theory or find ourselves discredited. We must recognize the full spectrum, from functionalist rehabilitation through historical restorations, to the hyperdiverse compositionalist refuges of the future.

1998 Jan
BIOLOGICAL PRESERVE

SEED GERMINATION, SEEDLING SURVIVAL AND FIRE MANAGEMENT OF AN ENDANGERED ANNUAL MUSTARD

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The federally endangered *Warea carteri* (Carter's mustard) is an annual plant virtually restricted to the xeric upland of the Lake Wales Ridge of central Florida. Aboveground populations often fluctuate dramatically, with postfire population booms followed by crashes. However, even unburned populations often fluctuate wildly. The demographic mechanisms and environmental drivers are not known, but could be important in guiding management actions. We investigated the conditions promoting or retarding seed germination by placing seed packets into various microsites. We periodically collected and tested seeds for germinability and viability. Seeds which are covered by thick oak litter remain viable but become dormant, while those on the surface or covered only by a thin layer of sand are immediately germinable. This pattern is consistent with the effects of fire on population dynamics. Fluctuations in aboveground population size could also reflect differential rates of seedling emergence or survival. We followed individually marked seedlings from emergence to flowering over four years at several sites. Seedling survival varied from 8 to 40% by year, with survival patterns varying among sites and years. While many questions about the population dynamics of *Warea carteri* remain unanswered, prescribed fire clearly promotes large aboveground populations.

GRASSLAND BIRD ABUNDANCE IN NATIVE AND NON-NATIVE PLANT ASSOCIATIONS IN NORTHWEST ILLINOIS

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The Savanna Army Depot in northwestern Illinois contains over 5000 acres of sand prairie, most of which has been heavily grazed. About 75% of the area is dominated by the native grasses *Schizachyrium scoparium* (little bluestem) and *Koeleria macrantha* (Junegrass), while the rest is dominated by introduced *Poa pratensis* (bluegrass). Bird surveys (5-minute point counts) were conducted 1994–1998 to develop management guidelines for nine regionally declining grassland bird species. On average more grassland bird species and more individuals per species were found in native grassland areas than in *Poa* grasslands. In contrast, *Poa* grasslands had more non-grassland bird species than did native grasslands. These comparisons are complicated by differences in vegetation structure and differences in plant species composition between the two grassland types as well as a lack of clear habitat preferences by some species. This study shows the need for more detailed information on specific habitat requirements of grassland birds to guide grassland management and restoration of non-native areas.

IMPLEMENTING BIOLOGICAL CONTROL IN NATURAL AREAS: PARTNERS AS MEANINGFUL PLAYERS

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The Illinois program for biological control of purple loosestrife has made great progress in a few years. More than one million leaf-eating beetles have been released at >80 sites and are impacting loosestrife populations at several sites. Acceptance of biological control, and the quick increase in efforts, are due to meaningful incorporation of diverse partners into the program. Partners find sites, rear and release beetles, and monitor the sites for impact. Involving local schools, nature centers, and homeowner groups in beetle production has increased awareness of and appreciation for nearby wetlands, and biological control as one management option. The involvement of the array of partners can serve as a model for partnerships for other programs for managing natural areas.

PRODUCTION IN PONDEROSA PINE STANDS IN THE BLACK HILLS, SOUTH DAKOTA

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Disturbances such as fire and logging have been absent from many forests for up to a century, with consequent impacts on ecosystem structure and function. In dense stands of *Pinus ponderosa* Laws. (ponderosa pine) in the Black Hills, understory vegetation has been replaced by a thick layer of pine needles. Our research addresses restoration of these systems. We experimentally addressed the main and interactive effects of prescribed burning and overstory reduction on understory vegetation. In addition, we examined the extent to which lack of a soil seed bank constrains understory recruitment in dense forests. Finally, stand history was estimated by: 1) dating fire-scarred cross-sections of stumps, snags, and living trees, 2) estimating stand age by dating cross-sections of trees felled during initiation of treatments, and 3) researching historical documents to determine logging history. Response of vegetation to treatments will be monitored this summer and presented at the conference. Only 24 individual plants (representing 14 species of herbaceous dicot and 2 species of grass) emerged from 1080 soil samples, which suggests that lack of viable seeds in the soil seed bank could constrain restoration of the understory. Dendrochronological results indicate that the stand is approximately 100 to 110 years old and has not burned for at least 100 years.

