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In This Issue

	Page
Urban Soils of the D.C. Mall	3
Ecological Society Meeting	5
Water Quality Monitoring at Santa Monica Mountains	5
Dall Sheep Research in Alaska	6
Alaska Sponsors Problem Analysis of Denali Caribou Herd Decline	7
Riparian Conference	8
Africa Project Stresses Conservation and Use	8
Superintendent's Corner	9
Letters to the Editor	10
Training to Deal with Oily Mess	10
Bat Study Provides Useful Baseline Data	11
An Ecological Study of the Chellburg Forest	12
Hawaii Symposium Follow-up	13
Chapman Keynotes Science Meeting	13
Information Crossfile	14
Prescribed Fire Qualification System Developed	15
Regional Highlights	16
Restoration of Historic George Washington Carver Prairie	17
Ice Cave Research Aids Management and Interpretation	18
Book Review: The Imperial Lion	19
RMPs Identify Baseline Data for Midwest NPs	19
Bald Eagle Feeding and Breeding Ecology	20
Atlantic Ridley Turtle Update	21
Meetings of Interest	21
Regional Chief Scientists Heading Back to Research	22
Revegetation on John Day NM	22
Scientists Follow Rabbits in Third Wave 'Invasion'	23
Differing Management Approaches Evaluated	23

What is a park?

The answer is a many-leveled thing. But as every scientist and resource manager knows, one definition would have to be that a park is a complex amalgam of problems, opportunities, failures and solutions. And definition for this level of "what a park is," involves much more than the area encompassed by the park's geographic boundaries. It must include (in addition to the resource base) the people who manage the park, the people whose activities impact the park, the people whose fortunes depend on the park, the people who enjoy the park, the people whose interests collide with management of the park — in short, "the people."

Just before press time for the preceding issue of Park Science, a report from Chuck Stone, Hawaii Volcanoes NP scientist, reached our desk. It dealt with the June 1984 symposium on Protection and Management of Terrestrial Hawaiian Ecosystems. While the report was specific to Hawaii, it spoke in a general way to resource managers everywhere, particularly as it seemed to address the most complex level at which a park can be defined . . . the one involving people.

The account described a symposium that focused on both problem areas and achievements, and then moved on to consider current and future roles of agencies, conservation groups, legislation, and the public, in preserving and managing Hawaiian ecosystems (see report on page 13.)

The representation at this refreshingly candid gathering was from the State senate, from conservation organizations, from a native Hawaiian group, from the ranching community, from State and Federal agencies, and others. A remarkable amount of optimism was expressed. Among the successes cited were cooperative research in biocontrol for alien plants, the cooperative mongoose control project, the Hawaiian goose captive propagation and release project, the endangered species recovery team work, and numerous activities of The Nature Conservancy. The key word here was "cooperative" and the agencies involved included Hawaii Division of Forestry and Wildlife, U.S. Forest Service, the Fish and Wildlife Service, NPS, the University of Hawaii, the Hawaii Department of Agriculture, and others.

In the "problems and opportunities" department, here is a quote from Stone's report:

"The usually expressed needs for increased communication and education at nearly all levels were articulated, and it is vital that these be better addressed. Additional problem areas identified (and perhaps aggravated by insularity and shortage of trained researchers, managers, and educators, in relation to the magnitude of the problems) are: Lack of adequate and comprehensive land use planning; a shortage of conservation advocates who are not scientists; conflicts between the advocacy and the scientific roles and loss of credibility for both so far as landowners and others are concerned; conservation 'gadflies' who polarize issues too frequently and too soon; bureaucratic inertia and lack of effort; unprofessional behavior of resource professionals as manifested in excessive pettiness; uncompleted, unpublished, and unreferenced reports and lack of follow through; lack of local training and education for resource specialists; and agency administrators/managers who choose not to protect, manage, and interpret the natural resources under their care, who are dominated by agency hierarchies and politics, and/or do not understand the needs for adequate and active stewardship in Hawaii and do not place a high priority on meeting these needs."

As this report missed the last issue and as time passed, it seemed that the message grew as large as the entire National Park System and that Hawaii's invitation to such a wide and representative group of park-related people, for such open and frank discussions was worth presenting in the larger context in which it actually is taking place.

What happened in Hawaii is only the latest example of a wave that has been gathering for some time now, all over the System . . . a wave of looking and listening and reaching out, in cooperation with other people, for ways of better serving the resource and the public.

Whenever and wherever the National Park Service takes the lead or any part in such an undertaking, dividends accrue to both our professional status and the resources we husband.

RUSSELL E. DICKENSON, Director
National Park Service
U.S. Department of the Interior

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3200 Jefferson Way, Corvallis, OR 97331 (503) 757-4579; 8-420-4579

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Cover Photo:

The Mall, looking East, viewed from the Washington Monument. Photo by Bill Clark, NPS National Capital Region.

Urban Soils of the Mall in Washington, D.C.

By John R. Short and James C. Patterson

Urban, or highly man-influenced, soils are becoming more commonplace with the extensive earth moving and manipulating activities of man. Such soils are not limited to urban areas, but may be found wherever activities of man result in disturbance of soil profiles. Disturbance may consist of compaction of an existing soil by foot traffic, or may result from large scale manipulation of soil materials to create entirely new land surfaces.

Urban soils have unique properties resulting from their mode of formation and the impact they receive. It is important to understand the properties of urban soils in order to manage them effectively as a resource, whether the soils are situated in an urban or rural setting. The study of urban soils is a new facet of soil science, with much to be learned. Since the National Capital Region is largely an urban park system, regional scientists have initiated a program to characterize urban soils.

Urban Soils and NCR

Parklands of the National Capital Region (NCR) receive heavy visitor impact, with many soils occurring on highly manipulated landforms. This impact, plus the need to maintain high quality, attractive plantings, provided the incentive to study the Mall soils intensively.

The Mall is managed by the National Park Service and is situated between the U.S. Capitol to the East and the Washington Monument to the West (cover photo). The soils of the Mall may be typical of highly man-influenced soils because they have evolved from fill material and are continually impacted by pedestrian and vehicular traffic. The Mall often is the site of major events such as the Festival of American Folklife.

The objectives in studying these soils were to:
1. determine their physical and chemical properties;
2. determine the variation of these properties;
3. develop a soil map based upon observable soil

properties; 4. attempt to classify them in a manner indicative of their highly man-influenced nature; and 5. provide management information to the Park.

A soil's physical properties are among the most difficult to modify, and yet can exert a profound influence on its management. Properties such as texture, bulk density, and amount of pore space determine the air and water relations within the soil profile. The mode of formation of these soils can result in strongly contrasting soil layers or horizons.

The soils of the Mall have developed in miscellaneous fill applied to a depth of about 6 m (20 ft.). Sharp delineations between contrasting soil materials (lithologic discontinuities) were found in 95 percent of the profiles. A lithologic discontinuity is the point in the soil profile where a change in particle size and/or mineralogy occurred prior to soil formation. A lithologic discontinuity is, therefore, the distinct boundary between two contrasting soil materials. These lithologic discontinuities can result in poorly drained soils, which often can be identified by mottled colors within the soil matrix. Artifacts of man, such as brick, glass, cinders, concrete, and slag, were found between 25 cm and 100 cm in 94 percent of the profiles. The presence of artifacts within the soil profile was significant as they demonstrated that man was instrumental in the accumulation of the parent material.

Further evidence of manipulation of the soil materials was indicated by the presence of buried A horizons and the variation of percent organic matter with depth in the profiles (Table 1). Soil A horizons are generally considered to be surface horizons, and are characterized by accumulations of organic matter. These horizons are usually darker in color than underlying horizons, with a softer, more friable, consistence. When fill material was deposited on the existing native soil surface, any A horizon which may have been present at the time of filling would have been buried. That soil formation occurred in this fashion on the Mall is evident by the presence of buried A horizons in 42 percent of the profiles studied.






The soils were found to be predominately loamy, which connotes a relatively balanced distribution of sand, silt, and clay particles. Such a texture provides a reasonable compromise between the drainage afforded by sand, and the water-holding capacity afforded by clay. However, loamy soils tend to be susceptible to compaction because the relatively even distribution of particle sizes permits small particles to be readily compressed into voids between larger particles.

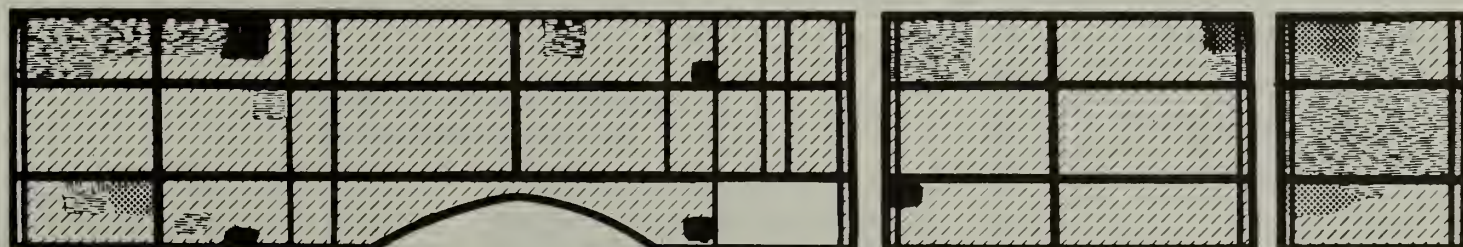
Table 1.
Mean of Selected Chemical Properties
of Mall Soils by Horizon.

Horizon (from surface)	pH	Organic Matter %
1	6.39	1.97
2	6.52	1.08
3	6.57	0.73
4	6.64	0.50
5	6.67	0.41
6	6.59	0.66

The visitor impact the Mall receives has resulted in an increase in bulk density, which is the weight of soil material in a given volume. The bulk density of an ideal soil is approximately 1.33 grams cubic centimeter (g/cc). The soils of the Mall had a mean bulk density of 1.61 g/cc in the surface horizon, and 1.74 g/cc at 30 cm (Table 2). Bulk densities up to 2.03 g/cc were observed. Studies have shown that soils with bulk densities of 1.67 g/cc or greater are often inhospitable to plants. The main result of compaction is a loss of pore space. While an ideal soil will contain approximately 50 percent total pore space, evenly distributed between air and water, the mean percent pore space of Mall soils was only 36.6 percent at the surface, and was 32.8 percent at 30 cm. These soils often have less available moisture as a result of the reduced pore space. The lack of sufficient pore space



-  Urban Udorthent (artifacts; little soil development)
-  Urban Eutrochrept (artifacts; more developed soils; more nutrients)
-  Spolic Eutrochrept (no artifacts; more developed soils; more nutrients)
-  Urban Dystrichrept (artifacts; more developed soils; fewer nutrients)
-  Spolic Udorthent (no artifacts; little soil development)



Detailed soil map of the Mall.

usually causes stress to plants. The packing of soil particles restricts root penetration, contributing to plant stress. A root system limited in extent by com-

are important to soil management. Some of these properties, such as pH, are more easily manipulated than the physical characteristics, although other properties, such as heavy metal content, cannot be easily modified. Knowledge of these characteristics is essential for satisfactory management.

Hydrogen ion concentration (pH) of a soil affects the retention and availability of nutrients by soil constituents. The mean pH of Mall soils ranged from 6.39 in the surface horizon to 6.67 in the 5th horizon (Table 1). However, pH values for 32 percent of the samples obtained were 7.0 or greater. These alkaline pH values may be a result of inclusion of lime-releasing artifacts, such as concrete, mortar, or compost, within the profile. Analyses have indicated that calcium was the dominant cation held within the exchange complex of the soil, possibly as a result of inclusion of lime-releasing artifacts within the profile. Lime should not be applied routinely to highly man-influenced soils such as these without testing. The value of a soil testing program is not limited to urban soils, but is applicable to any managed soil. Soil testing should not be restricted to pH determinations, but should be performed to determine fertilizer requirements as well.

