PARK SCIENCE
Integrating Research and Resource Management

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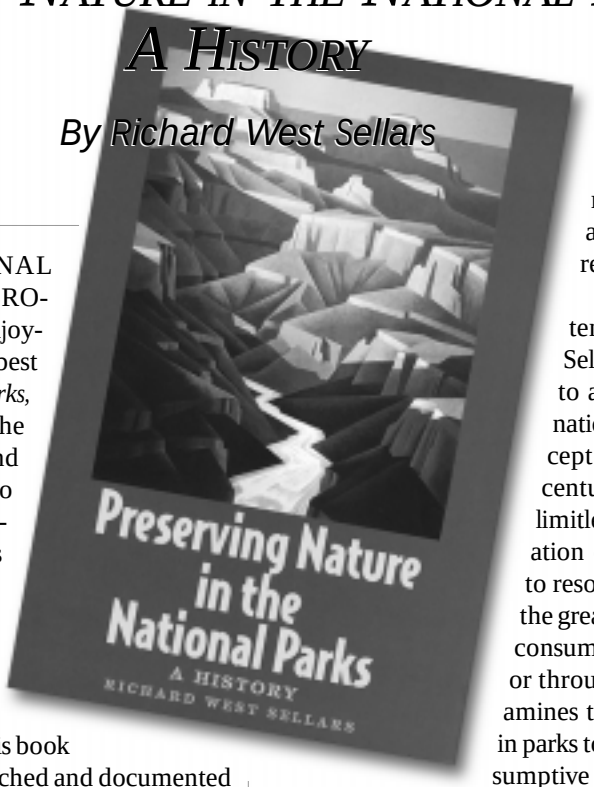
"America's Best Idea"

PRESERVING NATURE IN THE NATIONAL PARKS: A HISTORY

By Richard West Sellars



A BOOK REVIEW BY GARY E. DAVIS

THE CONCEPT OF NATIONAL PARKS, SETTING ASIDE UNBROken tracts of land and sea for the enjoyment of people, has been called America's best idea. In *Preserving Nature in the National Parks,* Richard West Sellars meticulously traces the evolution of the national park concept and America's national park system from 1870 to the present. From beginning to end, he confronts readers with evidence that disputes tradition. Among other beliefs, he authoritatively challenges the romantic campfire myth of an altruistic birth of Yellowstone National Park and the national park concept. He offers in its place a pragmatic rationale more consistent with the times. This book is a scholarly presentation of carefully researched and documented facts, woven into an unbroken story.

AN INSIDERS VIEW

The tale unfolds from the perspective of the National Park Service, the primary governmental agency responsible for conserving parks. It starts with the campfire myth and nationally known landscape architect Frederick Law Olmsted, Jr., crafting and shaping the National Park Service mission "to conserve the scenery and the natural and historic objects and the wild life [in parks]…unimpaired for the enjoyment of future generations." It ends with the 1993 creation of the National Biological Survey and the sweeping reorganization of the National Park Service in 1995. Throughout, readers get an insider's view of America's favorite government agency. As the story approaches the present, it necessarily shallows to encompass ever more territory, losing its rich historical texture, but gaining a journalistic perspective that serves readers well.

Great new ideas always create tension and elicit vigorous debate. Sellars skillfully draws our attention to a series of tensions created by the national park idea that shaped the concept and its manifestations in the 20th century. Born as a dream of profit from limitless recreational tourism, the creation of national parks was an attempt to resolve the conflict over how to wrest the greatest good and profit from the land: consumption through private exploitation or through public tourism. Sellars also examines the tension between development in parks to facilitate access, lodging, and consumptive recreation versus wilderness preservation. Landscape architects, engineers, and biologists expressed conflicting interpretations of "unimpaired" during the 1920s and 1930s. This tension has evolved into a continuing discussion of scenery or façade versus ecosystem management.

Clearly, early promoters of national parks had no qualms about developing facilities in parks and consuming park resources. In promoting creation of the National Park Service in 1916, Robert Sterling Yard wrote in *The Nation's Business,* "We want our national parks developed….We want good fishing. We want our wild animal life conserved and developed." The first two directors of the National Park Service, businessman Stephen Mather and lawyer Horace Albright, both believed the public needed to be enticed into parks with roads, lodges, and enhanced fishing, in addition to the park's scenery and other natural assets. They set about

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IN THE NEXT ISSUE. . .

Social scientists Sarah Flick and Jonathan Taylor review their research on the attitudes of backpackers and day visitors in Rocky Mountain National Park.

LESSONS IN HISTORY

A BOOK REVIEW IS UNUSUAL TO FEATURE AS A COVER STORY IN *PARK SCIENCE*. YET "Preserving Nature in the National Parks" by Richard Sellars is not an ordinary book. A study in the management of nature in the national parks, this work examines our record, inconsistent at best, in embracing science as a management tool over the past 125 years. Although biologists such as George Wright, Adolph Murie, and A. Starker Leopold advanced the notion that management of park resources requires a scientific approach, the book shows that the Park Service has been very reluctant to embrace scientific management since this was first promoted by Wright in the early 1930s. What we have been good at doing, Sellars details, is developing parks for visitor enjoyment, a tradition in park management with deep roots, extending back into the nineteenth century. Have we become prisoners of this success? Can we change? "Preserving Nature" is a fine historical basis for discussion of these questions; to be sure, it reminds us that natural resource management based on unsubstantiated beliefs comes with high ecological costs.

Park Science was inaugurated 17 years ago to address some of the same concerns analyzed in Sellars' book. The stories published in these pages are testimony that science in management is indeed a reality in parks today. However, we must further this union and increase our application of science in the parks if we intend to meet the vast resource preservation tasks at hand. Sellars' historical account may help elevate the role of science in management by presenting us with a clear analysis of the past. We will continue to do our part by publishing good examples of the application of research in management.

Jeff

Omission

Last issue, we featured our annual index of articles published in volume 16 (1996). This index would not be possible without the help of the Columbia-Cascades Support Office. Each year, library volunteer Edith Miller indexes the articles and Richard Aroksaar, an automation librarian, automates the index for electronic distribution. Most recently, Aroksaar created a Windows help file of all 16 volumes that can be downloaded from the *Park Science* web site at *http://www.aqd.nps.gov/nrid/parksci/citation.htm.* The help file is easy to search for article title, author, keyword, or park code. On behalf of our readers, I want to thank Ms. Miller and Mr. Aroksaar for their help in providing this important service.

Editor

Web address change

The *Park Science* web address has changed once again. It is now simpler than before–*http://www.aqd.nps.gov/nrid/parksci/*.

Natural resource stewards honored

Two resource managers, a researcher, a park superintendent, and an exhibit specialist were honored among their peers last summer at three different awards ceremonies as recipients of the prestigious Director's Awards for Resource Stewardship for 1996. All winners were recognized for their outstanding contributions to technical expertise, continuity, and innovative thinking in research and resource management.

Gary Davis, Senior Scientist and Research Marine Biologist at Channel Islands National Park, California, was given the 1996 Director's Award for Natural Resource Research. Davis is a champion of ecological monitoring and scientifically based ecosystem management. He has shown these strategies to be reliable and cost effective and has developed monitoring protocols used widely by others. He is an inspiration among colleagues and a mentor of young scientists. His research, which has contributed to marine conservation in the Caribbean, Florida, and California, has explored the role of maritime parks as refugia to sustain and restore coastal fisheries and protect biodiversity. Davis is also a leader and has served as president of the American Academy of Underwater Sciences and the George Wright Society; he was a board member of the Natural Areas Association. He returned to the National Park Service recently after serving with the USGS Biological Resources Division, California Science Center, since 1993. His research insights and broad understanding of marine resources have been very valuable assets to the National Park Service and the Biological Resources Division. "To be recognized among peers feels good," Davis said. "These awards remind us all of what a job well done looks like."

Gary Davis

The 1996 Director's Award For Natural Resource Management was awarded to Ken Czarnowski, Hydrologist at Rocky Mountain National Park, Colorado. Through his creativity and persistence, Czarnowski has resolved numerous complex natural resource issues at the park, primarily those dealing with water rights. For example, he negotiated with the Bureau of Reclamation and other parties to redirect water back into a park drainage, providing for natural park processes and restoring a high altitude park wetland. Working with the Department of the Interior Office of the Solicitor, the Department of Justice, and the NPS Water Resources Division, Czarnowski developed agreements to protect the park from future litigation on water issues. Additionally, Czarnowski's broad understanding of park resources, negotiation skills, and ability to work with attorneys and technical staff from other agencies have helped to address aircraft overflight issues at the park.

Alan O'Neill

Winning the 1996 Director's Award for Superintendent of the Year for Natural Resource Stewardship was Alan O'Neill of Lake Mead National Recreation Area. O'Neill is a visionary who has built a professional resource management program at the Arizona-Nevada park. His commitment to resource protection is evident from his support of the park's burro management program, the razorback sucker recovery plan, and the federally listed desert tortoise habitat protection endeavor. O'Neill also excels as a leader. He helped bring together numerous partners during the initial phases of the California Desert Ecosystem Management Initiative, a complex interagency framework for managing over 25 million acres of public lands. As chairman of the Pacific-West Region resource management and science task force, he leads by example, providing support to parks engaged in strategic planning efforts. His leadership has enhanced the NPS role in cooperative ecosystem management and sets an excellent example for all land managers.

Ken Czarnowski

For the first time, the Director's awards included the Trish Patterson-SCA Award, which recognizes excellence in natural resource management in small parks, where staff are often especially limited.

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Patterson was a Southeast Region resource manager who died in a 1995 car accident; she was well known for her efforts to assist small parks in her region. Sponsored by the Student Conservation Association, the award provides extra assistance to the winning park by supplying a seasonal resource assistant to help complete important resource management projects.