USE OF TURTLEHEAD (*CHELONE GLABRA*) AND OTHER HERBACEOUS PLANTS TO ASSESS INTENSITY OF WHITE-TAILED DEER BROWSING ON ALLEGHENY PLATEAU RIPARIAN FORESTS.

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A key factor affecting integrity of forest ecosystems in the eastern United States is heavy browsing by overabundant populations of white-tailed deer (*Odocoileus virginianus*). Deer impacts to upland forests of Pennsylvania's Allegheny Plateau have been especially intense: over sixty years of heavy browsing has strongly influenced forest pattern and process. Riparian forests of the region are rich in herbaceous plant species, but virtually nothing is known about how deer browsing may influence the structure and function of these systems. Moreover, reliable techniques for assessing and monitoring deer impacts to riparian forests are lacking. The goal of this study was to determine whether the herbaceous plant turtlehead (*Chelone glabra*) is a useful indicator species for assessing and monitoring intensity of deer browsing in the herbaceous layer (all vascular plants ≤ 1 m tall) of Allegheny Plateau riparian forests. The percentage of turtlehead stems browsed by deer was significantly correlated with intensity of browsing on the herbaceous community during one sample period, but stem height, an attribute used widely in other studies of browse indicator species, was poorly correlated with browsing intensity. Three other herbaceous plant species, white wood aster (*Aster divaricatus*), zig-zag aster (*A. prenanthoides*) and jewel-weed (*Impatiens capensis*), were preferentially browsed by deer and show promise for use as indicators of browsing intensity in riparian forests. Variability in browsing intensity on turtlehead across sites and sample periods suggests that use of an assemblage of herbaceous indicator species is preferable to sole reliance on turtlehead for assessing and monitoring deer browsing.

TRANSCENDING THE BOUNDARIES: A WATERSHED APPROACH FOR CONSERVATION IN A BUFFER ZONE

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In Montana, some private ranch lands provide critical wildlife habitat and high quality watersheds while acting as working landscape buffers between protected areas and growing urban development. Conservation of the matrix landscapes that surround core protected areas is a precautionary approach for maintaining wide-ranging mammal populations, conserving genetic diversity, and protecting biophysical ecosystem functions across temporal and spatial scales. A place that functions as a buffer zone is north-central Montana's "Rocky Mountain Front"—a unique ecotonal habitat that supports a wide array of flora and fauna. This research discusses the efforts of the Teton River Watershed Group, a grassroots NGO, whose primary mission is to conserve the Teton River by involving private, county, state, and federal land and water management interests in their conservation projects. Preliminary analysis suggests that this locally initiated effort is a useful example of an integrated management approach that has reduced hierarchical decision making among agency interests, earned the trust and participation of private landowners, and has achieved tangible conservation successes. Based on 8 months of qualitative participant observations, in-depth interviews, and project evaluation, critical analysis is offered on the following areas: 1) The efficacy of transboundary conservation and communication among multiple interests; 2) Invasive weed management and biological control across a watershed; 3) Saline seep across multiple land jurisdictions; 4) Prospects for participatory research with private landowners; and 5) The watershed approach as a mechanism for pragmatic conservation in a buffer zone.

AN INTERCONNECTED SYSTEM OF PROTECTED AREAS IN THE CENTRAL VENEZUELAN ANDES

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Central Venezuelan Andes has nearly 13,348 km² of forested slopes, divided in four isolated wildlands blocks. Fragmentation and isolation between and within these blocks is a major threat to biological populations viability. To preserve continuity within these blocks and to eventually restore it among them, a regional planning effort has been undertaken since 1986, with the support of the Venezuelan National Parks Service. Based on ecological needs of Andean Bear (*Tremarctos ornatus*), as a flagship species, an Interconnected System of Protected Areas (ISPA) has been proposed and partially implemented. Landsat images, conventional aerial photographs and extensive ground checking allowed us to map the wildland areas and the current distribution of Andean Bear in the central Andes. Both distribution are correlated, as presumed. The only four designated national parks in the region, by 1986, were considered as nuclei of the ISPA. Alternatives for new protected areas and corridors linking such nuclei were evaluated. As a result, by 1999 eight new protected areas were proposed and legally designated, and one was expanded, all of them as units of the National Parks System. The functioning as linking corridors is an inherent goal of all these new protected areas. Remaining unprotected gaps within major wildlands blocks could easily be filled given adequate political support. Lack of wide enough tracts of natural forest, connecting major blocks, is a severe limitation for interconnection among them. Multiple use management categories should be used to achieve the goal of a full ISPA as ideally conceived.