Organic matter in soils is highly beneficial. A favorable environment for soil fauna and mycorrhizal fungi

is provided by organic matter. As organic matter decays, it releases nutrients, acting as a slow release fertilizer. Organic matter also tends to improve the soil structure by acting as the "glue" binding the individual soil particles into larger aggregates, or peds. These aggregates improve drainage, aeration, and water infiltration capabilities of fine-textured soils, and increase resistance to compaction for most soils. Organic matter also increases the ability of the soil to retain nutrients, preventing them from leaching from the soil. The organic matter content of urban soils tends to vary with depth, and is often lower than that of natural soils because organic matter may be removed during routine maintenance practices such as mowing, dethatching, and leaf collecting.

The mean organic matter content of Mall soils tended to be low, less than 2 percent in the surface horizon, and decreased with depth (Table 1). Most natural soils in the Washington, D.C. area contain from 2 percent to 4 percent organic matter in the surface horizon. The low organic matter content, in conjunction with the loamy textures, caused these soils to be susceptible to compaction. Much of the buffering capability of organic matter to changes in pH and nutrient status is lost because of the low level of organic matter present in the soils.

pacted soil will create root-crown imbalance and result in a stressed plant, which will be most evident in dry periods. Storage of energy reserves in the root system also is reduced. Methods to alleviate or prevent soil compaction are, therefore, necessary.

The chemical characteristics, such as pH, organic matter, soluble salts, and heavy metals, also

Table 1. Vegetation Information Baseline Summary

Park	Approximate area (acres)	Vascular plant checklist or collection	Non-vascular plant checklist or collection	Endangered plant list	Exotic plant list	Vegetation map	Vegetation plot system
Isle Royale NP	571,796	yes	inc.	yes	yes	yes	yes
Voyageurs NP	219,128	inc.	inc.	inc.	—	yes	yes
Ozark NSR	81,216	yes	inc.	inc.	—	yes	—
St. Croix NSR	73,578	—	—	inc.	inc.	yes	—
Pictured Rocks NL	72,259	yes	—	inc.	yes	yes	—
Sleeping Bear Dunes NL	71,105	inc.	—	—	—	—	—
Apostle Islands NL	42,009	yes	inc.	yes	—	yes	—
Cuyahoga Valley NRA	32,460	inc.	—	inc.	—	inc.	—
Indiana Dunes NL	12,535	yes	—	yes	yes	inc.	—
Agate Fossil Beds NM	3,055	inc.	—	—	—	—	—
Scotts Bluff NM	2,997	inc.	—	—	—	—	—
Wilson's Creek NB	1,750	yes	—	inc.	—	inc.	—
Effigy Mounds NM	1,474	yes	—	—	—	—	—
Fort Larned	718	yes	—	inc.	—	yes	—
Grand Portage NM	710	—	—	—	—	yes	—
Pipestone NM	282	yes	—	—	—	—	—
George Washington Carver NM	210	yes	inc.	—	—	yes	yes
Lincoln Boyhood NM	196	—	—	—	—	—	—
Homestead NM of America	195	—	—	—	—	—	—
Herbert Hoover NHS	187	—	—	—	—	—	—
Mound City Group NM	68	inc.	—	—	—	—	—
Fort Scott NHS	17	—	—	—	—	—	—

Studies (2,3,6,7,11) have shown that soils in urban areas often have elevated levels of soluble salts and heavy metals. The soluble salt content of the Mall soils was found to be low, with most soils containing less than 300 ppm. Cadmium, nickel, zinc, and copper levels were similar to background levels reported in the literature, but the lead content was slightly elevated.

The Mall soils varied greatly in the number of samples required to estimate the mean for the properties examined. The physical properties tended to require fewer samples than the chemical properties to estimate the mean at a given level of accuracy. Determination of mean bulk density could be accomplished with only one sample, while up to 7,171 samples would be required to estimate the mean nickel content! Other properties were intermediate in their variability. Therefore, it is apparent that soils which have developed in manipulated soil material will require a greater amount of sampling than soils in nonimpacted areas.

A soil map of the Mall was prepared using taxonomic criteria developed for use with highly man-influenced soils. Subgroups previously developed for use with highly man-influenced soils, with "urbic" and "spolic" subgroups, were used in conjunction with standard soil taxonomy. The urbic subgroup consists of those soils which have been manipulated and contain artifacts of man, while the spolic subgroup consists of manipulated soils with no artifacts. The results of this reclassification were used to develop the soil map shown here.

Conclusions

The NCR is following a soil management program that includes aeration of these dense, compacted soils and topdressing with organic matter such as composted sewage sludge. Using post-and-chain to restrict visitor access in the most heavily impacted areas has aided recovery of some elm trees in highly impacted soils. Addition of woodchips in very heavily impacted areas where turf cannot tolerate the extreme wear has proven successful in minimizing soil compaction.

Management of highly man-influenced soils is made more complicated by their variable characteristics. Their compacted nature, with the resulting reduction in pore space, makes plant management difficult. Their texture makes them susceptible to compaction and, therefore, less able to support activities without being adversely affected. Layering of the soils during filling creates lithologic discontinuities that generally result in soils with poor drainage, moisture-holding capacity, and aeration. The chemical properties of the Mall soils are influenced by their highly impacted nature. Lead content, though elevated, is not limiting to plant growth. The great variation in some of the properties required over 7,000 samples in order to estimate the mean. Clearly, it is impractical to routinely perform sampling of this magnitude! However, no mat-

ter where such soils are found, the great variability of highly man-influenced soils will require more intensive sampling than natural soils to gain the same information for effective management. This study provides an example of how gathering basic data on a Park resource can provide management with information needed to effectively manage a challenging resource problem. For example, this study has shown that soil compaction is a serious management problem, and maintenance practices to minimize compaction should be implemented. Although the results of this study were obtained from a park in an urban area, the principles obtained are applicable to any park situation where impacted soil systems are located.

Short is a Soil Scientist and Patterson is Research Agronomist at the Ecological Services Lab, National Capital Region.

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36 CFR 2.5 Clarification

A statement of NPS policy with regard to the issuance of collecting permits within National Park areas is being readied in Washington, D.C., by Stan Albright, Associate Director for NPS Operations, and Tom Ritter, Chief of the NPS Visitor Services Division.

Clarification was requested in a letter to the editor from John Dalle-Molle, Resource Management Ranger at Denali NP. The Washington Office reply will appear in *Park Science's* Winter issue.

Water Quality Monitoring at Santa Monica Mts.

By Caroline Hall

One of the projects currently being conducted by NPS in the Santa Monica Mountains NRA is water quality monitoring. The project was initiated in 1982 under the supervision of Paul Rose, a resource management specialist with the Park Service. One aspect of the program focuses on the levels of fecal coliforms found at particular watershed sites in the mountains. Fecal coliform bacteria are found in the intestinal tracts of warm blooded animals and they are commonly associated with harmful organisms responsible for sicknesses transmitted through water contact. Fecal coliforms are used to determine water quality because they are easy to culture and can be accurately isolated and counted. The present EPA standard for water suitable for swimming is a maximum 200 fecal coliforms per 100 ml sample. Unfortunately, some locations within the Santa Monica Mountains exceed this level.

Typical sources for higher coliform densities include untreated sewage effluent, septic tank leaks, and streams which are frequented by livestock and wildlife.

Results thus far indicate a tendency toward higher fecal coliform levels in watersheds of the eastern portion of the Santa Monica Mountains. This area is closest to greater Los Angeles and is subject to intense development activity. The problem is thought to be a combination of faulty sewage systems, steep slopes that encourage rapid runoff, and poor, shallow soils which are unable to properly filter any effluent that escapes.

Conversely, the relatively undisturbed western part of the mountains reveals a low fecal coliform count. It is also believed that some relationships exist between rainfall and the amount of fecal coliforms "flushed" into the system, but more data must be collected before any specific determinations can be made.

At this time, the project is still at the data gathering stage. The numerous factors involved in the determination of water quality prevent quick interpretation of results. It is anticipated that after a few years of monitoring, pollution sites and causes will be pinpointed. This will encourage better health protection for the public and improve water conditions for ecosystems within the recreation area.

Hall was a summer intern at Santa Monica Mountains NRA from Colgate University.

Ecological Society Meeting Draws NPS Personnel

Twenty-five to 30 NPS scientists, resource managers and naturalists were among the 4,000 who attended the Ecological Society of America meetings in Fort Collins, Colo., August 5-9. Special sessions focused on management of natural systems and man-

agement of stressed ecosystems. The NPS people got together for one day of talk about NPS programs during the conference. The list of papers given, titles and authors but no abstracts, runs to 350 pages. No proceedings will be published.

Roundup:

Dall Sheep Research In Alaska: 1981-83

By Francis J. Singer

With passage of the Alaska National Interest Lands Conservation Act (ANILCA) on Dec. 2, 1980, the National Park Service received 13 new administrative units in Alaska. Six areas contain populations of Dall sheep; four of the six have portions in both "park" and "preserve" categories (Lake Clark, Denali, Wrangell-St. Elias, Gates of the Arctic), and two are entirely preserves (Noatak and Yukon-Charley).

Sport hunting is allowed in the preserves and subsistence hunting is allowed in the new parks by local residents who traditionally used the resources. Only previously established portions of Denali NP are totally protected from all human harvests of sheep. Subsistence hunting is limited to ground access (snow machines, foot, boat, all-terrain vehicles), and the sport hunt regulations apply: fall season and 1 bag limit of 7/8-plus curl rams.

As a result, subsistence harvests of sheep are typically light. However, in 1982 the State of Alaska Board of Game established two special sheep subsistence hunts, one in the Noatak and one in Gates of the Arctic, with winter seasons (Aug. 1 to April 30), liberalized limits (three per person but 50 total in both areas), and no sex/age restrictions. The new NPS areas in Alaska include outstanding scenery and mountainous terrain, much of it habitat for Dall sheep. Consequently, Dall sheep have been among the most controversial elements of the new parks, both during Congressional hearings on ANILCA and since its passage.

We report here on sheep surveys and research in Alaska from 1981 to 1983.

Statewide Inventory

A total of 30,455 Dall sheep was recorded in the six NPS areas during 1981-83. The survey required 505 hours of aerial searching by NPS and Alaska Department of Fish and Game (ADF&G) crews. Nearly 60 percent of the work was accomplished by one helicopter pilot on contract to NPS and with NPS Wildlife Biologist F. Singer observing and classifying. It was the largest sheep inventory of its kind ever conducted.

A number of NPS employees were responsible for the massive effort, but particularly Roy Sanborn, Bob Peterson, Al Lovaas, and Dick Ring.

Two major pieces of new information appeared from the inventory. First, the statewide population estimate now has been elevated from 50,000 to 73,000. Many more sheep were found in previously uncounted areas than had been estimated, and 45 percent more were counted in previously counted areas. Prior survey techniques and estimates proved to have been conservative. Second, 40 percent of the sheep were observed in *preserve* and 54 percent in *park* categories. Higher densities of legal rams (2.6 to 4 times higher) were in preserves, and disproportionately more rams were in preserve than in park boundary areas.

Estimates had been made that creation of the new National Parks and Preserves would reduce the Alaska Dall sheep harvest by 29 to 50 percent; this



proved to be an exaggeration. Post-ANILCA harvests (1981-83) have averaged 22 percent lower than the 1977-78 average, but much of this decrease is due to a change in legal size restriction from 3/4-plus curl to 7/8-plus curl horns – a change which took effect in 1979. True reduction of the Alaska sheep harvest as a result of the new NPS areas is probably only 10 to 15 percent.

Brooks Range Studies

Dall sheep populations in the Brooks Range are being closely monitored relative to the new (since 1982) and more liberal subsistence hunts. Two harvested count units near Anaktuvuk Pass (Gates of the Arctic) are being counted along with two similar "control" or remote units. The biological effects of either-sex harvests of Dall sheep are not known from the more northerly and severe Brooks Range. Subsistence harvests of either-sex sheep have been relatively light thus far 32 to 38 per year near Anaktuvuk Pass and 9 to 10 in the Noatak.) Sheep have been more important in the past to local residents, particularly when caribou migrations bypassed communities and prior to 1950 when sheep fur was a major clothing material for northern natives.