The first Trish Patterson-SCA honoree is Zandy-Marie Hillis-Starr, Biological Technician at Buck Island Reef National Monument in the Caribbean. The sole resource manager at Buck Island Reef, Hillis-Starr has established an internationally renowned sea turtle monitoring program at the park and nearby Christiansted National Historic Site; she also has established coral reef monitoring at Buck Island Reef. Her preparation of the Buck Island Hawksbill Turtle Research Program Manual has served to standardize data collection methods for endangered turtles and reef monitoring. Information derived from the sea turtle program has been used to protect the hawksbill sea turtle under the Endangered Species Act. With a knack for getting things done, Hillis-Starr instituted a program with volunteers and visiting scientists to document the effects of Hurricane Hugo (1989) and monitor subsequent reef recovery. She also arranged cooperative agreements with government and private organizations to assist in reef and turtle projects.

Zandy-Marie Hillis-Starr

The Ray E. Appleman-Henry A. Judd Award, which recognizes achievement in cultural resource management, went to Jake Barrow, a Supervisory Exhibit Specialist with the Intermountain Cultural Research Center in Santa Fe, New Mexico. Barrow has been instrumental in several multiyear projects to conserve historic structures at Fort Union National Monument and Hot Springs National Park and other cultural resources in the Southwest. His efforts have advanced the conservation of cultural resources made of earth, stone, and wood. Whatever the need, Barrow marshals researchers, conservators, and funds to initiate projects and keep them going until completion. In almost every case, the lessons learned at one site are applicable elsewhere. PS

Jake Barrow

GULF COAST

Oil and gas collaboration a success

Padre Island National Seashore, Texas, completed a successful collaboration with the Railroad Commission of Texas in November 1996, culminating three years of effort to bring a leaking gas well under compliance with NPS nonfederal oil and gas rights regulations. The well operator's lack of diligence prompted growing concern about navigational safety and potential environmental degradation at the park. As a result, the park filed a complaint to the state about the well, which is located in the Laguna Madre, a shallow, hyper-saline water area of the park noted for its extensive seagrass beds, productive fishery, and migratory bird rookeries.

The Railroad Commission, the state agency that administers the statewide oil and gas production and permitting program, prompted the operator to comply with state oil and gas rules and pollution prevention laws. But when the operator failed to respond, the commission held an administrative hearing in June 1995 to determine appropriate penalties. Linda Dansby, the Intermountain Region Minerals/Oil and Gas Program Leader, assisted Paul Eubank, Environmental Protection Specialist at the park, to prepare the NPS statement for the hearing. Held before a legal and technical examiner, the hearing resolved the issue, and the Railroad Commission ordered the well plugged and fined the operator $3,000. Subsequently, the commission plugged the well and bore the cost of $120,000.

The remote location of the well, shallow waters of the lagoon, and seagrass beds contributed to the complexity of plugging this well. Mr. Tim McGilvary of the San Antonio office of the Railroad Commission coordinated the project. His professional expertise and close communication with the park resulted in identifying access and resource issues, and developing innovative methods, such as using air boats to bring the plugging rig to the well. The well was plugged in November 1996 without impacting ecologically important seagrass beds.

In May 1997, the Railroad Commission continued its work with the National Park Service by using the same oil and gas rules and fund for plugging wells to seal an abandoned oil well at Big Thicket National Preserve. The inactive oil well was the subject of a complaint filed by the park in 1995, and the commission notified the operator to plug the well. The park monitored the site and documented that the operator had failed to take action. Later, the Railroad Commission plugged the well, at a cost of $8,000, and also removed salvageable oil field equipment. The park's skill in applying NPS regulations along with state oil and gas rules, maximized their ability to develop a partnership with the Railroad Commission of Texas toward a common goal of protecting park resources.

ALASKA

Ecosystem partnership formed

Working closely with the Biological Resources Division of the U.S. Geological Survey (BRD), Wrangell-St. Elias Na-

tional Park and Preserve has helped form the Prince William Sound-Copper River Natural and Cultural Resources Cooperative, an ecosystem partnership. The cooperative includes the primary federal, state, and native resource managers for the ecoregion. The park has led the cooperative in the realm of geographic information systems by sponsoring training and providing spatial data sets to cooperative members.

Participation in the cooperative has strengthened the relationship between the park and the BRD. The cooperative has also helped depolarize formerly troublesome relationships between some of the partners. This improvement in relationships paves the way for cooperation to address the priority issues for Wrangell-St. Elias and the region–burgeoning tourism and a catastrophic spruce beetle infestation that has killed trees on more than 600,000 acres (an area the size of Rhode Island).

• • •

Whale photo catalog no fluke

Researchers Chris Gabriele of Glacier Bay National Park and Preserve and Jan Straley of the University of Alaska Southeast (Sitka) will be publishing in December a catalog of southeastern Alaska humpback whale "mug-shots." Individual humpback whales can be identified by the coloration, shape, and scarring of the ventral surface (belly side) of their tail flukes. Released in both hard copy and on a series of CD-ROM discs, the images show the tails of some 1,110 humpbacks identified in southeastern Alaska between 1986 and 1996. Each fluke identification photograph is indexed and corresponds to sighting data for that individual that is contained in a companion database. Together, the sighting data and photographs will help the researchers learn more about reproduction and recruitment of the humpback whale in southeastern Alaska.

GLACIER BAY NATIONAL PARK & PRESERVE; CHRIS GABRIELE

Whale #117—"White Eyes"

The partners secured funding last year for the project through the NPS Challenge Cost Share Program. In October 1996, the humpback whale researchers began gathering sighting data and organizing the photographic catalog. "We are very enthusiastic about the potential uses of the sighting history database," Gabriele said, "because it will allow us to document the movement of whales throughout southeastern Alaska. In particular, we will use it to compile the reproductive histories of southeastern Alaska female humpbacks and the return of their young to the study areas." Humpback whales have strong site fidelity to their feeding areas, with calves returning to the same places where their mothers took them to feed in their first year of life. Thirty-six calves have been identified in the Glacier Bay area, and park staff have documented the return of 16 of them, including one female who returned with her first calf at age eight. The eventual recruitment of individuals as breeding adults is a vital component of the future health of the population.

The researchers plan to update the photo catalog and sighting information database annually. The photo catalog will be distributed to local charter boat operators to help them recognize whales seen out on the water. The database and catalog will be circulated to colleagues to facilitate collaborative research on the behavior, migrations, and biology of the species throughout the North Pacific. A number of catalogs will be also be made available to the public. For more information, contact Gabriele at *chris_gabriele@nps.gov*.

SOUTHWEST

El Malpais reclaims sandstone quarry

Students from New Mexico Highlands University kicked off a large-scale project last April to reclaim an abandoned sandstone mine at El Malpais National Monument when they salvaged 150 plants for later use in revegetating the disturbed site. The 5-acre quarry, which is located in the southeast portion of the park, was a safety hazard and blemish in the scenic landscape. The park spent nearly a year planning the project, which involves the help of the NPS Geologic Resources Division and Southwest Support Office, U.S. Army Reserve, the university, and other partners.

In July, Army Reserve engineering units from Santa Fe and Albuquerque began moving earth to reduce the 30-foot high walls of the quarry and recontour the pit to blend in with the surrounding area. The same crews also constructed a wayside exhibit and viewing area for McCarty's Crater and the distant chain of craters, important volcanic features of the park. Additional park improvements were undertaken at the same time and include construction of a road to an existing trailhead (Lava Falls), removal of an eroding road, and removal of water impoundments.

The project has been very cost-effective for the National Park Service, and all partners have benefitted from the experience. The NPS Geologic Resources Division funded on-site technical support for the earthmoving phase of the project and paid for diesel fuel for the heavy equipment. The Army Reserve donated staff time and equipment in exchange for a practical field training exercise. The students, who collected plants from the site for later use in the revegetation phase, receive credit to meet undergraduate degree requirements in biology and environmental science and management. Some of the materials used in preserving the native plants were donated by a local company, Santa Fe Greenhouses. Revegetation will be completed this fall and topsoil will be added to the quarry next spring. PS

GEOLOGIC RESOURCES DIVISION, DAVE STEENSEN

An Army Reserve bulldozer recontours the sandstone quarry at El Malpais National Monument

Electronic journal launched

The Ecological Society of America recently launched *Conservation Ecology*, an electronic, peer-reviewed, scientific journal that is available on the World Wide Web at http://www.consecol.org/Journal. Editor-in-Chief C.S. Holling writes in his inaugural editorial that the publication does not focus on traditional ecological research, but interdisciplinary communication and insight. This "is a new journal covering a new application of science, using a new medium. It requires novelty and experiment."

Papers are organized around the themes of synthesis, research, insight, and perspective. They deal with the topics of (1) the conservation of ecosystems, landscapes, species, populations, and genetic diversity; (2) the restoration of ecosystems; and (3) the management of resources. Articles are posted continuously and new issues of the publication are declared semiannually or as adequate materials accumulate.

One especially interesting feature of the first issue of the electronic journal is the discussion of the role of ecology in shaping management policy. One paper explores the problems managers have today with traditional descriptive ecology, which does little to address system dynamics at meaningful scales, while seven additional commentaries enrich and challenge that view. A sampling of other articles includes the resilience and restoration of lakes; the relation between threatened species, their protection, and taboos; and using ants as bioindicators. An electronic public forum is also available to facilitate discussion among readers.

Conservation Ecology already boasts 5,000 subscribers and is a great forum for the exchange of ideas on the application of ecology in resource management. Access to the Internet publication and e-mail subscriptions are free of charge. To subscribe send an e-mail message to *subscribe@consecol.org* containing only "subscribe conservation-ecology" in the body of the text. Prospective authors will also find article submission instructions by visiting the web site.

Paleontology publication planned

Researchers in the paleontology of national parks now have an opportunity to publish their most recent work in the upcoming third volume of National Park Service Paleontological Research. With earlier versions appearing in 1993 and 1995, this nonpeer-reviewed publication features brief accounts (5-6 page mini papers) of recent original paleontological research occurring within units of the national park system. Vincent Santucci, Resource Management Specialist and paleontologist at Fossil Butte National Monument, Wyoming, will serve as editor and is now soliciting titles for the volume. Interested contributors should submit their titles to Santucci by December 15 at (307) 877-4455; *vincent_santucci@nps.gov*. According to Santucci, "A collective work such as this illustrates the diverse and often cutting-edge research going on in parks. It demonstrates our appreciation of the efforts of paleontology researchers and will help foster future work." The publication is sponsored by the NPS Geologic Resources Division.