Dall sheep occur at the extreme northwestern distribution of their range in the Noatak National Preserve. Sheep numbers there were little known but observations suggested intermittent occupation of certain ranges, low densities, and possible high mobility. The herd is subjected to both sport (ram) and subsistence (either sex) harvests. NPS initiated a study in 1983, primarily funded by the Special Initiative

Parks Account, to completely inventory the sheep herd and to compare Dall sheep densities, productivities, movements, and habitat uses north and south of the Noatak River.

The southern herd is subjected to both sport and subsistence and the northern to sport-only hunting. Densities in the north are 1/3 lower and sheep occupy patches of suitable habitat there, whereas in the south, continuous habitat occupation occurs. Home ranges in the north are much smaller, but lamb productivity there was nearly double in 1983. A total of 17 ewes and rams were radio-collared in 1983 by NPS – 7 in the north, 10 in the south. Lee Anne Ayres, a graduate student from University of California, Berkeley, is following the movements, habitat use, and activities of the two herds of sheep.

Role of Large-Horned Rams in Hunted and Unhunted Herds

Traditional sport harvesting of Dall sheep focuses on the oldest males – the same individuals that are most dominant and influential during the breeding season. In most hunted areas, many of these larger-horned rams are not harvested, but in some accessible areas nearly all are taken. Past studies in Alaska have suggested that on a short-term basis, reproductive rates are maintained or even increased when all large-horned rams are removed. However, these prior studies did not explore long-term reproductive effects, possible increases in mortality rates of younger rams, ewe condition and harassment rates, or any role of older rams in teaching home range traditions to younger rams.



Dall sheep in Alaska – their rutting behavior, lamb production, and ram dominance interactions in wintering groups, are the object of research in two contrasting herds.

Singer currently is investigating some of these topics in a comparison between two sheep populations – one in the eastern end of the totally protected Denali NP and one at Usibelli Mine, located only 10 miles to the east in the same mountain range. Rutting behavior, lamb production, and ram dominance interactions in wintering groups are being observed in the two herds, 1983-85.

Ram characteristics are drastically different in the two areas. During the 1983 rut, in the hunted herd, all rams were 3/4 curl or less, and there was only one ram per four ewes, while in the protected herd there was nearly one ram for every ewe and one full (4/4-plus) curl ram for every four ewes. Ram/ram competition appeared much more intense in the unhunted herd and the checking and tending of estrous ewes was much more time consuming.

Other impressions were gathered but must await analysis of the first year's data. Plans for the 1984 field season included continuation of the ram studies, attempting to learn more about "natural and healthy" versus "healthy" wildlife populations, as mandated by ANILCA for parks and for preserves, respectively. The radio-telemetry and range studies in the Noatak are being concluded in the summer of 1984, and evaluation of the sheep subsistence hunt in the Anaktuvuk Pass area will continue.

Singer is a Research Wildlife Biologist with the NPS Alaska Region in Anchorage.

Biosphere Reserves Focus on Management

Participation in the Conference on Management of Biosphere Reserves, slated for Nov. 27-29, 1984, at the Great Smoky Mountains NP Biosphere Reserve in Gatlinburg, Tenn., will feature a balanced mix of scientists and park managers, according to Roland H. Wauer, Great Smoky Mountains Assistant Superintendent. Supts. Boyd Evison (Sequoia/Kings Canyon NPs), Robert D. Barbee (Yellowstone), Donald R. Brown (Isle Royale), David B. Ames (Hawaii NP), and Robert C. Haraden (Glacier) are among the management persons who will fill leading roles in the three days of Conference proceedings.

Southeast Regional Director Robert M. Baker and Great Smoky Mountains NP Supt. John Cook will deliver opening remarks. Workshops will be conducted on the following management issues: Air pollutants, development of non-renewable resources, use of renewable resources, problem species, and visitor activities.

Alaska Sponsors Problem Analysis of Denali Caribou Decline

By F.J. Singer

On November 29-30, 1983, the Alaska Region brought a group of biologists together in Anchorage to conduct a problem analysis of the reason(s) for the decline of the caribou herd at Denali National Park and Preserve. A nine-member committee was formed, consisting of some of the most experienced and respected caribou researchers and managers in western North America, including: A.T. Bergerud (University of Victoria), Glen Ellison (Arctic National Wildlife Refuge), Frank Miller (Canadian Wildlife Service), Mitch Taylor (University of British Columbia), and Raymond Cameron, James Davis, Al Franzmann, and Bob Pegau (Alaska Department of Fish and Game), along with Francis Singer (Alaska Regional Office, NPS). The committee heard seven speakers discuss caribou movements, reproduction, and habitat studies at Denali, and then met in closed session November 30 to review the problem.

Naturalists, including Olaus Murie, had crudely estimated in 1943 that the Denali herd then numbered 30,000 animals, but by 1963-66 it numbered as few as 8,000 and stood at only 1,000-1,200 by 1974. Accurate total counts were impractical after 1975 because of herd dispersal, however aerial trend counts on a southern post-calving ground suggest further downward trends of about five percent per year from 1976 through 1983. This continued reduction occurred while several adjacent herds (Delta, Nelchina, Mul-

chatna) experienced strong growth and multiplied two- to several-fold.

Low Calf Recruitment

The committee considered the recent, continuing reductions, 1976-83, and the catastrophic early herd declines, 1943-74; their consensus, based on study findings was that recent reductions result from very low recruitment of calves (23-28 calves per 100 cows). The June calf crops are only about half those in healthier herds and a third those of herds expanding very rapidly. Unknowns include, are few calves born, are they born weak and sickly, or are they killed by predators? Several observed aspects of the herd's calving indicate predations on young calves may be responsible, primarily by wolves and bears (probably both blacks and grizzlies). Cows isolate themselves on steep mountain slopes to calve, which was interpreted as predator-avoidance strategy, and there is some indication numbers of new-born calves reach very sharp peaks then decline rapidly, the usual pattern if predators are active and effective in a herd. Calf crops were particularly low in northern calving areas, where wolves and grizzlies are much more numerous, than in the south. Predators are also abundant along migration routes in the park interior, and drastically low calf crops were documented for caribou which calved in the north, then moved south through the park with very young calves at heel.

Despite the indirect evidence, few predator kills or

Alaska caribou: Is their decline at Denali natural or is it in any way human-caused? Research team members search for the answers.



caribou carcasses are observed. Based on studies elsewhere, the committee explained that many losses occur while calves are only a few hours or days old, which is prior to the usual calf ratio counts. Predators consume nearly all of a calf carcass and wolves carry remnants to their dens. Also, wolves typically hunt alone and at night when preying on caribou calves.

Predators Not Blamed

Whatever the reasons for present herd reductions, the committee believed the park's predator populations were not nearly large enough to have caused the earlier, more dramatic declines. Limited by the dearth of early information, the committee could not agree on causes for those declines, but theories include herd emigration/dispersal, winter kills (probably a factor in 1970-72 when many Alaska herds drastically declined), and possible heavy hunter harvests south of the park in the 1960s. Two theories, which can be tested but have less to support them, are heavy metal poisoning at licks, and poor physical condition of adults. Poor condition of cows may have contributed to low calf survival earlier, but studies indicate the herd is in good physical condition now with high availability and use of lichens, short feeding bouts, long nursing bouts, low insect harassment, and high nutrient content of forage.

The committee made recommendations for research into the herd's decline and for long-term monitoring of key population and demographic parameters. All recommendations, particularly for monitoring, are beyond the present financial and staff capabilities of the park, but with recently obtained Significant Resource Problem (SRP) funding from the Washington Office research will intensify this year. Park and Regional personnel are now refining strategies based on the committee's recommendations. They include obtaining information on the poor calf crops by making udder counts of cows from a helicopter as an evaluation of pregnancy rates (which is as difficult to do as it sounds), documenting actual calving sites, determining antler retention rates of cows as an index of pregnancy (pregnant cows usually retain antlers longer than those not pregnant), placing mortality-sensor collars on a sample of neonatal calves, and radio-collaring wolves. Other recommendations were for long-term monitoring of bull ratios as an index of population dynamics, recording snow depths on wintering and calving areas, attempting total herd counts, and measuring trends in wolf and moose numbers. Wolves may use moose or Dall sheep as alternate prey if caribou decline further, which could delay or prevent the wolf population from declining along with the caribou. Good data are available on the sheep population.

Decline Causes Sought

A primary concern of management is whether the caribou reductions and lack of recovery are natural or in any way human-caused. Even if they are completely natural, NPS will have need for some factual answers if the population slides to zero! Some sources speculate park facilities and activities, including past caribou research, contribute to the declines, and heavy hunter harvests south of the park may well have been a factor. The herd is not hunted now but could be again, outside of the old core park, if it increases sufficiently. The caribou make use of an abandoned mine site as a lick, which will be tested for heavy metal concentrations and, if necessary, covered over.

Hunter harvests of adjacent herds may greatly influence the future of the Denali herd. According to a published hypothesis that has drawn mixed reactions from caribou biologists, when caribou herds grew to



Research team members, studying the decline of the caribou herd at Denali National Park and Preserve, from left: Mitch Taylor, Bob Pegau (hidden), Tom Bergerud, Ray Cameron, Frank Singer, Glen Ellison, Frank Miller, Al Franzmann, and James Davis.

extremely large sizes, segments naturally broke away and dispersed or emigrated to adjacent herds. Emigration from the Denali herd when it was at or near its peak may have contributed to its decline. Immigration from nearby herds to the Denali herd could help it "escape" from its present critical situation but is unlikely because present State management goals for those herds include maintenance of stable populations through hunting harvests. Predator control was attributed by State biologists as triggering increases in those herds from previously low levels. Caribou herds at very low population levels sometimes become erratic in their migration and the possibility exists that all or part of the Denali herd might emigrate.

Another concern of management is to assure caribou protection in upcoming decisions on mining and mine access improvements proposed for the Dunkle and Kantishna Hills areas of the park additions, in other proposals for visitor access and facilities, and in closure of areas to mechanized transportation. Knowledge of factors affecting the herd is essential for those decisions and the research is counted upon to play a major role.

Riparian Conference

The University of Arizona will host an Interagency North American Riparian Conference in Tucson April 16-18, 1985, as part of the University's Centennial Program. Sponsored by agencies from the United States, Mexico, and Canada, the conference is entitled "Riparian Ecosystems and Their Management: Reconciling Conflicting Uses."

Abstracts from which papers will be selected for the conference are due October 31, 1984. Symposium proceedings will be published by the Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service. For further information, write R. Roy Johnson, #125 Biological Sciences East, University of Arizona, Tucson, AZ 85721.

Africa Project Stresses Conservation and Use

Vernon C. (Tommy) Gilbert, retired from NPS research administration and currently working in Nairobi, Kenya, for U.S. AID's Environmental Training and Management in Africa project, was a major shaper of the August policy level conference on "Endangered Resources for Development" – a strategy conference for the management and protection of Kenya's plant communities: woodlands, forests, bushlands, savannahs, and aquatic communities.

A letter from Gilbert, received at *Park Science* editorial offices, accompanied a conference booklet, which Gilbert said "pretty much summarizes my thinking on the reasons for management and protection of habitats in Africa, or anywhere.

"Natural resources are the engine of development," the booklet begins, "conversely, development is dependent on the continued productivity of the natural resource base. The paradox that emerges is that development is dependent on the very resource it threatens with extinction. Unless management strategies are developed that combine use with conservation, improvements in living standards and national wealth are jeopardized."

The publication examines the major ecosystems, discusses inventory, mapping, and monitoring; its authors consider education, training, manpower assessment, and collaboration in research; it discusses specialized activities supporting ecosystem management such as germplasm research, botanical gardens and sanctuaries, field books and keys, and the work of non-governmental organizations.