New angle on kudzu control

A September 7 article by Rick Bragg in the *New York Times* described a new biological control effort to fight the "legendary weed" kudzu. Originally from Asia, kudzu has evaded ecologically safe and effective control in the Southeastern United States for more than 50 years and is a problem in numerous units of the national park system. In research funded by the U.S. Forest Service and the Department of Energy, North Carolina University researchers are introducing a caterpillar, the soybean looper, into kudzu fields. The insect eats the kudzu and subsequently dies from wasp larvae previously injected into them. The Forest Service may test the strategy in remote areas of national forests where heavy equipment or herbicides are a threat to other organisms.

Old problem, new solution?

Park visitors will always feed wildlife to some extent, and rangers will always grapple with finding the best deterrent. However, a photo processor in Banff National Park in Alberta, Canada, has discovered a novel approach to addressing the age-old problem. The September issue of *National Geographic* reports that an "exasperated photo shop manager" began including warnings on his clients' photos when the images depicted the unsafe and illegal behavior of a person feeding park wildlife. Parks Canada followed suit by printing 40,000 cards that several photo processors now distribute on their behalf whenever these kinds of pictures are processed. The cards depict the international symbol– ⃠ –printed over pictures of people feeding several kinds of animals; they are printed in four languages and carry the message, "A Fed Animal is a Dead Animal." The park reports a positive response and plans also to place the cards in hotel literature.

I&M Program releases first annual report

The first comprehensive annual report of the Inventory and Monitoring Program is available on the Internet at *http://www.aqd.nps.gov/pubs/i&mann96/cover.htm*. Hard copies are also now available. The five major parts of the report describe the parks where prototype monitoring is being developed; provide summaries of inventories of soil mapping, vegetation mapping, geologic mapping, base cartographic data, bibliographic databases, and water quality; give accounts of various resources in the parks, including glaciers, aquatic and terrestrial communities, forest insects and diseases, listed species, fishes, birds, mammals, and others; and briefly describe data management in the program and the I&M Training Program. The report gives readers good insight into the many threats to natural resources in the national park system.

Logging and the abundance of Northwest fishes

Logging of a riparian forest usually reduces the rate of deposit of large woody debris into a stream. Debris depletion of this kind continues during times of little or no deposits, which can cause a net decline for several decades and a sustained low amount of debris for 50-100 years after logging. In their 1997 paper, "Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams" (*Transactions of the American Fisheries Society* 126:217-229), authors T.J. Beeche and T.H. Sibley describe many of the ecological effects associated with the loss of this debris for certain species of fish in the Northwest.

Large woody debris forms pools in streams, and pools retain sediment and particulate organic matter. Woody debris therefore can influence the distribution and abundance of juvenile salmonids in streams because such pools are preferred habitat of, for example, juvenile coho salmon *(Oncorhynchus kisutch),* cutthroat trout *(O. clarki),* and steelhead *(O. mykiss).*

In accordance with their findings, the authors predict declines in number and area of pools in channels of low and moderate slopes but greater declines in moderate-slope channels than in low-slope channels. The decline in pools may favor species that are better suited to rearing in riffle environments, such as steelhead, and may lower the abundance of species or age classes with strong preferences for pools. Changes would be greater in moderate-slope channels. The authors provide suggestions for management of riparian forests to offset the effects of reduced large woody debris from logging.

USGS water resources software on the Web

A suite of 51 software packages and related materials, used by the U.S. Geological Survey for hydrologic analysis and modeling, is now available for electronic retrieval through an online repository on the World Wide Web. The repository is accessible at *http://water.usgs.gov/software/* and can also be retrieved via anonymous FTP from the USGS water resources information fileserver: *water.usgs.gov or 130.11.50.175* (path: pub/software). The software is grouped into the categories of geochemical, groundwater, surface water, water quality, and general. Each package consists of compiled or source code, test data sets, and documentation files. All of the USGS water resources, hydrologic analysis, and modeling software applications available publicly at these locations are documented by published USGS reports.

The software packages have been prepared primarily for the Data General AViiON DG/UX platform and for compilation on other UNIX-based computers. The USGS continues to prepare software packages for its own use on UNIX-based and other computer platforms such as DOS-based personal computers. As these packages are available, they will be added to the repository.

Integrated pest management and the white-tailed deer

Densities of white-tailed deer have increased to probably the highest recorded levels in the eastern United States. The distribution of the species across its former range may also have changed drastically. These changes are probably attributable to fragmentation of habitat, creation of urban greenbelts, spatial changes in agricultural landscapes, changes in availability and types of agricultural crops, restrictions of hunting season and bag limits, elimination or reduction of lands for hunting, and predator control. In their 1997 paper, "A planning process for managing white-tailed deer in protected areas: integrated pest management" (*Wildlife Society Bulletin* 25(2):433-439), NPS biologists Michael A. Coffey and Gary .H. Johnston discuss how the integrity of protected areas (such as parks) may be impaired by the density of a deer population, and that hands-on management may be necessary. The authors promote integrated pest management that is based on (1) clear, precise goals and objectives, (2) problem identification, (3) and the development and implementation of scientifically valid monitoring. The authors provide alternative management, a decision key that assists managers with the completion of specific and necessary actions, and an alternative key that provides alternatives ranging from those with the least ecological, economic, sociological, and political effects to those that are most difficult to implement.

Grouse papers published

University of Maine CPSU Leader Allan O'Connell wrote about the effects of fragmented landscapes on the management of Spruce Grouse in Acadia National Park in *Park Science* 15(3):10-11. He is now coauthor of two manuscripts about the ecology of a small population of Spruce Grouse with respect to habitat fragmentation in the Northeast. The citations are:

Whitcomb, S.D., A.F. O'Connell, Jr., and F.A. Servello. 1996. Productivity of the Spruce Grouse at the southeastern limit of its range. Journal of Field Ornithology 67(3):422-427.

Spruce Grouse

Whitcomb, S.D., F.A. Servello, A.F. O'Connell, Jr. 1996. Patch occupancy and dispersal of Spruce Grouse on the edge of its range in Maine. Canadian Journal of Zoology 74:1951-1955.

PS

Preserving Nature continued from cover

building facilities, including fish hatcheries, and planting alien fish in parks as their first order of business for the new agency. They also believed they should "enhance" the parks by suppressing fires, eradicating predators, and controlling forest pests and diseases, which they did vigorously.

Scientists, managers clash

At its inception, national park management was a new human endeavor. No one before had tried to preserve intact large tracts of wild land and seascapes for public enjoyment and to pass them on to future generations. Unlike forest and fisheries management that had centuries of precedent and practice, what park managers needed to do had no precedent. They were truly exploring the unknown and relied on extant professions for guidance. Foresters, landscape architects, and engineers who used land to produce commodities and who molded landscapes to fit human perceptions of idyllic and pastoral settings came the closest to fitting the new paradigm so they got the job: directed by businessmen and lawyers. However, national park management is more than a simple combination of these early professions, it also requires applied sciences, particularly ecology. Adding ecologists to this mix, was like combining oil and water. We are still looking for an emulsification agent.

Sellars makes it clear that the tension between scientists and nonscientists regarding national park management was the same in the 1930s as it is today. In part, the differences arise from nonscientists relying on untestable, belief-based consensus versus scientists adhering to a testable knowledge-based system of learning from experience. If one believes that fire destroys forests, or that wolves threaten elk populations, there is no reason to waste time and money testing the concepts. One simply acts on his beliefs and suppresses fire and kills wolves. Testing such beliefs threatens the belief and the believers, and thus creates a perception that science would make park management more costly, difficult, and time consuming. This may be at the root of the issue that creates the tension between so-called traditional and ecological approaches to park stewardship.

Science as a way of knowing should make attaining the National Park Service mission more certain and cost effective. The true costs of ecological restoration and of losing America's heritage to unfounded beliefs are vastly greater than the costs associated with learning first how ecosystems work and doing the job right the first time. We paid dearly for early misguided forest fire suppression. First we paid the unnecessary costs of suppression. Now we are paying the costs of restoring fire, with the risk of losing the very assets we sought to protect if we delay any longer. We paid to eradicate wolves and other predators, then paid to reduce elk and deer, lost soil and vegetation, and now we must pay to restore wolf populations. This kind of cost dwarfs the minimal costs of using science to learn what is in parks, how to restore impaired assets, how to maintain restored parks, and how to protect parks from pollution, unsustainable uses, fragmentation, and alien species. In short, using science to learn from our experience reduces uncertainty and costs.

In the last century, the parks could afford the boosterism, "enhancements," and facilities of Mather and Albright and still recover, because parks were not the islands in a fragmented and diminished landscape that they are today. Few refugia exist today, outside legislated wilderness, from which to find replacement genomes and species to repair the damage wrought by misguided policies. We are already beginning to lose our heritage in the marine environment where we have no wilderness, no refugia, and denial of human impact is rampant even in the national park system. Time is short. Options to conserve and pass on unimpaired parks to future generations become more limited every year.

The true costs of ecological restoration ... are vastly greater than the costs associated with learning first how ecosystems work and doing the job right the first time

Will history repeat itself?

Change is inevitable. Will we use science to learn from experience, or continue to blindly accept and act on unsubstantiated beliefs? The National Park Service will not accept a change from its primary goal of recreational tourism to science-guided resources protection until its leaders personally experience success with science. As a result, people such as Richard Sellars run great risk of being attacked by opponents vested in the old system and only moderately supported by skeptics of the new, science-based system. Since the national park concept is new and unique, few have the necessary personal experience, yet. Perhaps the introspection in this book will lead to trying new ways to conserve parks.

Preserving Nature

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Contact: Jim Stritch (203) 432-0939

In interpretive jargon, scenery is the hook. Once enticed into in the parks by the scenery, the public can personally experience the wonders they contain, beyond the view. Mather and Albright believed they had to entice the public to visit parks and to support the park concept. The National Park Service did that during the 20th century. The public has found and loves their park system and the National Park Service. Now the hard work begins--learning what is in the parks and how they work, restoring impaired assets, maintaining impaired processes, and protecting parks as islands of wilderness in a landscape dominated by human activities.