The booklet's concluding note warns: "Options open to us today will gradually diminish as resources are lost and claims on scarcer resources grow. Exploiting the options to preserve our environmental heritage now, however, will widen development choices in the future."

Fossils – The NPS's Forgotten Resource

By Joe L. Kennedy, Superintendent,
Dinosaur National Monument

The Park Service is rightfully proud of the great natural areas it protects for posterity. However, amid all these treasures, one important resource has been almost totally forgotten. That resource is fossils. At least 10 units have been established to protect fossils or contain significant fossil deposits within their boundaries. The rich record of past life preserved on NPS lands ranges from 220 million-year-old conifers, reptiles and amphibians (Petrified Forest National Monument) to 140 million-year-old dinosaurs (Dinosaur National Monument) to a 60 million-year-old fish (Fossil Butte National Monument) to 35 million-year-old beetles and butterflies (Florissant National Monument). Such deposits have long been recognized by paleontologists worldwide as superlative examples of particular episodes in the history of life.

Specimens from these areas have contributed and continue to contribute to our understanding of evolutionary processes, extinction, migration, adaptation, functional morphology, comparative anatomy, evolutionary relationships, paleogeography, paleoclimatology and paleoecology (and the like) to mention a few. Clearly, these materials are international treasures.

Nevertheless, protection and management of fossil resources have generally been less than adequate and often performed in a vacuum. We would like to briefly touch on what we see as the common problems faced by all those managing fossil resources, regardless of the taxa involved:

Sun, wind, rain, ice, and snow are the traditional enemies of fossils. However, over the last 15 years additional threats have arisen. There now exists a lucrative international trade in fossils of all kinds, ranging from trilobites glued to magnets for use on refrigerators to entire dinosaur skeletons selling for \$150,000. A patchwork of federal and state regulations, a high profit margin and weak penalties have combined to produce a new and ominous threat. Some managers strongly suspect that illegal collecting is occurring in NPS units. These are not the occasional visitors who pick up a souvenir, but commercial collectors. This loss of fossil specimens is unacceptable to both the NPS and the scientific community and must be addressed.

As budgets continue to tighten and funding becomes ever more difficult to obtain, it becomes imperative that fossil resources be properly addressed in Resource Management Plans. The baseline data needed to evaluate and manage fossils include:

- What is the geologic and geographic distribution of fossils within the park?
- What is the scientific significance of the material?
- What areas represent depositional environments having a high potential for producing significant fossil materials?
- Which localities and/or specimens are threatened with irreparable damage or loss through erosion, theft, and/or vandalism?

These questions should be answered in each

NRMP. If they can not, then these questions should form the basis for funding requests for gathering baseline data. Without such data, adequate management and protection is impossible.

Although the subject matter is dead, the science of paleontology is not. With more researchers active now than in all of the past combined, new data is constantly appearing. NPS-6 directs us to insure that our interpretation reflects the highest standards of scientific research. Yet keeping up with the highly technical literature published in professional journals is difficult for the non-specialist. What are the methods by which interpreters can successfully breach the interface between themselves and the professional paleontological community? How can we effectively transmit that "uncommon knowledge" to the visiting public?

An exchange of ideas, techniques, experiences, expertise, and services has been almost non-existent among units with significant fossil resources. Many park service managers are not even aware that a professional paleontologist, Dan Chure, is stationed here at Dinosaur and serves as Park Service Paleontologist. With such poor communication, all aspects of management and interpretation may be negatively impacted by repeated attempts to invent the wheel or misguided actions taken due to lack of knowledge or expertise. A sharing of skills in the collecting, protecting and preserving of fossils will enhance their care Servicewide.

In spite of these common problems and threats, there never has been a Servicewide meeting of NPS personnel involved in managing and interpreting fossil resources. Such a gathering could address the above-stated concerns and serve to mesh professional paleontologists (both within and outside the service) with resource managers, interpreters and protection rangers. We strongly feel that the time has come for such a meeting at which fossil resource management in the NPS will finally come of age.

Editor's Note: Superintendent Kennedy has offered to make available for consultation the services of his fulltime professional paleontologist, Dan Chure, to other park areas with similar resources and problems.

Science Helps Carry the Day

By Gilbert E. Blinn, Superintendent
Badlands NP

Science recently provided some key information which allowed Badlands National Park and Colorado National Monument to resolve some longstanding problems in their bison herds.

Bison had been reintroduced to Badlands in 1963, when 53 animals were brought into the Park from Theodore Roosevelt NP in North Dakota. By 1983 the herd numbered about 375 head, and several hundred surplus animals had been turned over to Indian tribes for restocking their herds over the years. But managers were concerned about inbreeding, and for several years had been looking for new animals which could be brought in to broaden the gene pool.

An opportunity arose when Colorado National Monument decided to surplus their herd of about 25 bison in early 1983. Their range would not support a bison population, and Supt. Denny Huffman wanted to relocate the animals to another park.

There was a hitch, however. South Dakota law prohibits the importation of bison or cattle that have

not been tested and, for females, vaccinated against brucellosis as calves. Cattle growers are concerned about brucellosis; it is contagious and causes spontaneous abortion in a cow's first pregnancy. As a Federal agency we were not bound by State law, but we wanted to work with the State rather than risk losing their cooperation in other areas.

With the help of local legislators, we were able to get the State legislature to authorize the bison transfer if approved by the State Livestock Sanitary Board. Composed of cattle producers and veterinarians, this Board has veto authority over the importation of cattle and bison into the state.

We met with the Board in April of 1983, and they greeted our proposal with skepticism. They felt that the Colorado herd would not increase our genetic variability for two reasons: The Colorado cows were too small to carry calves sired by the larger Badlands bulls, and the two herds could have come from the original stock. Additionally, the risk of bringing in diseased animals from other states could not be justified by the limited chance of breeding success. The Board suggested that only bulls be introduced into our herd, and that they come from within South Dakota. Nevertheless, the Board scheduled a hearing for June to consider testimony and decide on the matter. We knew we couldn't match the expertise of the cattle breeders. We needed good scientific information if our proposal was to succeed – and we needed it soon.

We found the help we needed by calling Dr. Christine Schonewald-Cox, a specialist in bison genetics in WASO's Division of Biological Resources. She was very supportive of our proposal and assured us our approach was sound. She said that while size differences are important in breeding domesticated cattle, they are not significant in the breeding of wildlife. She pointed out that individuals of a species are larger in more northern latitudes in order to retain body heat, but that skull sizes of Colorado and South Dakota bison showed no significant differences. In any event, the Board's argument was rendered weak by a history of successful bison breeding between cows from the Great Plains and bulls from Canada's Wood Buffalo NP.

Additionally, introducing only bulls would not be effective because the new bulls would not be able to compete successfully for breeding rights in the wild against the established Badlands bulls. It would take an influx of both bulls and cows to insure successful cross-breeding between the two herds. Finally, the disease questions could be resolved through testing the Colorado animals for brucellosis immediately after capture, and then retesting 30 days later before shipping them to South Dakota. We also learned that the Colorado herd had come from the Denver Mountain Parks and was not the same stock as the Badlands herd.

Armed with this information, Superintendent Huffman and I appeared before the Board in June and we carried the day: the Board voted unanimously to allow importation of the Colorado bison to the Badlands herd!

October 27, 1983 was a big day when the Colorado herd was delivered to Badlands NP. Today these animals have become fully integrated into the Badlands herd and are contributing to the gene pool. Both herds are healthier and the range in Colorado National Monument is recovering to a natural, ungrazed condition. The information provided by Dr. Schonewald-Cox played a critical role, not only in making the bison transfer possible, but in making park managers more aware of the factors involved in improving the gene pools of these wild and magnificent animals.

letters

To the Editor:

[Here are] Some items of information for you to use as you see fit in your story on Regional Chief Scientists heading back to the field. My areas of professional expertise (if I have any) and interest are seabird ecology and management and coastal (especially barrier island systems) ecology and management. Technically, I left the job of Chief Scientist, North Atlantic Region, with the start of FY 1984, but I remained in Boston while things were getting sorted out, not actually taking up my new duties at Rutgers until mid-January 1984. Thus, I apparently beat out Don Field as the last holdout among the *original* cohort of Regional Chief Scientists – excepting, of course, for Jim Reid, who, I am convinced, is immortal.

I was in my NARO job just six months shy of 10 years . . . too long, most (and I) would say. The Rutgers Cooperative Research Unit (that's what it is known as, to parallel the same concepts in FWS and Forest Service) was established after quite some spirited competition, with which I was mercifully not involved. The three finalist institutions were Woods Hole Oceanographic Institution, Rutgers, and a SUNY consortium consisting of Stony Brook, Binghamton, Cornell, and CESF-Syracuse. It was established – jointly, by three regions: North Atlantic, Mid-Atlantic, and Southeast – to serve the barrier island park needs in those regions. Thus, I deal with Cape Cod, Fire Island, Gateway, Assateague, Hatteras, Lookout, Cumberland, Canaveral, and Gulf Islands. It is a good system that is working well, and is involving much cross-fertilization among the three regions and the nine parks.

I agree with the statement in your story about re-entry, but perhaps I have had an easier time re-entering, as I have tried to maintain a modest program of research and writing over the last 10 years. It was difficult juggling time and responsibilities, and it is something I would not recommend for those not given to taking work home at night or spending long hours on the weekends preparing reports, briefing papers, or manuscripts. The travel demands on all Regional Chief Scientists only exacerbate the difficulty. But I would not have done otherwise. I had the best of both worlds: the satisfaction of establishing and nourishing a Regional science program, seeing direct research results applied to knotty management problems, serving as a principal in the planning for Fire Island and for the Pinelands, learning the intricacies of Regional and Servicewide operations (especially contracting and resource management), getting to know parks and superintendents, and undertaking a research problem, seeing it through to completion and eventual publication, and then gleefully mailing out those reprints.

The Park Service is a very special organization and collection of marvelous people, such that I frankly have difficulty understanding how people can enter and leave the Federal employ as if it were just some sort of train station. It is easy to see why so many people want to get *in*, however, and I am constantly queried by Fish and Wildlife people who want to join us.

I suspect that more than five years as a Regional Chief Scientist in an on-going, thriving program could well result in burn-out. Perhaps maintaining a personal research program helps extend that period, but without it I agree that it would be very difficult to get

Training to Deal With an Oily Mess

By John T. Tanacredi

Every year in this country more than 10,000 oil and hazardous material spills are recorded by the U.S. Coast Guard. These spills empty around 14 million gallons of materials into our coastal environment. For shore cleanup alone the bill surpasses \$80 million annually.

With tankers whose capacity exceeds a quarter million tons, and with the knowledge that these materials, once they get into the coastal ecosystem network, will continue for years to leach out and seep through the systems, it is imperative that our natural resource managers become familiar with various detection, clean-up, and monitoring techniques.

The U.S. Environmental Protection Agency has a primary role in this effort. Every two years, EPA par-

back in the mainstream of (especially academic) research. Having had the Regional Office experience has proven invaluable in managing a complex, three-Region program such as I have. The Fish and Wildlife Service has a requirement of WASO experience for certain kinds of managerial positions anywhere; perhaps it might be advantageous for us to phase in a similar kind of Regional Office or WASO experience requirement before assignment to direction of Co-op units.

One last pet peeve: I am sure you are aware, paragon of prose that you are, that "Natural Resources Management" is at best a solecism. The management of natural resources is called *resource* (no plural) *management*, in parallel with say, the repair of autos being called auto repair. Safire had a column on the topic not long ago, and I howled with delight, as I had long been correcting the error. You are in a singular position to hurl editorial polemics at the Philistines – go for it!

**Paul A. Buckley, Director
NPS Cooperative Research Unit
Rutgers State University of New Jersey**

To the Editor:

Since your visit here to Gateway last April, I have done some thinking about one of the *Park Science* themes we discussed – the use of scientific research having to do with the parks as part of the interpretive programs. The research papers presented at the recent Jamaica Bay Conference here showed me that raw research data need working on before they can be included in interpretive programs.

First, the material must be selected and translated into layman's terms. Second, it must be surrounded by appropriate caveats so that people are not led to generalizations too broad or inferences too optimistic or pessimistic.

Third – in Gateway's case anyway – the research needs to be placed in a context which is based on a considerable amount of non-NPS research into Jamaica Bay, the New York Bight, and the broad problem of estuarine pollution.

And finally, the public should be made aware of all the research that still needs to be done. It's a big job, and I hope I am able to hire an interpretive specialist who will be up to it.

**Sam Holmes, Chief of Interpretation
Gateway National Recreation Area**



EPA test tank at Leonardo, N.J. serves as demonstration and training facility for exercises in handling oil and hazardous material spills.

ticipates in a major international conference addressing the issues of oil pollutional loads as they impact on our coastal environments. In order to assist our new North Atlantic Region resource management trainees and the Gateway NRA staff, a one-day tour was arranged recently at the USEPA's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) in Leonardo, N.J. This facility provides an environmentally safe place to conduct testing and development of devices and techniques for the control and clean-up of oil and hazardous materials spills.

The facility's primary feature is a concrete tank, 667 feet long, 65 feet wide, and 8 feet deep. The tank can be filled with either fresh or salt water and is spanned by a bridge capable of towing floating equipment at speeds of 6.5 knots for approximately 40 seconds. The towing bridge is equipped to lay oil or hazardous materials on the surface of the water several meters ahead of the device being tested, so that reproducible thicknesses and widths of the test slicks can be achieved.

The principal systems of the OHMSETT tank include a wave generator and absorber beach that can produce and withstand regular waves to two feet in height. A filtering system of diatomaceous earth keeps water clear for underwater photographic work and video imagery and removes pollutants that enter the tank water as a result of testing.

This government-owned, contractor-operated facility is available for testing purposes on a cost-reimbursable basis. The USEPA provides expertise in the area of spill control technology and overall project direction. The OHMSETT facility houses a quality control laboratory to test waters in the tank prior to recycling.

Approximately 15 NPS staff people attended such a field exercise and I believe that the experience added greatly to our Region's general alertness to the potential hazards from oil and hazardous material spills that face all our coastal parks.

Information about the OHMSETT facility can be obtained by calling (201) 321-6629; for information on oil/hazardous materials research, call Tanacredi at FTS 665-3730.

Tanacredi is Natural Resource Management Specialist at Gateway NRA.

Bat Study Provides Useful Baseline Data

By Stephen P. Cross

Recent studies of the bat community at Oregon Caves National Monument (OCNM) have provided information concerning their numerical status, natural history, and compatibility with human activities and, in the process, turned up some amazingly "old bats." The studies were initiated in 1976 because of concern about a possible decline in bat use of the main cave, but the first detailed records go back to the 1948 Master's research on mammals of OCNM by Aryan Roest.

Roest's thesis, published in 1951, reported observation of fewer than 100 bats and identified only four species. In 1958, Ray Albright conducted a capturing and banding study, primarily in the exit tunnel (mostly summer work). In his published results, Albright indicated that 383 individuals of eight species were captured and marked by banding.

According to an in-service report by Glenn Walthall prepared in 1960, the banding was continued in 1959 by Ranger/Naturalist Tom Ford and Ranger Jim Jack. Walthall noted that "according to Jim Jack, 239 bats were banded . . . Eleven of these were retakes from 1958." The records of the 1959 study never were located.

During the summer of 1960, Walthall was able to capture and band 16 bats of two species, and recaptured 11 additional bats which had been banded in 1958 and 1959. He concluded, from his capture of only 27 bats, that the population had declined.

As a result of Walthall's findings, Roger Contor (then NPS Management Assistant) recommended on Sept. 10, 1960, that all bat banding activities be discontinued "until populations return to their former patterns or until the need for such research justifies its effect on the cave ecology." The notion that the populations were declining was based entirely upon decreasing capture success and no attempt was made to estimate actual community size in any of the three years of study. Apparently the recommendation regarding banding was heeded, since no other concentrated effort was directed toward studying the bats until 1976.

During his 1958 study, Albright noted that only a few bats were observed during daytime trips through the cave in July. The bats he banded were captured with a butterfly net in the main exit tunnel between 10 p.m. and 2 a.m. From these observations he concluded that late-night users of the cave were "returning" to the cave and were "apparently using secluded recesses away from the generally travelled part of the cave" for their diurnal roost sites, a conclusion not supported by more recent findings.

With this background in mind, a study of the current numerical status of the bat community at OCNM was initiated in the spring of 1976. The study continued most intensely during the summers of 1976 and 1977 and then briefly each year thereafter during late summer and early fall. Resulting quantitative assessments were compared with those derived from re-evaluation of data collected by Albright in 1958 to determine the relative stability of the bat community. Additional information was gathered concerning daily and seasonal activity patterns, cave roosting conditions, migratory movements, longevity and other factors deemed important in gaining an understanding of the use of the Caves by bats.

Quite unexpectedly, several bats banded by Albright in 1958 were recaptured from 1976 through



Long-eared Myotis, shown here, is the most abundant species of the Oregon Caves community, comprising between 56 percent (in 1958) and 62 percent (in 1977). Photo by Bruce Hayward

1982. Four Long-eared Myotis, four Long-legged Myotis, and one Fringed Myotis were recaptured, some of them several times. The Fall 1982 capture of a banded Long-eared Myotis indicates that bat had to be at least 24 years old. The longevity records uncovered by this study are the longest recorded for all three species and also the greatest for any species in North America, except for the Little Brown Myotis.

Considering the relatively small number of bats initially banded by Albright, these results seem to indicate a high survival rate and great loyalty to the Oregon Caves site.

Bats were captured for study mainly by a nylon strand trap across the opening of the main cave exit and with mist nets placed over the pond near the cave entrance. Some bats with metal bands attached during the 1958-59 studies were re-marked with new bands. Most bats were marked with tiny wing perforations.

Results of the capture-mark-recapture programs of 1976 and 1977 seem to indicate bat usage of the cave similar to that found by Albright in 1958. A total of 230 individuals of eight species were captured in 1976, yielding community size estimates based on the ratio of marked to unmarked individuals of 600 to 784 bats. A total of 340 individuals of eight species were captured in 1977, yielding community size estimates of 779 to 1049. Estimates derived from Albright's 1958 data range from 743 to 885 bats. The most abundant species is the Long-eared Myotis, comprising between 56.1 percent (1958) and 62.6 percent (1977) of the community.

Three species, the Yumas Myotis, the Little Brown Myotis, and the Long-legged Myotis comprised between 29.1 percent (1977) and 32.1 percent (1976) of the captures. Other species captured were the California Myotis, .5 to 2.4 percent; the Fringed Myotis, 3.8 to 7.6 percent; the Big Brown Bat, .5 percent, and Townsend's Big-eared Bat, 2.4 to 6.1 per-

cent. Approximately 80% of the bats were male.

Research shows that variations in techniques and times of capture are important because of differences in behavior of the separate species. When the capture rate of the three most abundant species is plotted against time after sunset, it becomes immediately apparent that they have different times of peak use of the cave. Thus, sampling undertaken at different times yield large differences in apparent total use of the cave.

Only one species, Townsend's Big-eared bat, appears to use the cave routinely as a daytime roost. This species uses the cave most extensively in winter as a place to hibernate. Decreased use during warmer periods of the year may be the result of increased tourist activity, since this bat is known to be quite sensitive to disturbance. The majority of bats using the cave do so at night and generally are not in conflict with human activities. These bats probably roost in nearby buildings, trees, or rock crevices during the day. It appears that the greatest seasonal use of the cave by bats occurs in the late summer and early fall—a phenomenon known in bats as autumn swarming.

Bats are important natural cave visitors and serve as agents for transporting nutrients into the cave ecosystem. The gates at the cave openings appear to allow relatively good access by bats. There are some unlighted areas away from the main tour routes that are used by the relatively few daytime inhabitants. Disturbance of these areas generally can be avoided.

The lights in the cave usually are turned off at night and visitation then is minimal, largely restricted to NPS supervised exploration. Consequently, the pattern of use by bats, as it now stands, is generally compatible with human use and probably will continue if care is taken to avoid interference.

Dr. Cross is a professor of biology at Southern Oregon State College, Ashland, Oregon.

An Ecological Study of the Chellburg Forest

By

Vicki L. Dunevitz, Dale K. Otto and Ron Hiebert

The Indiana Dunes National Lakeshore sponsors an annual Sugar Maple Festival which draws 5,000 visitors per year on the average. Because of popularity of the festival and the opportunities for environmental education it affords, the Lakeshore hopes to continue the program for many years to come. However, the park staff is concerned about what effect continued tapping may have on the health of the sugar maples and whether there will be enough trees of large enough size to tap in future years. To answer the latter question, a structural and compositional study of the forest was initiated in June, 1983.

The primary goals were 1) to assess the size and vigor of the sugar maple population on the site, 2) to determine age/class relationships within the sugar maple population in order to predict the future status of the trees on the site, 3) to make quantitative measurements of other tree species in the forest, and finally, 4) to make management recommendations enabling park personnel to optimize the recreational, conservation, and educational resources of the forest in the future.

Forest Survey

A total of 36 woody species occurred in the plots established for the forest analysis, 27 reaching diameters at breast height (DBH) of at least 5 cm and the remainder occurring only as seedlings or saplings. Importance values, calculated from frequency and density data, revealed that sugar maple was the most important species followed by red oak, white ash, and slippery elm. However, red oak trees were by far the largest trees in the forest, with more than three times as many trees in the largest size class (over 50 cm diameter) as sugar maple. In the seedling and sapling size classes, sugar maple was the clear winner, with over four times the density of the next most frequent species.

There were very few young red oaks. The pattern of many relatively small sugar maples and relatively large red oaks suggests a successional sequence of red oak dominating and sugar maple gradually replacing it. The absence of many dead or dying sugar maples or a preponderance of suppressed trees indicates that the youthfulness of the sugar maple population is not due to a failure of the species to reach large size classes.

Sugar Maple Age/Size Class Distribution

We measured diameters and extracted tree ring cores from 92 sugar maples in the forest, all greater than 5 cm in diameter. We gleaned several useful pieces of information from the ages determined from tree ring counts (see chart).

We found that sugar maples were fairly well distributed across the different age intervals, ranging from 10 to 150 years old. The younger age classes were best represented, as would be expected in a healthy population which was reproducing successfully. A

number of the trees showed very low growth rates for their ages; those were likely suppressed due to low light availability. There were also a good number of trees exhibiting healthy sizes for their ages.

The relationship between size and age of the trees was quantified, demonstrating a good correlation between the two parameters. This enabled us to do several things: growth rates of the sugar maples were determined, and equations for estimating age from tree diameters and vice versa were calculated. These relationships, in turn, can be used to estimate the number of tappable trees in the forest as well as the predicted number of tappable trees in the future.