Until we learn our history, how we came to where we are, and where we thought we were going, we risk endlessly repeating the same mistakes. This account illuminates our path. Read it. You will like it. You may not agree with everything in it, but you will learn from it. We and our national parks will all be the better for it. PS

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The Desert Tortoise in the Mojave Desert Parks

A preliminary research update

By Michael Boyles and Jerry Freilich

Few reptiles of the desert southwest garner as much attention as the desert tortoise *(Gopherus agassizzii*). Unfortunately, one reason for this attention is the dramatic decline of tortoise populations throughout a large portion of the species' range (U.S. Fish and Wildlife Service 1994). Reductions of up to 20% per year have been reported (U.S. Fish and Wildlife Service 1994), causing alarm within the biological community. Reasons for the decline are not completely understood, but urban development, off-road vehicle use, livestock grazing, poaching, increased predation by common ravens *(Corvus corax),* and a recently discovered upper respiratory disease are likely contributing factors (U.S. Fish and Wildlife Service 1994). In 1990, the U.S. Fish and Wildlife Service listed as threatened the entire Mojave Desert population (fig. 1), defined as all individuals north and west of the Colorado River. The Sonoran population, south and east of the river, remains a candidate for listing as a threatened species.

Figure 1. The threatened Mojave population of the desert tortoise occurs north and west of the Colorado River, while the Sonoran population lies south and east. Interestingly, the boundary between the two populations bisects Lake Mead National Recreation Area.

Research by parks

Within national parks, the desert tortoise is protected from many of the human influences that may be causing its decline. Parks serve as a control framework with which to evaluate declines elsewhere in the species' range. For example, if the tortoise is declining due to direct human factors, these declines are less likely to be seen in parks. If declines are observed in parks, the causes may be attributable to influences not limited by park boundaries, such as atmospheric or global effects. Tortoise research in parks may help elucidate other, as yet unknown, factors that contribute to the decline of tortoise populations.

The role of the National Park Service in managing the desert tortoise regionally expanded in 1994 with the initiation of a three-year research project funded by the Natural Resources Protection Program (NRPP). One of the main objectives was to implement several of the recommendations in the 1994 Desert Tortoise Recovery Plan to protect the tortoise and its habitat and ensure future viable populations throughout the southwestern deserts. These recommendations include surveys to determine the location and density of tortoises; establishing long-term monitoring plots; improvement, restoration, and protection of habitat; and strengthening public awareness and environmental education.

Five parks are participating in the research: Lake Mead National Recreation Area, Nevada and Arizona; Joshua Tree and Death Valley National Parks, California; and Organ Pipe Cactus National Monument and Saguaro National Park, Arizona. Staff from each of these parks assisted in the design and establishment of the study. However, because the extent of information and research on the tortoise varied considerably among the parks at the onset of the study, each park developed its own study design.

Life history of the desert tortoise

Research and monitoring of the desert tortoise is difficult because of the species' unusual life history. The reptile is adapted to living in a harsh and variable environment. It retreats into burrows and reduces its metabolism during periods of adverse environmental conditions. Thus, it spends much of its life underground, hibernating during the winter and escaping from the hot temperatures of summer (Woodbury and Hardy 1948). Its active period is largely confined to the mild spring and fall, and even at these times, it may reduce its activity if the season is unusually extreme as during the recent drought in the Mojave Desert. Thus, biologists must concentrate their efforts into a few months for any research that requires seeing the animals above ground.

The longevity and reproductive strategy of the tortoise also complicate monitoring. With a potential life span of many decades, the desert tortoise can compensate for variable reproductive success by breeding many times throughout its life,

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and one year of reproductive success may offset several years of failure. In order to get a realistic idea of population trends, biologists must not only make an accurate determination of population size (a difficult task in itself), but also follow population recruitment for many years (Doak et al. 1994). One year of successful reproduction is no more indicative of population recovery than several years of reproductive failure is of extinction.

Transects and plots established at Lake Mead

At Lake Mead National Recreation Area, we have established 14 1-km^2 (247-acre) study plots over three years to begin population monitoring. In addition to the plots, we have also established over 400 1.5-mile triangular transects in which biologists identify tortoise habitat and map tortoise distribution (fig. 2). Transects and plots are separate techniques that provide us with different types of information. Transects involve a single visit to a site in which biologists look for live tortoises, burrows, scat, and shell remains. The findings give us a preliminary idea of relative tortoise population density, and by spreading the transects across the park's 1.3 million terrestrial acres, a once patchy notion of tortoise distribution has become more complete. Plots, on the other hand, provide a way to monitor a localized group of tortoises for a long period of time. By making repeated visits to a plot and conducting intensive searches for tortoises and other sign, we can collect valuable ecological and life history data on the animals. Over the long term, this information may allow us to determine population trends, if only at a very localized scale.

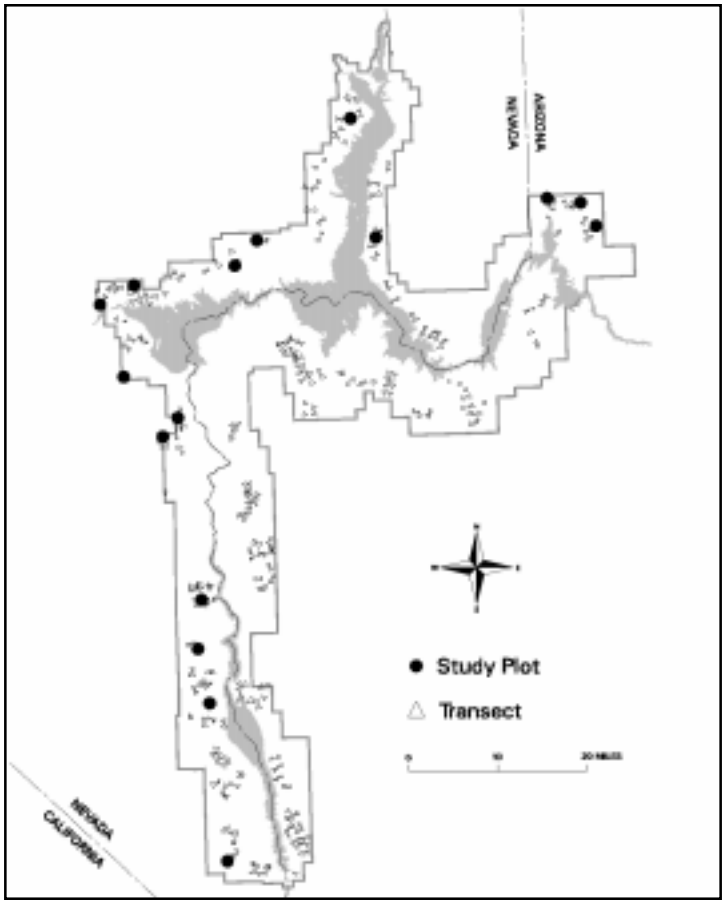

Figure 2. Biologists have established 16 permanent study plots and over 400 1.5-mile triangular transects in Lake Mead National Recreation Area to learn about tortoise distribution.

Our transect work was highly successful in helping us determine which areas of the park contain desert tortoises. The 400 transects surveyed translate into roughly 960 km (600 mi) of surveyed ground. While most of Lake Mead's terrestrial acreage could be considered potential tortoise habitat, distribution of the animals is quite patchy. A few "hot spots" of high tortoise density have been found, as have several medium-density areas. Still other areas of the park show little or no evidence of tortoise occupation, even in what appears to be suitable habitat.

From our work on plots, we have established a baseline data set that we can follow for years. All tortoises found on the plots have been permanently marked. Thus, future sightings of these individuals will provide data on survival and movement patterns. Even as the NRPP project draws to a close, we have plans to extend our work and continue adding to our rapidly growing database.

Limitations arise

Where the transect monitoring method has provided new information about tortoise distribution, plot monitoring has posed at least as many questions as answers. One problem is the relatively short amount of time spent monitoring each plot. Our method consists of inventorying the plots within a series of parallel, 10-m (33 ft) wide transects (fig. 3). Because of such a short window of tortoise activity in the spring, we must concentrate our work into a 10-week period. During this time, biologists make two four-day passes over each plot for a total of eight days of sampling per plot. Do these days adequately represent the spring activity season? If not, the number of tortoises observed may differ greatly between the two passes, which makes population estimates based on this particular mark-recapture technique extremely difficult.

All plot-based methods suffer from the problem of limited inference. While intensive effort on a plot may lead to robust density estimates and can possibly identify certain population trends, the results of such efforts are site-specific and do not necessarily indicate what is happening regionally. As with any threatened species, the critical need is for information on the temporal and spatial trends of population abundance over the entire range of the species' habitat. Plot monitoring is time consuming, requires repeated visits, and is not likely to provide this information.

Monitoring methods pioneered at Joshua Tree

At Joshua Tree National Park, we also dealt with some of these issues and found that years of data proved invaluable in helping determine the preferable method of studying tortoises. Beginning in 1991, before the NRPP study, we spent four years monitoring tortoises in a known hot spot (the Barrow site) and 12 other plots.

Figure 3. Biologists use GPS (global positioning systems) units to record tortoise locations within the study plots.

For the first few years, we found many new tortoises during each survey, suggesting that tortoises are easily missed by biologists. Initially, we were not sure if this was due to tortoises hiding underground or moving in and out of the study area. However, after six years, two of which coincided with the NRPP study, we learned that tortoises exhibit extreme site fidelity, with 72% of tortoises not seen for one year or more ultimately being recaptured within 300 m of their original capture point, and 22% within 100 m of that point. The ease with which tortoises can escape observation is an important reason why we sought new methods.

At Joshua Tree we pioneered the use of distance sampling for tortoise surveys. In distance sampling, straight-line transects of precisely calculated length are surveyed by teams of observers. We measure the perpendicular distance to the transect line of any tortoises found. This method, championed by Dr. Ken Burnham and Dr. David Anderson of Colorado State University, has been successfully used on dozens of other animals including whales at sea, but only recently for tortoises. The method gives an accurate population estimate even if 70-80% of the animals present are missed.

During the present NRPP study, we abandoned all the plots except the Barrow site, using instead, these 4-km long distance sampling transects in the shape of a square to survey nearly the entire eastern half of the park. Most NRPP funds were expended on a work leader and a team of five Student Conservation Association (SCA) resource assistants each spring. The SCAs, in turn, supervised teams of two to eight volunteers recruited through newspaper and radio ads. These teams, usually two teams of 10 people each, walked the transects. In 1995, approximately 90 transects were surveyed and nearly as many in 1996. The only problem was that 1995 was a "good" year with plenty of rain, whereas 1996 was a drought year with less than 100 mm (3.9 in) of rain recorded at Twentynine Palms.

By using both plots and transects as corroborative methods, we gained many insights into tortoise surveying and monitoring. One of the most important findings was the significance of variability in rainfall and its effect on our ability to find tortoises. During years of high rainfall (and subsequent high forage production), tortoises will spend much of the spring above ground. During droughts, tortoises may remain underground to conserve water and energy. This can have a profound influence on the number of tortoises seen during the season. In 1995, a relatively wet year, our team walked 300 km (186 mi) of transects and found 203 tortoises. In 1996, an extremely dry year, we surveyed a similar number of transects and found only 30 tortoises with the same expenditure of effort. This discrepancy was also evident on the plots, and demonstrates the need to consider environmental parameters when conducting tortoise surveys, regardless of the survey method used.

Our findings indicate that a single year of surveys may yield questionable results, especially if weather conditions have been unfavorable for tortoises. Indeed, research suggests that surveys performed in drought years may not be valid. This problem could be overcome by developing a set of decision rules that would determine whether surveys should be conducted in any given year. For example, a certain minimum amount of rainfall or annual biomass production would need to be reached before a season is deemed acceptable for tortoise inventory and monitoring.

During the spring of 1997, Joshua Tree continued distance sampling, but also made a large effort to equip tortoises with radio transmitters in order to improve the sampling technique. Since tortoises often remain underground, depending on a variety of factors such as time of day, time of year, and temperature, many tortoises will not be observed during surveys. Radio-telemetry data can be used to estimate the proportion of tortoises underground at any given time; this information can then be used to adjust and improve future density estimates derived from distance sampling. This is the combination of methods presently recommended by the U.S. Fish and Wildlife Service for tortoise surveys.

Death Valley

Very little was known about the desert tortoise in Death Valley National Park, California, before the NRPP project. However, since 1994, 248 transects have been surveyed to determine the presence of the tortoise and to gather general density data. Tortoise sign was found along 60 transects, and sign counts indicate that population levels may be in the range of 20 to 50 animals per square mile in the Greenwater Valley area of the park. Elsewhere in the park, densities are much lower, and for the park as a whole, tortoise densities appear to be low when compared to other areas of the Mojave Desert.

The future

The work being conducted by the five parks is already contributing to the knowledge of the desert tortoise regionally. The methods pioneered at Joshua Tree, in conjunction with radio-transmitter studies, have been adopted by the U.S. Fish and Wildlife Service for tortoise sampling. At Lake Mead, we are continuing to expand our knowledge of the distribution of tortoises and their habitat using transect methods. Death Valley, Organ Pipe Cactus, and Saguaro will continue with survey and monitoring to develop a regional

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Springs and Seeps of Colonial National Historical Park

Groundwater study will help analyze off-site impacts to park ecosystem

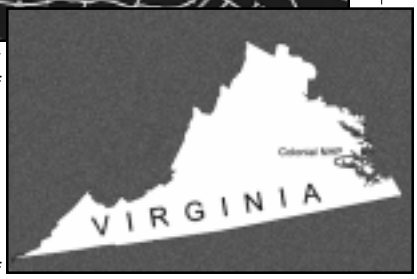

Figure 1 (right). The study focused on the Yorktown Unit of Colonial National Historical Park, located in southeastern Virginia. Figure 2 (above). In the reconnaissance map, springs are identified by triangles. Water from at least one spring shows the possibility of influences from deicing salts in runoff from a nearby road.

By Michael Focazio

The Yorktown unit of Colonial National Historical Park is located on the Atlantic coastal plain near the mouth of the York River in southeastern Virginia (fig. 1). In 1994, the park published a water resources management plan[1] that includes background information on the geology and water resources of the park. The plan states that contaminated or altered flow of groundwater could adversely affect the water resources and ecosystems of the park. For example, the Virginia Division of Natural Heritage has identified viable populations of northern spring isopods (tiny crustaceans listed as species of special concern in Virginia) that live in park springs[2]. The plan also indicates that little is known about the groundwater resources of the park and surrounding areas at the level of detail desirable for sound management activities. In 1995, the U.S. Geological Survey (USGS) submitted a proposal to the National Park Service entitled "Investigation of Shallow Ground-Water System at Colonial National Historical Park" outlining the work that would be necessary to achieve the desired level of understanding of the groundwater system. Currently underway is a study that was designed to address one aspect of that original USGS proposal while maintaining a phased approach to the overall investigation.

[1]The report was prepared by Colonial National Historical Park, the NPS Water Resources Division, and the Center for Coastal Management and Policy, a contractor to the National Park Service under cooperative agreement # CA4000-1-0018.

[2]Springs and seeps are both manifestations of groundwater discharge but are defined differently. Seeps can be entire hillsides or other large plots of land where groundwater discharges to the land surface. Springs, on the other hand, are confined to limited areas, often found where small void spaces in the aquifer coincide with land surface.

Study design important

This phase of the study was designed to provide some preliminary information that would be helpful in devising and implementing the overall investigation. Locations of springs in the Yorktown unit of the park and general indicators of water chemistry from the springs were deemed important initial information for the type of hydrogeologic environment found in the park. This preliminary information would be useful in future studies that assess relations of the water resources in the park to the nearby land uses that include residential areas, highways, forests, underground storage tanks, and National-Priorities List\Superfund sites. The information is also useful when assessing relations of water quality with occurrences and distributions of flora and fauna found in the park. Additionally, the knowledge gained from this study can be used for investigations of the surroundings and nearby natural resources such as the Grafton Pond Sinkhole complex. Forty sinkholes of the larger complex are found on park lands and contain hydrogeologic features and associated ecological systems that are unique to this part of Virginia.

Investigation begins

Investigators located 31 springs within the boundaries of Colonial National Historical Park during a field reconnaissance survey in May and August 1996. Outside the park boundary, we also located five additional springs that feed streams flowing to the park (fig. 2). The location of each spring was recorded with a Global Positioning System, and water from each spring was analyzed in May 1996 for pH (a measure of the acidity of the water), specific conductance (a measure of the amount of dissolved substances in the water, or salinity of the water), water temperature, and the amount of oxygen dissolved in the water.

The study focused on the Yorktown unit of the park, and not all streams that originate outside the park were searched for springs and seeps. We found the springs in various landscapes and elevations (fig. 3). Field observations indicate that water from most springs flows through a shallow aquifer system that is predominately comprised of fossil shell material (fig. 4). This shallow aquifer system is extensive and found throughout the park and surrounding land. Springs like these are not typically found in the coastal areas of Virginia and therefore provide unique ecological environments. The original source (recharge area) of the water issuing from these springs cannot be determined by these preliminary results. It is likely that the springs are recharged within the park boundaries and outlying areas. The water from at least one spring indicates that some springs are associated with a more local flow system that does not flow through the shelly aquifer and therefore have recharge areas that are restricted to within park boundaries. Water from another spring shows the possibility of influences from deicing salts in

Figure 3 (left). George Washington Spring, where the general's encampment got its water, is one of many springs surveyed during the study.

Figure 4 (above). Water from most springs flows through a shallow aquifer system that is predominantly composed of fossil shell material.

Figure 5 (below). Different than springs, seeps can be entire hillsides or other large plots of land where groundwater discharges to the land surface. Springs are confined to limited areas, often where small void spaces in the aquifer coincide with land surface.

runoff from a nearby road. Additionally, water from all springs, where measurements were possible, was well oxygenated and had near neutral pH values.

We also found diffuse seeps of groundwater throughout the park (fig. 5). The seeps are located at, or near, headwaters of streams, along valley bottoms, and alongside streams. The locations of the seeps coincide with wetland maps that were previously generated for the park and are stored in the park's geographic information system.

Several springs that were flowing in May were dry in August. More work needs to be done to quantify why these springs dry up while others remain flowing; but it is likely related to topographic position and the aquifer material. The water from the springs was generally warmer, and had slightly lower dissolved oxygen in August than in May, indicating that the water is influenced by seasonal climatic changes. The pH and specific conductance were relatively unchanged between the May and August observations, suggesting that the overall chemistry of most springs did not change over the time period.

Water from eight selected springs was analyzed for chlorofluorocarbon compounds in order to determine modeled recharge dates. The dates from the five springs range from recent (within the past two years) recharge events to recharge that occurred in 1980.

Management of the biodiversity and ecological integrity of the park depends, in large part, on the quantity and quality of surface and groundwater flowing in, and through the park. This reconnaissance study indicates that groundwater that feeds streams within the park can be influenced by off-park and within-park activities. In order to effectively plan for the management of these resources, a more complete understanding of the shallow aquifer system within, and around, the park is needed. This would provide a framework from which relationships of the various local hydrologic environments to the presence and viability of specific targeted organisms (e.g., northern isopods) could be developed in context with potential influencing factors. PS

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database. Continued research is of paramount importance for the future, and a reliable data set is needed to guide future research objectives. This will help us improve our ability to monitor populations of the desert tortoise and play a more effective role in securing its future. PS

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REDWOOD NATIONAL AND STATE PARKS, HOWARD F. SAKAI

Figure 1. Wilson's Warbler is one of the common neotropical migrant bird species caught in mist-nets during the breeding season from 1993 through 1997 in an alder-dominated riparian habitat in Redwood National and State Parks

REDWOOD NATIONAL AND STATE PARKS' NEOTROPICAL MIGRATORY SONGBIRD PROGRAM:

Monitoring for Avian Productivity and Survivorship (MAPS)

BY HOWARD F. SAKAI

REDWOOD NATIONAL AND State Parks, a world heritage site and biosphere reserve, are recognized for their magnificent groves of relict old-growth coastal redwoods *(Sequoia sempervirens)*. Concomitant with old-growth redwoods, the California parks' 42,719 hectares (approx. 106,000 acres) contain a mosaic of habitat types including coastal dunes/scrub/mixed-conifer forest, second-growth redwood/mixed conifers, riparian red alder-dominated *(Alnus rubra)* corridors, Douglas fir/mixed conifer/hardwood, coastal grasslands, and oak-woodlands. A diverse bird species richness of 404 species, as noted in the parks' bird checklist, illustrates the influence of this diverse mix of habitats. Neotropical migrants, defined as species for which the majority of the population winters south of the U.S.-Mexico border, make up about 27% of the total species occurring within the parks. Only recently has the demise of migratory songbirds on their breeding and wintering grounds been given national and international recognition. This threat has been acknowledged through ongoing research and monitoring efforts by public, private, and philanthropic agencies involving international cooperation. For this article, I will describe an ongoing monitoring program Redwood is conducting on neotropical migratory songbirds, discuss some of the study results, and briefly provide an assessment of the program.