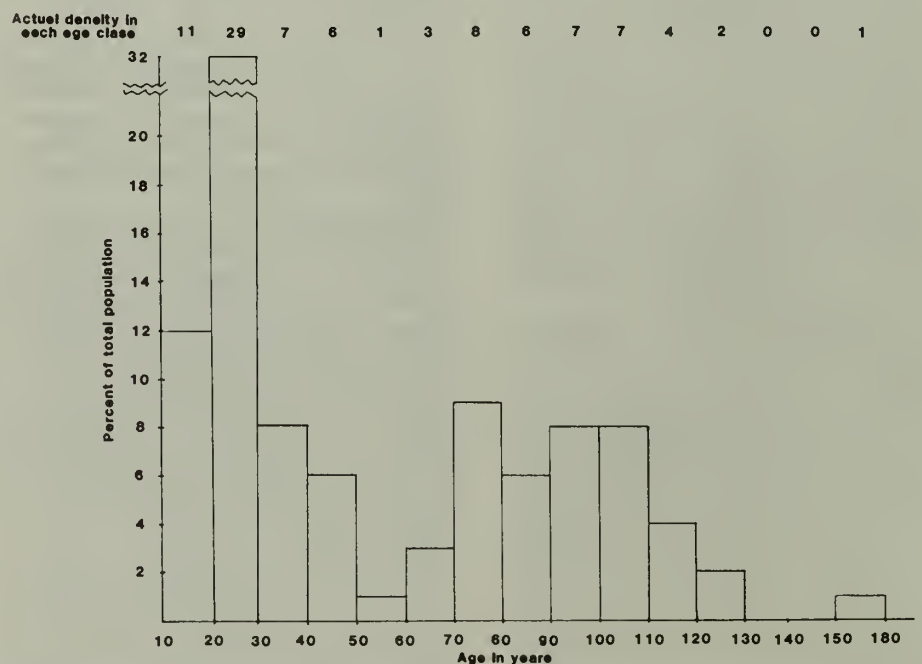
We estimate that the forest contains about 165 tappable sugar maple trees (the recommended diameter for tapping is 25 cm or more). Predicted numbers of tappable trees are 196 by the year 2000, and 250 by the year 2020. Naturally, the dynamics of the forest make such predictions approximate, but it looks as though sugar maples will certainly increase in importance, barring any disturbance or major changes.

Management Recommendations

Management objectives for the area include insur-

ing the health of the sugar maple population as well as preserving the integrity of the forest ecosystem and its aesthetic value. The results of this study indicate that the sugar maple is regenerating naturally and growing healthily in the area, and the stand should increase in numbers of individuals for some time. If it is decided that park personnel should try to improve the stand's maple sugar producing capacity, there are some steps that can be taken. Past research has shown that the best sap and sugar producers are those trees with the largest stem diameters and the broadest crown diameters. It would be advantageous, then, to encourage individual trees by selectively cutting trees around them, enhancing growth conditions for the targeted individuals. It has also been shown that size of trees accounts for only about one third of the variation in maple sugar production, and other factors such as genetic stock and soil conditions also affect production. The best strategy may be to let nature run its course, thus preserving the natural processes of the forest while maintaining an adequate sugar bush.

Dunevitz and Otto worked as Biological Technicians at the Lakeshore in the summer of 1983. Hiebert is Chief Scientist and Plant Ecologist at the Lakeshore.



Age distribution of sugar maples in 12 plots sampled. Bars represent the percent of total density in each age interval.



Park Ranger Jim Bull demonstrates the proper way to tap a sugar maple during the annual Sugar Maple Festival at the Indiana Dunes National Lakeshore.



A portion of the forest near the Chellburg Farm which is used as a "sugar bush."

Hawaii Symposium Follow-up Underway

The June 1984 symposium on Protection and Management of Terrestrial Hawaiian Ecosystems, attended by representatives from State and Federal agencies, a Hawaiian native group, conservation organizations, the State senate, and others, uncovered a host of questions and set in motion a concerted effort at finding answers.

According to Chuck Stone, research scientist at Hawaii Volcanoes NP, experts in the audience volunteered, in response to attendees' questions, to make available short descriptions of ecosystems and vegetation types in Hawaii. All those in attendance were challenged to list the "top ten" resource problems in terrestrial ecosystems protection and management and to submit them to the Symposium leadership for summary and evaluation. Dr. Frank Howarth of the B.P. Bishop Museum will report on the findings.

An additional attempt to make this invitation as widely representative as possible was made by Stone in a letter to all Symposium participants. The letter asked the receiver to rank 10 issues outlined in the letter and to indicate the receiver's own desired actions. "The emphasis," Stone's letter stated, "is on specific management issues and achievable goals."

Plans have been made for prompt publication of the Symposium proceedings.

Chapman Keynotes Science Meeting

Western Regional Director Howard Chapman, in his Sept. 6 keynote address to the Second Biennial Conference on Research in the National Parks of California at U/Cal Davis, told the 130+ participants:

"We need solutions that only science can furnish. If I have one overriding message to deliver here," he said, "it is this — that intelligent protection of park resources will progress only at the rate that new knowledge is discovered and put to use in the System."

"The great natural park systems," he continued, "must be managed in ways that allow them to continue to evolve as much as possible in a natural way. If our hand is needed to keep them functioning, then something is lacking in our management."

Chapman included a strong endorsement of the upcoming international MAB conference at Great Smoky Mountains NP (Nov. 27-29) on management of the world's biosphere reserves.

"I find," Chapman said, "that the Service still is searching for how NPS relates to the World Biosphere Reserve program. I would hope that the November meeting clarifies this relationship. When we have an area that has been designated as a world biosphere reserve, we should take proper recognition of that fact. We in the Western Region will support and emphasize the role of our designated areas as they relate to the wider world picture."

The continuing theme of the California conferences (held every other year at U/Cal, Davis), is "The Integration of Research Into Resource Management Decision Making in the National Park Service."

Channel Island Supt. William Ehorn's conference windup, "Politics and Its Relationship to Research and Resource Management in National Parks," will appear as a Superintendent's Corner in the Winter issue of *Park Science*.

information crossfile

"Parks: How Big is Big Enough?" is the title of a Roger Lewin article in the Aug. 10, 1984 issue of *Science*. Lewin reports on "the world's most ambitious environmental experiment . . . designed to determine how best to protect the dwindling habitat resources that remain" in the Amazon forest.

"A fair number of studies have addressed the problem of ecosystem decay," Lewin writes, "but none has been prospective. The great strength of the 'minimum critical size of ecosystems project,' as the Brazilian-U.S. venture is called, is that it is the first time the effects of fragmentation and isolation will have been closely observed throughout the decay process."

The project is co-directed by Thomas Lovejoy, World Wildlife Fund scientist, and Herbert Schubart of Brazil's National Institute for Amazon Research. Lovejoy conceived the idea in 1976, when ecologists were arguing over application of the island biogeography theory to the design of ecological refuges. According to Jered Diamond, UCLA ecologist, the project is "beautifully designed. It is unique in human history."

Two separate but unrelated questions in establishing minimal critical size for a rain forest habitat are (1) Are species lost in some sort of predictable order? and (2) Will forest fragments of similar size end up with similar final species compositions? Another concern was size — a matter that was "the focus of most folks' minds" at first; events, however, forced attention to be turned to the phenomenon known as the edge effect. Lovejoy describes a series of systematic studies aimed at determining the magnitude of the edge effect.

Acid rain is vying with grizzly bears as the hottest topic outside of breaking news in the public press. *United Press International* and the *Washington Post* ran extensive treatments in August at the start of a 10-year study to determine the effects of acid rain on historic monuments and other structures around the country. Scientists from the U.S. Geological Survey and NPS spokespersons are quoted in describing the test sites and the questions being asked.

In Washington, D.C., 650 pounds of stone and an additional quantity of metals are exposed on top of several racks at a Northwest branch library. Other sites where the testing has begun include New York, New Jersey, and North Carolina. Sites in Canada and the Midwest will be added to the study in 1985.

The work is being conducted by an Interagency Task Force on Acid Precipitation, including the Environmental Protection Agency, the Bureau of Mines, USGS, and NPS.

The rapid growth of the aquatic weed, hydrilla, on the Potomac River, "now threatens to inspire a parallel proliferation of red tape," according to a July 11, 1984 story in the *Washington Post*. Richard Hammerschlag, chief of the NPS Ecological Services Lab in D.C., is quoted in the story, the news peg for which was the Army Corps of Engineers' call for "immediate action" to control the weed.

"There's never going to be a total Potomac control

system strategy," Hammerschlag is quoted as saying, following a meeting with Corps officials to discuss the hydrilla problem. He suggested that there may be some small-scale testing of hydrilla control methods this summer, but that "basically hydrilla is here to stay. It's too late," he said. "It has already distributed itself. It is a new adjustment that a new generation will have to make."

Hammerschlag described his main interest as a search for "a calmer view. There is no question," he said, "that hydrilla provides positive virtues to some extent, but it doesn't provide any that native species don't also offer."

A new Wildlife Management Institute book, *White Tailed Deer: Ecology and Management*, has been announced by Stackpole Books, Box 1831, Harrisburg, Pa. 17105. The study is authored by more than 70 persons who have devoted their professional lives to the science and art of wildlife management. Edited



by Lowell K. Halls and illustrated by Cindy House, the 46 chapters, more than 670 photographs, 137 maps and figures and 118 tables, the study carries a price tag of \$39.95 plus \$2.50 for shipping and handling.

The June 22, 1984 issue of *Science* contains an article by R.O. Peterson, R.E. Page, and K.M. Dodge (all of Michigan Technological University's Department of Biological Sciences) on "Wolves, Moose, and the Allometry of Population Cycles." The authors report evidence, from long-term studies, of long-term oscillatory behavior in a large mammal predator-prey system, and that their data are consistent with the proposal that "herbivore populations should fluctuate at periods proportional to the fourth root of body mass." They note that the relationship between body size and life cycles "is so simple and pervasive that it can be overlooked." The dependence of cycle period on body size "follows logically," they state, "the premise that animal cycles reflect the interaction of natality, mortality, and dispersal, coupled with the allometric scaling of physiological functions and life history characteristics to $M^{1/4}$."

The September 1984 issue of *Scientific American* is entirely devoted to computers. Of particular interest to readers of *Park Science* are the articles on "Computer Software for Information Management," by

Michael Lesk ("Stored data are of use only if information can be retrieved quickly in an understandable form"), and "Computer Software in Science and Mathematics," by Stephen Wolfram ("Simulation programs offer a new way to study natural phenomena . . .").

From Bill Halainen, editor of the NPS *Ranger Newsletter*, comes a swatch of clippings from the East — *New York Times*, *Concord (MA) Journal*, etc. — on resurgence of wildlife in the East, particularly in the area commonly referred to as "Thoreau country." Halainen writes: "This is really exciting stuff. Here at Minuteman (National Historic Park) we've had 15 fox sightings recently, also raccoons, opossum, and deer — all up perceptibly"

Jay Fitzgerald's story in the *Concord Journal* even claims the reentry of coyotes, and rates the comeback as "approaching a level not seen since the American Revolution." The *New York Times* story, by Harold Faber, reports a major shift in the migratory patterns of Canada geese, many of which are not flying as far south as they once did for the winter. The change is laid not to weather, which hasn't changed that much in the past 20 years, but to the changing patterns of agriculture, particularly in the Delmarva Peninsula "where truck farms have given way to cornfields that feed the chicken industry."

Wind, accompanying a thundershower passing through the central portion of Yellowstone NP on Sunday, July 8, felled approximately 100,000 trees in a matter of minutes. Supt. Robert Barbee was quoted in an NPS press release, commenting on the blowdown near Elk Meadow on the Gibbon River:

"It is indeed an impressive sight. The sheer magnitude is awe-inspiring and it provides an excellent example of the workings of nature, which is the reason why Yellowstone is a national park."

The downed trees all lay in one direction, most uprooted but some snapped off 4 to 8 feet above ground. The blowdown occurred in a mature lodgepole pine forest, where trees are estimated at 250 to the acre. Downed trees blocked roadways until forestry crews and other park staff could clear them with chain saws and heavy equipment.

The October issue of *Horizons*, publication of U.S. Agency for International Development (AID), (Washington, D.C. 20523) is devoted to biological diversity. The issue includes an article by Caldwell Hahn, "Preserving the Earth's Genetic Resources," that describes the accelerated pace of species extinctions in the 10,000 years since the human agricultural revolution began, and reports on the U.S. strategy for preservation of biological diversity. November 1984 is the target date for presentation of that strategy to the U.S. Congress. AID is the lead agency in the strategy/task force that includes 11 agencies as well as environmental groups, international organizations and the private sector. The question of preservation of genetic diversity is being systematically addressed at both the technical and the policy levels.