MAPS

Our constant-effort mist netting study (Monitoring for Avian Productivity and Survivorship or MAPS), initiated in the summer of 1993, provides baseline information and is one of several ongoing park bird projects contributing to the understanding of neotropical migratory songbirds on their breeding grounds. Our MAPS program provides critical long-term data to a broader regional study conducted by Dr. David DeSante of the Institute for Bird Populations at Point Reyes Station, California. Dr. DeSante's study is attempting to compare the productivity and survival of migratory songbird species throughout their breeding range.

The park MAPS study area is located within a 6-ha (14.8-acre) riparian corridor dominated by mature red alder. Our constant-effort mist-netting station followed Dr. DeSante's MAPS protocol for maintaining standardization amongst all participating MAPS cooperators. Ten mist-nets spaced 150-200 m apart within the study area were operated for six hours per day, starting within 15 minutes of sunrise, every 10 days between mid-May and mid-August. All captured birds, except hummingbirds, game birds, and raptors, were marked with a U.S. Fish and Wildlife Service sequentially numbered aluminum leg band. All newly captured birds were processed for a variety of morphological and physiological measurements. Recaptured birds were also processed again and identified by their band numbers.

COSTS AND OTHER CONSIDERATIONS

The cost of operating a MAPS station is dependent upon initial equipment investment (in 1993 about $750, which included 24 electrical conduit poles and rib bars, 15 mist-nets, and 100 feet of 1/8" nylon rope); replacement mist-nets every second or third year (five nets at current price of $250); personnel costs, which vary with type of personnel (volunteer or paid staff) and grade level for 80 hours per sala-

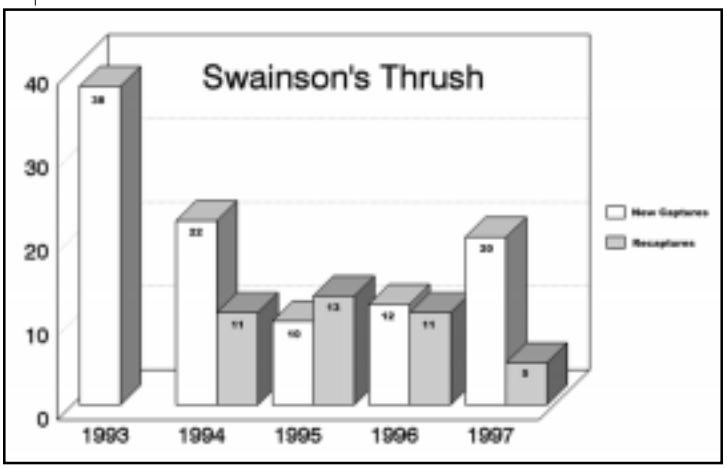

Figure 2. Captures and recaptures of Swainson's Thrush, 1993-'97

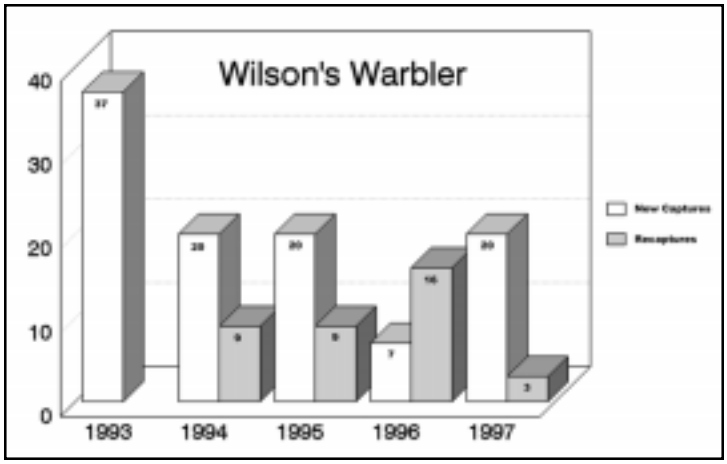

Figure 3. Captures and recaptures of Wilson's Warbler, 1993-'97

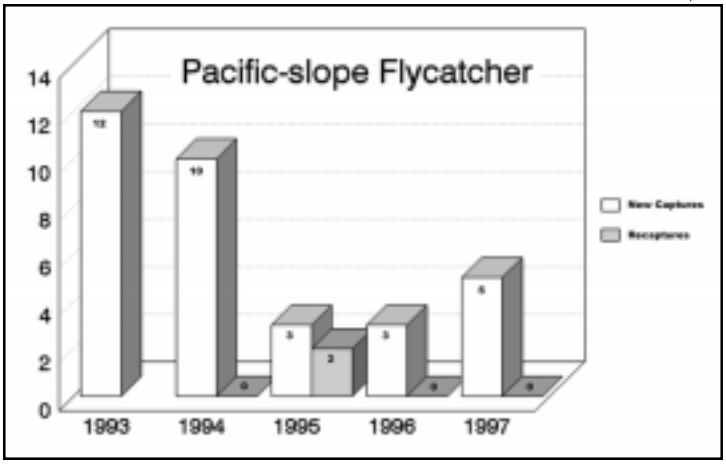

Figure 4. Captures and recaptures of Pacific-slope Flycatcher, 1993-'97

ried individual per breeding season; and number of personnel needed to operate a MAPS station (dependent upon participant level of expertise). Safety of netted birds should always be the primary concern for any program manager operating a mist-netting station. Accordingly, two trained bird banders are highly recommended in operating a MAPS station; however, an experienced bird bander with several years of experience could independently operate a station while still maintaining bird safety. At our parks, an experienced bird bander with a *master* bird banding permit supervised either one or two inexperienced staff members the first three field seasons for the purpose of providing training. For the 1996 field season, the experienced bird bander ran the MAPS station alone for an extended period, which contributed to lower program cost. However, a program manager should never use less staff to simply lower operation cost without *always* first considering the safety of netted birds.

Results and discussion

Results of our four-year mist-netting effort during the breeding season provided baseline information for 15 migrant and resident species. The most commonly caught migrants were Swainson's Thrush *(Catharus ustulatus)*, Wilson's Warbler *(Wilsonia pusilla* [fig. 1]), and Pacific-slope Flycatcher *(Empidonax difficilis)*. Winter Wren *(Troglodytes troglodytes)* and Varied Thrush *(Ixoreus naevius)* were the most common resident species. The constant-effort mist-netting technique provides a means for monitoring species movement within the study area, especially for lower to mid-canopy species, and verifies for the uncommon species their presence or rarity. For example, an unexpected mist-net capture in July 1996 of an Ovenbird *(Seiurus aurocapillus)*, a species common to the east coast and ranging as far west as Colorado, documents its presence within the parks despite being outside of its normal range. A similar unexpected capture of a Brown-headed Cowbird *(Molothrus ater)* in our forested riparian study area documents its rare presence, as this species is normally not common in interior forested habitat. However, the Brown-headed Cowbird does occur locally in agricultural fields about 1½ miles from our study area. This capture could be a precursor to the cowbird's potential threat to this interior riparian habitat.

Recovery of marked individuals from previous banding efforts documented site fidelity for the common migrant and resident species. Yearly recaptures of migrant Swainson's Thrush (fig. 2) and Wilson's Warbler (fig. 3) individuals have been documented since the inception of the banding program in 1993. Recaptures of migrant Pacific-slope Flycatcher (fig. 4) individuals were documented for one summer. Of the common migrant individuals recaptured for two or more consecutive summers, the male to female Swainson's Thrush (n=20) and Wilson's Warbler (n=19) recapture ratio was 70%:30% and 68%:32%, respectively. A similar comparison for Pacific-slope Flycatcher recaptures by sex was impossible as males and females could not be distinguished by plumage or anatomical (i.e., cloacal protuberance) differences, and none of the captured individuals possessed a brood patch. Analysis by mist-net capture locations showed that 15 of the 20 returning Swainson's Thrushes, 11 of the 18 Wilson's Warblers, and 1 of 2 Pacific-slope Flycatchers were caught within a 300-m or less radius of their initial capture location. It is simply amazing that these tiny migrant songbirds survive the perils of migration, over several consecutive years, to return to the same breeding location from

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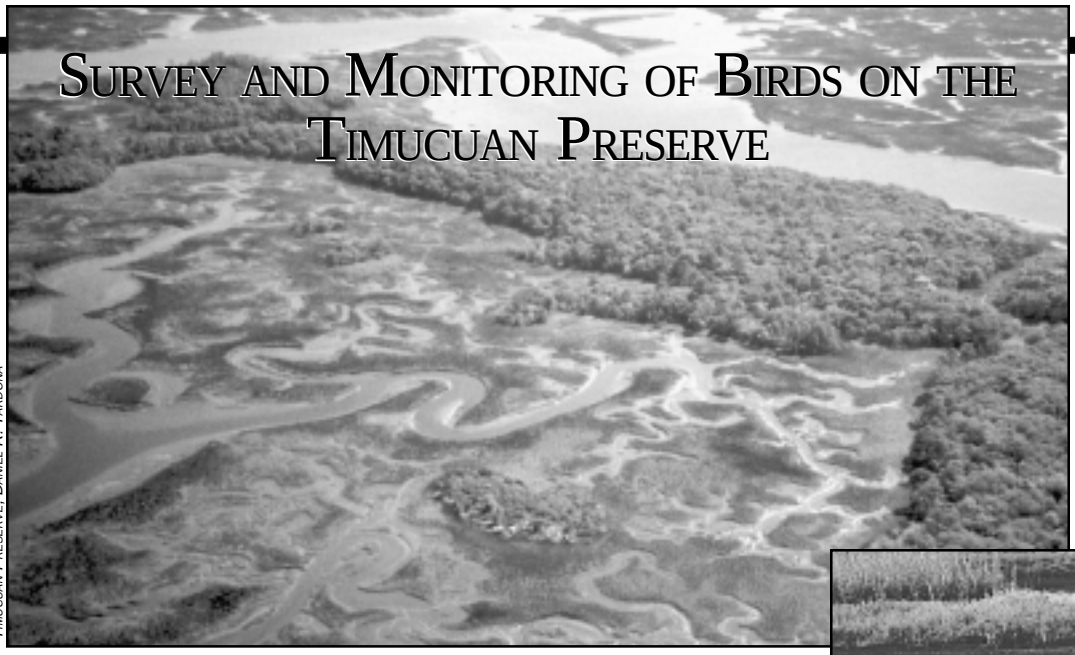
Survey and Monitoring of Birds on the Timucuan Preserve



Timucuan Preserve, Daniel R. Tardona

Figure 1 (left). The Timucuan Preserve features diverse habitats that include marshes and upland areas, which are important for birds.

Figure 2 (below). The Wood Stork is an endangered species that nests within the preserve.

Timucuan Preserve, M. Sharp

By Daniel R. Tardona, Roger Clark, Amy E. Hanigan, and Ian Hanigan

Named for the Native Americans who lived here for more than 3,000 years, the Timucuan Ecological and Historic Preserve on the Atlantic coast in northeast Florida encompasses hammock uplands, coastal marshes (fig.1), salt flats, islands, tidal creeks, and the estuaries of the St. Johns River on its southern perimeter and of the Nassau River on its northern perimeter. Almost 75% of the lands in the preserve are wetlands and waterways. The preserve teems with a wide variety of plant and animal species.

The preserve is especially important for birds (fig.1). It is the lower breeding limit of many northeastern bird species; it is in the Atlantic flyway and offers habitats for wintering and migrating birds; it provides habitats for birds that depend on estuarine and maritime environments; and it is a refuge for many birds that are increasingly threatened by land development and recreation along coastal areas (fig. 2).

Sound management of bird habitats in the preserve and region requires knowledge about population sizes, seasonal and annual species compositions, and the relative abundance of species across specific sites. The preserve began collecting such data in 1996 with plans to maintain these efforts as a permanent avian monitoring program. Survey results are recorded in an automated management database, provided by the U.S. Fish and Wildlife Service, which provides resource managers with a tool to track population trends and evaluate avian responses to specific management actions to various habitats.

Study sites

Two sites in the preserve were selected for the collection of data. The 159-ha (392 acre) Cedar Point area consists of tidal marshes, upland oak (*Quercus spp.*) forests, hammocks, pine (*Pinus spp.*) flatwoods, and a remnant pine plantation. The upland areas are interspersed with small freshwater wetlands (fig. 1). The approximately 243-ha (600-acre) Theodore Roosevelt area consists of tidal marshes, brackish sloughs, and a relatively undisturbed maritime hammock community. A recently acquired third site, the 474-ha (924-acre) Thomas Creek area, will be added in the spring of 1998. The mixed-forest wetland at Thomas Creek includes a 106-ha (262-acre) hardwood freshwater wetland, an 11-ha (27-acre) lake (borrow pit), and important upland areas. The north end of the area is bordered by saltmarsh and has been managed as a pine plantation of mostly loblolly pine (*Pinus tadea*). This area will be important to survey and monitor for birds as it will be transformed to a more natural vegetative state beginning in approximately six years.

Methods

Because the small staff compliment of the preserve was not available for the survey and monitoring of birds, we placed a call for volunteers in the *Opportunities for Birders*, an annual publication of the American Birding Association, and was promptly met with numerous responses from experienced birders. The local chapter of the Audubon Society and area ornithology students also augmented our volunteer roles to expand and maintain the program.

The number of birds by species in the study sites is estimated with point counts (Hamel et al. 1995; Ralph et al. 1993). A point count is a tally of all birds detected by sight or sound by a single observer from a fixed station during a specified time period. The survey points are distributed as evenly as possible throughout each of the two study areas at a minimum separation of 250 m (820 ft.). The points were established by overlaying a 250-m x 250-m scaled grid on detailed maps of each study area. Intersections of trails in the preserve and accessible areas at grid nodes

were potential sampling points. The maximum number of intersections in each site were generated by moving the grid. One of the intersections was chosen as a starting point from the grid. By drawing a 250-m circle around a random point, the next point was located at a trail intersection or at an accessible area on a grid node and the circle. In the field, each sampling point was marked with a stake (fig. 3) and a map of the points was given to each observer.

TIMUCUAN PRESERVE, JAYNE TARDONA

Figure 3. The first author stakes one of the bird survey points

During a point count, each observer (one or two) makes a series of 10-minute observations beginning 30 minutes before dawn until 10:00 a.m. The observation periods are separated into segments of the first three minutes, the next two minutes, and the final five minutes, for a total of 10 minutes of observation per location. The distance between the observer and birds is recorded in one of four categories: less than 25 m distant, 25-50 m distant, over 50 m distant, and flyovers. Data are recorded using a bull's-eye data record sheet (fig. 4) for each count station. The observer orients the sheet, records date, time, observer, and wind and sky conditions, and then begins the count using a timer. Each bird that is seen or heard is recorded, noting distance and approximate azimuth (i.e., compass bearing). A multicolored pen is used to record data for the different time intervals: green for the first three minutes, blue for the next two, and red for the final five. Each bird observed or heard is recorded just once with a mark (using a species code); thus, observers must judge whether subsequent songs are from new or already mapped individuals. All flyovers are recorded outside of the bull's-eye underneath *flyovers.* The field notations from the bull's eye data sheets are transcribed to bird count data forms at the end of the day, and the data are then entered into the U.S. Fish and Wildlife Service GSB-Base Bird Monitoring Database. One survey is made at each site during the spring migration, fall migration, breeding season, and during the winter.

TIMUCUAN PRESERVE, DAN TARDONA

Figure 4. Park VIP Carol Richards collected survey data in the field using the bull's-eye data record sheet. Data from each observation point were later consolidated on another form and entered into a database for analysis.

RESULTS AND DISCUSSION

Preliminary data collected suggest that the Timucuan Preserve study areas contain one of the highest concentrations of nesting Painted Buntings *(Passerina ciris)* in northeast Florida. This species is of particular concern in the region as a result of habitat loss. In addition, the data suggest that compared with other point counts in the southeast our study areas have a lower concentration of the Brown-headed Cowbird *(Molothrus ater).* The cowbird is a brood parasite that lays its eggs in the nests of other bird species. Its eggs hatch earlier than those of its host, and the chicks grow faster, reducing the food intake of the host species. As a result, the cowbird threatens the survival of many other bird species especially warblers, flycatchers, vireos, and finches. Further data collection and analysis over the years in conjunction with other habitat studies will yield important information to consider in future habitat management decisions.

CONCLUSION

In order to achieve many important resource management objectives within funding and staffing limits, resource managers must continually seek creative and nontraditional alternatives. As we have shown with the Timucuan bird survey, important and viable natural resource management programs can be accomplished with the assistance of knowledgeable, skilled, and dedicated volunteers. In addition to the benefit gained from the data gathered during the surveys, involvement of people from the local community can also strengthen and expand support for park goals and management activities. PS

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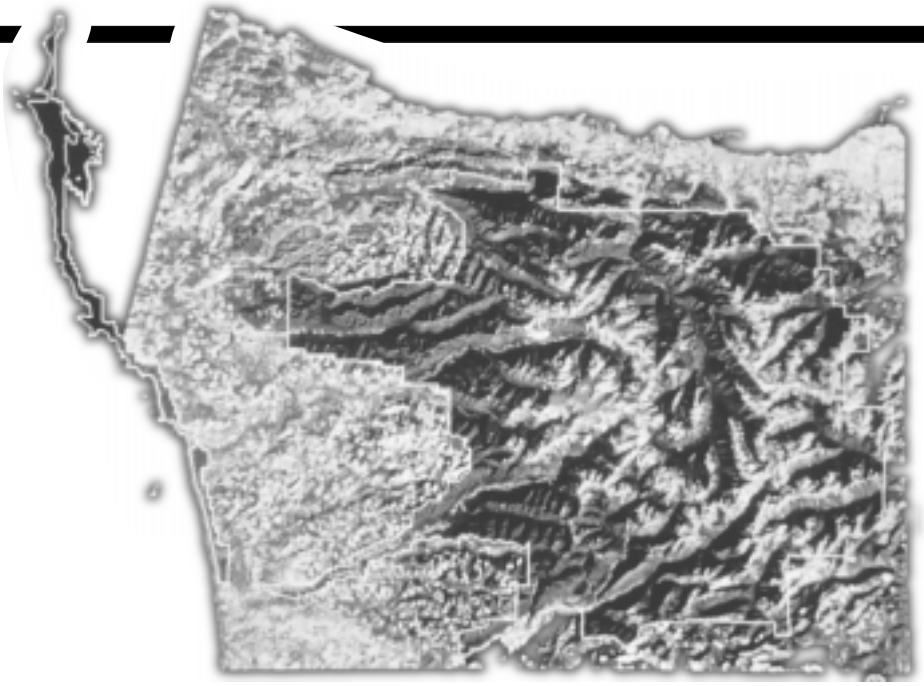


PACIFIC MERIDIAN RESOURCES

Figures 1 (left) and 2 (right). The database development process uses Thematic Mapper satellite images, such as these of Olympic (left) and Mount Rainier (right) National Parks, Washington. The images reveal tree size and forest structure, species composition, forest crown cover, and geomorphic characteristics of the land. Clear cuts outside the parks show as white patches.