Also included in the October issue is "Genetic Resources for Development," by John Daly.

Horizons is edited by Sharon Isralow of AID's Bureau of External Affairs and is available to the public without cost.

Information Crossfile

(Continued)

Air pollution in the dramatic natural area National Parks of the West occupied a considerable number of inches in Western newspapers this summer, with NPS scientists, university professors, and private research outfits all serving as sources for the articles.

The *Rocky Mountain News* quoted David Ross of Air Resource Specialists in Fort Collins, whose research showed that visitors at Grand Canyon and Mesa Verde rated visibility-related attributes of the parks as most important to their park experience. Psychology professor Ross Loomis of Colorado State University said visibility is often taken for granted and because its impairment is gradual, its loss tends to be accepted for some time.

Phil Wondra, chief of the NPS research branch, division of air and water quality, Denver, and William Malm, a research physicist in Wondra's group, were the sources for a comprehensive story in the *Deseret News* (June 5-6, 1984). The major human-caused pollutant affecting such parks as Grand Canyon and Mesa Verde is sulfur dioxide and sulfates from southern California and southern Arizona, the scientists stated. "After seven years of monitoring in southern Utah," Wondra said, "there isn't a day when we can't measure man-made pollutants." The hazy air that sometimes hangs over Bryce and Zion National Parks "first passed over southern California 400 miles away or copper smelters in Arizona," said Malm. Malm's studies showed that sulfates were responsible for 50 to 70 percent of all lost visibility in Western parks.

A *Citizen's Guide to River Conservation*, by Rolf Diamant, J. Glenn Eugster, and Christopher J. Duerksen, is available now from The Conservation Foundation, 1717 Massachusetts Ave., N.W., Washington, D.C. 20036. The 100 page paperback, with maps, illustrations, appendixes and bibliography, is a how-to book stressing conservation tools and containing case studies of innovative programs using easements, voluntary agreements, land purchases, tax incentives, zoning ordinances, and government permitting. Cost is \$7.95 plus \$2.00 handling and mailing charges.

How does our research look to others? *Sports Illustrated*, July 20, 1984, in an article by Bil (with one "l") Gilbert, gives us a chance to "see ourself as others see us." Writes Gilbert:

"To show concern for another species, up-to-date wildlife scientists almost reflexively try to put collars, bearing radio transmitters, on the creatures in order to follow and collect information about them. This is called research, and it sometimes is beneficial to the animals but if not, at least it gives a soothing sense that good works are being done on their behalf."

A joint study by NPS and the National Oceanic and Atmospheric Administration (NOAA) of the complex air currents in and around the Grand Canyon this fall and next spring was described in *USA Today*, August 15 edition. Don Henderson, an NPS meteorologist in Denver, is quoted as saying the study will help the Service pick the best times to burn underbrush along the rims without smoke going into the canyon.

Henderson has promised *Park Science* a story when the study results are in.

Prescribed Fire Qualification System Developed

By Thomas M. Gavin

The Western Region Prescribed Fire Qualification System, which has attracted considerable interest recently both from other resource management agencies and from elsewhere within the NPS, was developed in FY 1983 and now has been fully implemented.

The system consists of three prescribed fire position levels: Prescribed Fire Manager, Prescribed Burn Boss, and Crew Member. The training course prerequisites for each position were defined in conjunction with the recommended skill/knowledge levels prepared by the Prescribed Fire and Fire Effects Working Team in 1979 (see *Prescribed Fire Job Qualification Guide*, National Wildfire Coordinating Group). Because of the wide diversity in vegetation types among the different parks in the Western Region, we elected to define a set of mandatory core courses which address the common training needs in all our parks.

Electives Requested

Each park involved in the use of prescribed fire was asked to submit an expanded set of electives that would supplement this core. Electives were to have been site-specific in nature. For example, Sequoia/Kings Canyon NP requires S-212 (Power Saws) as a requirement for Prescribed Burn Boss, where Joshua Tree National Monument, for obvious reasons, does not.

The Western Region core, together with the expanded list of park-specific electives, was approved by Superintendents and is maintained on file in the Western Regional Office. This has been of tremendous value in defining overall Regional Training needs.

While developing the course curricula for each of the three positions, we attempted to shape each position to the organizational structure of most of our parks using prescribed fire. The Prescribed Fire Manager is typically the responsibility of the Natural Resource Management Specialist concerned with fire effects, post-burn monitoring, and overall program management. Ideally, this individual will generate burning prescriptions and plans. The Prescribed Burn Boss is more of a practitioner and ideally is responsible for fire suppression within the park. The thrust of this position is burn plan implementation. The Crew Member position usually is assumed by all others within the park who provide support to prescribed burning programs.

Briefly, the courses desired of a Prescribed Burn Boss emphasize concepts in Natural Resource Management and may not necessarily be fire-specific. The Burn Boss courses focus on skills, organization, safety and suppression capabilities. The Crew Member program is designed to provide a minimum level of knowledge in fire behavior. All three position requirements differ, both in Regional core requirements and park-specific electives. Likewise, physical fitness requirements are slightly different between

positions. In some areas, one individual may have to assume all three positions, depending upon the size of the park staff. However, our ultimate goal is to have an individual or individuals qualified as Prescribed Burn Boss and Prescribed Fire Manager in each park conducting a Prescribed Fire or Natural Prescribed Fire Program within the Region. The current Red Card System is being used to track an individual's skill level.

Key Requirement

The fundamental and key requirement within the qualification system is the Western Region Prescribed Fire Course. This is a two-week Park Service specific course designed to train people in the skillful application of prescribed fire. Emphasis is placed on classroom knowledge of fire behavior and field application of prescribed fire to meet a predetermined *NPS objective*. During the course, students are exposed to the Standardized Western Region Prescribed Burn Plan Format being used at all parks within the Region. Completion of the course requires that students successfully complete an actual burn during the training course. In turn, this is supplemented by a minimum of two burns by each student within his/her base park. This gives students exposure to a variety of burns within differing fuel models. Following the completion of the formal training course, a cadre of Regional course facilitators moves from park to park in order to grant final certification relating to the park specific burns. These hands-on actions have contributed to the accumulation of a Burn Plan Library, being maintained in the Regional Office. Ultimately, prescriptions in all fuel models within the Region will be represented and will be at the disposal of all field managers.

We in the Western Region believe that this certification system shows real promise. Individuals from many parks have completed certification burns and a major result has been a sense of sound communication and cooperation within the Region and with other agencies.

For those of you considering such a system, one last comment is warranted. Implementation is not easy. It may present hardships and may curtail, at least in part, burning programs that may have existed prior to implementation of the system. Furthermore, it is expensive and requires extreme dedication on the part of the Superintendents, park staff, and ultimately the Regional Director. However, any misuse of prescription fire by the National Park Service has the potential to claim human life, destroy personal property and unnaturally alter our ecosystems. With this in mind, we feel that a qualification system for the use of prescribed fire is no less important than the one we have established for fire suppression. This is especially significant when we consider that, unlike the case with wildfires, the Service is directly liable for all fires that are NPS-initiated.

Gavin is a Fire Ecologist for NPS in the Western Region.

regional highlights

Water Resources Lab

A combination of acid deposition policy and science was the fare at the Acid Rain and the West conference held in Gunnison, CO July 23-25. Among highlights of the meetings was the excitement caused when two researchers, Erich Elstner from Germany and Richard Klein from Vermont, claimed to observe forest damage in Colorado that "precisely parallels that seen in southern West Germany and in New England." An emergency group was formed to conduct further investigations.

Another highlight was the official announcement of the formation of the Western Atmospheric Deposition Task Force. The group will attempt to coordinate atmospheric deposition research in the Rocky Mountain States, making sure that needed research gets done and lines between scientists and policy makers are kept open. Two members of the National Park Service, Chris Shaver and Jill Baron sit on the Task Force, which also includes EPA, US Forest Service, US Geological Survey, environmental and industrial members.

Southwest Region

The Submerged Cultural Resources Inventory for Point Reyes NS and Point Reyes-Farallon Islands National Marine Sanctuary, authored by Toni Carrell, is now in print. The shipwreck survey for the same area, prepared by Larry Murphy, is at the Government Printing Office in Denver, ready for delivery. Both documents are available from the Submerged Cultural Resource Division, P.O. Box 728, National Park Service, Santa Fe, NM 87501.

★ ★ ★

An 8-year-old boy, walking with his parents, a brother and sister in the well-populated Basin area of Big Bend NP on July 28, was attacked and badly mauled by a 70-pound, 2-year-old, male mountain lion. The boy's father attempted to rout the lion and was himself attacked and bitten.

Twenty-four hours later, after tracking the animal in a 20-mile circle, Big Bend Rangers and Texas trackers overtook and killed the lion at a spot almost exactly where the boy was attacked. Lab analysis of the animal's head was negative for rabies; the stomach analysis was positive for human flesh and hair.

Big Bend NP has recorded 494 documented lion/human interactions since 1952, according to Milford Fletcher, Southwest Regional Chief Scientist.

Western Region

The annual report for 1983 from the NPS Cooperative Resources Studies Unit at the University of Arizona, Tucson, is now available. It covers research activities at Grand Canyon NP and at Chiricahua, Organ Pipe Cactus, and Saguaro National Monuments, plus unit-facilitated projects, CPSU/UA published reports, other reports by Unit staff, and the Unit's plans for the future.

Rocky Mountain

Four grizzly bears, stranded for several months on Frank Island in Yellowstone lake – approximately two miles from the closest shoreline – after their ice bridge melted, have been trapped and moved to shore by boat. The mature sow, possibly 12 to 13 years old, weighed only 150 pounds instead of the 250 or so pounds she should have weighed, according to park biologists. One female cub and one male cub weighed only 20 pounds, compared to a normal of 35 to 40 pounds for cubs their age. A second female cub, the runt of the litter, died on the boat trip from the island. Scat analysis indicated the sow was subsisting on fish remains, small rodents, vegetation, one elk carcass, and possibly ants. The one-square-mile island simply could not sustain the female adult and her milk was insufficient to provide three cubs with necessary nutrition. The natural range of an adult grizzly in the wild is approximately 40 square miles.

★ ★ ★

Researchers interested in presenting research information on atmospheric deposition, sources, and effects at the Air Pollution Control Association (Rocky Mountain States Section) Symposium at Boulder, CO January 30, 31 and Feb. 1, 1985, should contact Dr. Jim Blankenship, 240 W. Prospect St., Fort Collins, CO 80526. (303) 221-4390 or FTS 323-1328.

The symposium will focus on the research needs in the area of acid deposition, its measurement, and its effects on ecosystems and materials damage. Papers on six topics are sought: (1) sources, natural and anthropogenic, (2) atmospheric processes – transport, transformation, and deposition, (3) monitoring, wet and dry, (4) terrestrial effects, (5) aquatic effects, and (6) effects on material.

For information on registration, the contact is Charles Stevens, EPA, 1860 Lincoln St., Denver, CO 80295. (303) 844-3711 or FTS 327-3711. The NPS is a co-sponsor of this symposium; Jill Baron is on the technical committee and Water Resources Lab Director Ray Herrmann is serving as session chairman for the effects on materials paper session.

Mid-Atlantic Region

Paul Buckley, Director of the NPS Cooperative Research Unit at Rutgers University, on June 15, conducted a training session with three Jamaica Bay Wildlife Refuge staff members on techniques to be used in aerial surveying (colony location) and censusing (estimating of numbers) of colonial waterbirds. After the four-hour field session in the helicopter, the Gateway NRA resource managers then conducted their own survey and census of the area and plan to assume these duties each year beginning in 1985.

North Atlantic Region

Herb Cables, NAR Regional Director, in July attended the Liverpool Congress on Green Cities and Towns UK/USA in Liverpool, England, where he spoke at the banquet and presented a workshop on "The Changing Social Function of Green Spaces."