VEGETATION AND LANDFORM DATABASE DEVELOPMENT

Satellite imagery eases updates, applicability in Pacific Northwest parks

BY JEFF CAMPBELL AND DAVID PETERSON

AN IMPORTANT NEW DATABASE WAS recently developed for national parks in the Pacific Northwest that will aid resource managers and scientists interested in a wide variety of natural resource issues. In 1992, the Natural Resource Preservation Program of the National Park Service provided funding for a contract with Pacific Meridian Resources, Portland, Oregon, to develop and produce a comprehensive GIS vegetation land cover and geomorphologic landform database for four national parks in the Columbia-Cascades Cluster: Olympic, North Cascades, and Mount Rainier National Parks, Washington, and Crater Lake National Park, Oregon. The study was designed to develop a comprehensive, consistent inventory and mapping of the vegetation and landform characteristics for the four parks using digital Landsat Thematic Mapper (TM) satellite imagery (figures 1 and 2) and field collected data as the primary information bases.

Using satellite imagery as the primary information base for developing a comprehensive, consistent vegetation landcover database has four advantages:

1. Substantially less time and cost is needed to produce the GIS layers as compared to aerial photo interpretation
2. Much more useful data can be produced; image raster data can be intersected with GIS polygon (vector) coverages providing information about the diversity of vegetation cover within each polygon
3. Analyses across ownership boundaries can be performed. The great economies of scale provided by digital image processing make it relatively inexpensive to map large expanses of land
4. Landsat TM satellite data are captured over the same area every 16 days. Thus, fast and inexpensive database updating is possible. Landsat TM data and extensive field-based observations were used as base data for the study. Computer classification was an iterative process. Aerial photographs, ancillary GIS layers, field and office reviews, and NPS personnel input were used to refine the maps through modeling and manual editing

PRODUCTS

Final products resulting from the study are three separate raster GIS data layers of tree size and forest structure, forest species, and forest crown cover. Image-based raster map acreage totals for these layers are included in the final report for the project. In addition, a spatially related database of vegetation characteristics was developed from the compilation and analysis of an extensive vegetation inventory completed for each park as part of this study. Also, a digital map of geomorphologic landforms was produced through the analysis and interpretation of digital elevation data, aerial photography, and digital satellite imagery.

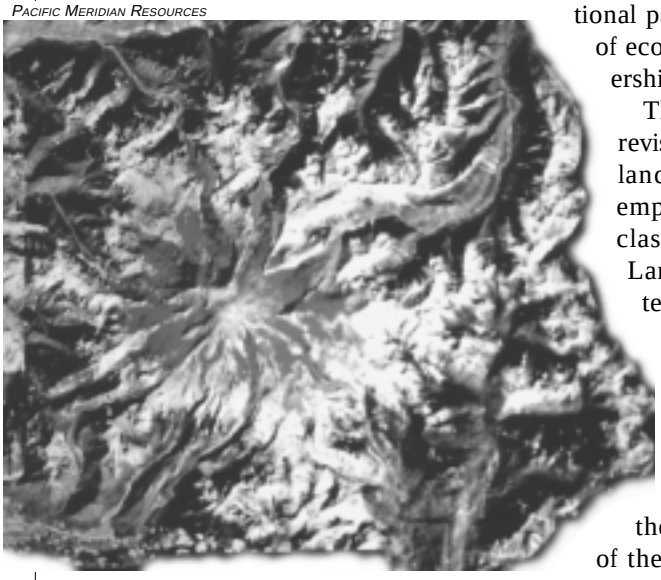
The accuracy of the image classifications was assessed and difference matrices are provided for the study. Accuracies in excess of 85% were achieved for all image-based data layers. More extensive field data collection, draft map review, and editing would further improve the quality and accuracy of the map data. The map data should be viewed as a dynamic, evolving database that should be consistently updated, evaluated, and improved.

DATABASES IMPROVED

The powerful, comprehensive databases developed through this study have several distinguishing characteristics: these databases provide the National Park Service with comprehensive baseline data

for each park in the Pacific Northwest. This data set can serve the basis for various long-term ecological research and monitoring efforts. The hierarchical data structures for the databases allow for landscape characterization and analysis at multiple scales. Future studies and analyses can utilize these data sets for project- or watershed-specific areas or for more broad-based, regional and landscape-scale analysis by utilizing the full detail of the data or by aggregating the data into broader categories of information.

PACIFIC MERIDIAN RESOURCES



The raster data sets provide a more realistic depiction of diversity and variation of landcover across the landscape than do polygonal, usually photo-interpreted, data sets providing a single landcover label for often large (several acres) land areas that many times possess tremendous biodiversity.

DATA USES EXPANDED

The integration of spatial and tabular data provide greatly expanded applications for both data sets. Field-based measurements not measurable from remotely sensed data can provide much greater site-specific descriptions of cover types produced from satellite imagery. The spatial cover type data provide the means to consistently stratify field-based measurements and apply them across a park. The result is a powerful data set that can be used not only for general, regional summary statistical measurements, but also for site specific spatial assessments (i.e., habitat conditions, connectivity, biological indicators, etc.)

The data classification schemes allow for seamless analysis of ecosystems across the landscape regardless of ownership. Obviously, since the ecological world does not end at the boundaries of national parks, comparison and analysis of ecosystems across adjacent ownerships is critical.

The databases are easily updated, revised, and enhanced. Since the landcover classification process employed easily repeatable image classification methods utilizing Landsat TM imagery, change detection analysis and map updating procedures can result in a very cost-effective and fast approach for keeping the data sets current. Also, the standardized field data collection procedures allow for the enhancement and expansion of the field-based vegetation inventory database during future field studies.

Finally, as accurate, comprehensive, and powerful as the databases developed from this study are, they will only gain true legitimacy and the confidence of the user through extensive use and review. The potential utility and application of the data sets is limited only by the imagination of the user. While these databases certainly do not represent the end-all data sets needed for the region, they do provide a powerful state-of-the-art launching pad for further study, analysis, and ecosystem management for the parks of the Pacific Northwest. PS

Jeff Campbell was with Pacific Meridian Resources in Portland, Oregon, at the time of the study. David L. Peterson is the Unit Leader of the Cooperative Park Studies Unit, Forest and Rangeland Ecosystem Science Center, USGS-Biological Resources Division, Seattle, Washington. He can be reached at (206) 543-1587; Fax (206) 685-0790; e-mail wild@u.washington.edu.

Redwood continued from page 15

their wintering grounds located many thousands of miles away (i.e., Mexico, Belize, and Guatemala for Wilson's Warbler and Pacific-slope Flycatcher; northern South America for Swainson's Thrush)!

CONCLUSION

The Redwood MAPS station validates the importance of this riparian corridor for these three neotropical migrants. However, more constant-effort mist-netting stations are needed to verify our results for similar riparian habitats throughout the park complex or within the species' breeding range. Although our findings are limited to our study area, our parks' contribution of data to the Institute for Bird Populations is very useful for the regionwide analysis in comparing productivity and survivorship of these species within a portion of their breeding range.

There are obvious beneficial uses of MAPS data, but there are limitations, as well. For example, inferences may be made for a banding site only and may not be extrapolated to broader areas. Regardless of this limitation, the low overhead cost for materials ($750) invested in establishing the MAPS station is worth the expense. Such easily and inexpensively collected data also clearly illustrate the importance of each habitat in a broader ecosystem context. Redwood can monitor a vital sign related to its resources that is pertinent on a local and regional scale. Because of the stability of parks, these protected areas are particularly critical for the survival and maintenance of these long-distance migrants. Parks have a responsibility to participate as much as possible in this way given the broad context of ecosystem management and maintenance of biodiversity. PS

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Meetings of Interest

1998
MAY 5-7

Researchers and partners in land stewardship may be interested in "A Century of Parks in Southern Arizona: The Second Conference on Research and Resource Management in Southern Arizona National Park Areas." The three-day conference will explore the areas of archeology, historic preservation, ecosystems, physical sciences, and both plant and wildlife ecology and management. A closing session will address publicizing research results. Contact Kathy Hiett of the USGS Cooperative Park Studies Unit at the University of Arizona in Tucson for registration information: (520) 670-6896, ext. 3; *katherine_hiett@nps.gov.*

MAY 27-31

The University of Missouri is sponsoring the Seventh International Symposium: "Society and Resource Management" to be held on the Columbia, Missouri, campus. The biennial symposium focuses on the contributions of the social sciences and humanities to a better understanding of the environment and resource management. The goal is to foster increased dialogue among natural resource managers, social scientists, policy makers, and researchers. A commitment to understanding the links between culture, environment, and society will be the guiding theme at the 1998 event. This thrust is based on the notion that complex resource issues are societal problems grounded in cultural systems and can be addressed by multidisciplinary perspectives. Presentations will explore natural resources and local communities, cultural diversity and gender issues in natural resource management, the social and cultural dimensions of environmental conflicts, social science perspectives on land-use issues, international issues in resource management, biodiversity management, and public participation in natural resource planning, among others. For more information, visit the website *http://www.ssu.missouri.edu/SSU/issrm/default.htm* or contact Sandy Rikoon at (573) 882-0861; *ssrsjsr@muccmail.missouri.edu.*

OCTOBER 13-16

Still a year away, the Seventh Annual Watchable Wildlife Conference is now accepting proposals for papers. The conference promises to explore innovative ways to appreciate wildlife, and will bring together people from government agencies, nonprofit organizations, and the business community. Conference tracks include conservation education, recreation and tourism, expanding the Watchable Wildlife program, and others. Visit the Watchable Wildlife website *http://sturgeon.irm1.r2.fws.gov/u2/refuges/watchwil/main.html* or contact Jill Simmons at (505) 248-6635; *jill_simmons@mail.fws.gov.*

MAY 23-27, 1999

Dates have changed for the conference, "Wilderness Science in a Time of Change," to be held in Missoula, Montana. Originally scheduled for May17-22, 1999, the meeting will now take place May 23-27. A description of the conference appeared in *Park Science* 17(1):16. For additional information, contact the Center for Continuing Education at (406) 243-4623; *ckelly@selway.umt.edu.*

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