★ ★ ★

Michael Soukup, Regional Chief Scientist, has been working on research on the effects of liming of Great Pond and the Herring River. Cooperative agreements have been started at U Mass Amherst and SUNY Syracuse for deer, fire, and vegetation studies. A Pamet River study at Cape Cod NS also has been initiated with the Marine Research at Falmouth, Mass.

Southeast Region

From the South Florida Research Center at Everglades NP comes word of Technical Report #SFRC-84/01, "Summary of Fires in Everglades National Park and Big Cypress National Preserve, 1981." The report is available through the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

★ ★ ★

The Third Annual Chattahoochee River Research/Resource Management Conference will be held at the Chattahoochee River National Recreation Area, Dunwoody, Georgia, Oct. 26-27, 1984. The Conference objectives are to share information on completed or ongoing work on the natural and cultural resources of the Chattahoochee River NRA and to identify information gaps. Proceedings of the Conference are planned for publication in January, 1985; persons interested in obtaining copies should address their requests to Ken Hulick, Resource Management Specialist, Chattahoochee River National Recreation Area, 1900 Northridge Road, Dunwoody, GA 30338.

★ ★ ★

A national symposium entitled, "Outdoor Recreation Trends II" is scheduled for Feb. 25-27, 1985, at the Myrtle Beach Hilton in Myrtle Beach, SC. Symposium objectives are to (1) identify recent trends in outdoor recreation, their causes, their probable short range outcomes, and their policy implications; and (2) provide examples of current trends affecting outdoor recreation, available trend indicators, data series, and trend monitoring programs applicable to recreation planning, decision-making and policy formulation. Clemson University is hosting the symposium, and cooperators include the U.S. Forest Service, the National Park Service, the University of New Hampshire and Utah State University. The NPS Southeast Regional Office will publish the proceedings as part of its contribution to the symposium.

★ ★ ★

Research/Resources Management Report SER-67, *Geology and Geomorphology of the Southern Central Blue Ridge: An Indexed Bibliography* by Stephen P. Yurkovich contains nearly 875 references dealing with the geology and geomorphology of the southern and central Blue Ridge Mountains. Copies are available through the Uplands Field Research Laboratory, Great Smoky Mountains National Park, Twin Creeks Area, Gatlinburg, TN 37738.

★ ★ ★

Proceedings of the Ninth Annual Scientific Research Meeting of the NPS Southeast Region, held May 19-20, 1984, are now available in printed form. The publication (24 pages) contains abstracts of completed or ongoing research in the areas of Plant Ecology and Soil Chemistry, Fish and Aquatic Ecology, Wildlife, Social Science Studies, Spruce-Fir Ecosystems in the Southern Appalachians, and Environmental Monitoring of Mountain Stream Ecosystems. Copies may be obtained by writing the NPS, SE Regional Office, 75 Spring St., S.W., Atlanta, GA 30303.

Restoration of Historic George Washington Carver Prairie

By George Oviatt and Gary Willson

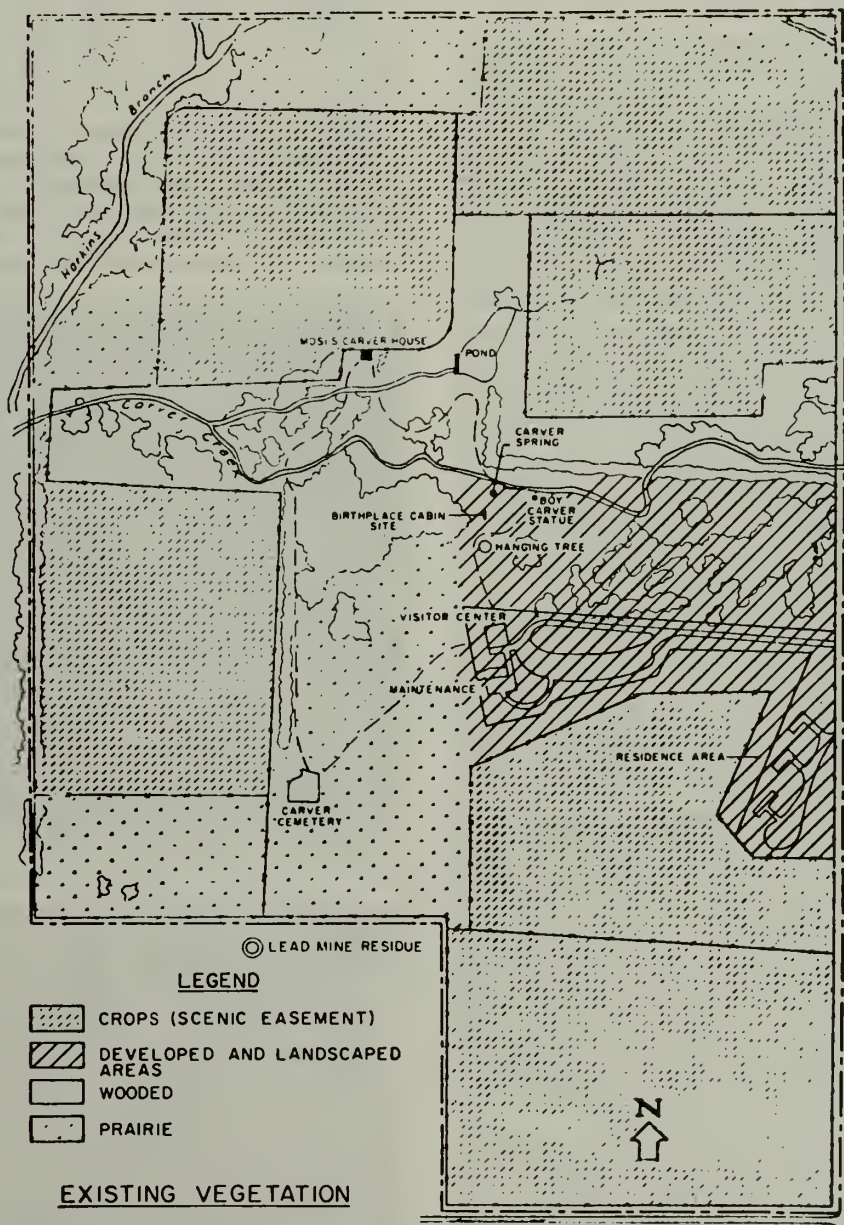
The presettlement prairie in Missouri occupied 27 percent of the state's total land area. This 18,474 square mile area now has dwindled to some 40,000 acres and because of agricultural impacts it has lost much of its presettlement character. Originally, vast stretches of prairie with vistas of 8 miles or more were common. These now are gone and the remaining prairie is relegated to small remnants in isolated areas and along roadsides. The land within George Washington Carver National Monument (GWCA) contains several scraps of a prominent 19th-century landmark called Diamond Prairie, which stretched for some 25 miles across southwest Missouri.

In 1981, a program was initiated to restore the native prairie remnants at GWCA and thus implement one of the park's primary management objectives: "to restore the historic scene to that of the Moses Carver farm of the 1860s and 1870s." Several preliminary studies demonstrated the need for this restoration. Although the original land survey of 1842 describes the area encompassing GWCA as being almost entirely native prairie, vegetation sampling during 1981 showed the area to be a mosaic of weedy old fields, pieces of prairie, and young forest. In addition, subsequent studies found soils within the monument to be predominately associated with prairie.

George Washington Carver lived on the Moses Carver farm during the 1860s and 1870s and historic prairie areas were thought to be significant because of the role they played in shaping his scientific interest in later life.

Sound management planning was needed to restore the prairie as close to that of the 1860s and 1870s as possible. This need was partially met through the design and implementation of a Prairie Restoration Action Plan. This plan documented management alternatives and their probable environmental impacts and recommended specific management actions to restore prairie. Management practices proposed included reseeding, prescribed fire, mowing and herbicides use. In conjunction with this document, a prescribed burn program was implemented.

With a project of this magnitude, success depends a great deal upon the cooperative efforts of all parties involved. From the beginning, cooperation was solicited from various state agencies such as the Missouri Department of Conservation, which provided free equipment, labor and professional opinions. The park VIP program, in association with a local college, initiated scientific studies that documented baseline data and monitored changes as restoration progressed. In no other area was this cooperative effort more evident than in the exchanges of personnel and time that took place between park divisions to meet common restoration objectives.



Results of the most recent scientific monitoring done on the prairie restoration areas have shown a definite improvement in native prairie species composition. This past year native grasses were found to be increasing in dominance in all areas. Future management actions will include inclusion of new areas

for reestablishment of historic prairie and the examination of the woodland/prairie ecotone to better define the historic prairie borders of the 1860-1870s.

Willson is a Midwest Region Ecologist; Oviatt is a Resources Management Technician at George Washington Carver NM.

Ice Cave Research Aids Management and Interpretation

Editor's Note: James Sleznick, Jr., superintendent of Lava Beds National Monument, sent the following article to Park Science, with the observation that "this information is extremely important to the interpretation of caves – even to explaining caves without ice. The temperature effects are due to the lava and the air circulation, and Charlie has definitely thrown into some doubt the old cave theories on which we had been basing our interpretation."

By Charles L. Arnold

Lava Beds National Monument presents a fascinating picture of the different kinds of cave temperature patterns that can be produced, depending on whether they are controlled by the surrounding rock temperatures or by air circulating through the caves. The following information, which I believe to be useful in both managing and interpreting the caves at Lava Beds, summarizes the early findings in five caves between July 1982 and April 1984. Valentine cave is used as the reference cave because of its unique characteristics.

To fully appreciate the wide range of cave characteristics at Lava Beds, a visitor should first visit Mush Pot, leaving Valentine till last. For a really well-rounded look at this Monument, the visitor also should visit the Lava Beds in winter.

Valentine is unique among the caves easily visited. Three characteristics distinguish it from the others:

- air circulation from outside is minimal;
- the temperature at the end of the cave is warmer in winter than in summer, and
- the cave is almost free of collapse rock.

Air from outside Valentine cave tends to circulate around the central pillar just inside the entrance. It penetrates the cave on the left as one enters; displaced air must leave the cave on the slightly higher right side of the entrance. This configuration limits the influence of air circulation to within approximately 300 feet of the entrance.

On a cold winter morning, the visitor may see a plume of steam rising from the cave mouth. Later in the day, when the plume no longer is visible from outside, the inside observer may notice a light fog as the circulating air leaves the cave.

Temperature changes at Valentine are unlike any of the other easily visited caves at Lava Beds. Near the entrance, the thermometer reflects the seasonal changes found in all the caves, but at the end of the cave (1,000 feet from the entrance) the temperature pattern is directly at odds with the season outside . . . colder in summer, warmer in winter.

Cave interpretation can include an explanation of this paradoxical phenomenon, starting with the 30-foot thickness of the lava that overlies the far end of Valentine cave. Summer heat and winter chill take approximately six months to work their way from the surface through the lava and into the cave. The result is that the warm wave of summer surface temperature arrives at the cave level in winter and the cold wave of winter surface temperature arrives in summer.

The uniqueness of Valentine's floor is its exceptionally clean condition. It consists of ropy lava, generally damp or wet, and is uncluttered except for a few blocks of collapse rock.

The following chart summarizes the difference between Valentine, where the surrounding rock temperature, which is 52 degrees, controls the overall cave temperature, and the rest of the caves, where air circulation is the controlling temperature factor.

	Observed		Annual Average
	High	Low	
Valentine	53	51	52.5
Sentinal (at steps)	51	36	42.8
(at bridge)	63	38	44.9
Indian Well	41	26	34.8
Skull	34	28	32.6
Merrill	34	30	32.5

Indian Well cave is a classic cold trap. Its entrance faces north, which prevents direct sunlight from heating the interior. It also is closed at the bottom, but has an opening to the surface at the south end. Warm air rising to the roof easily vents to the outside, leaving the cold air to remain undisturbed at the cave bottom.

Note that Indian Well has the coldest observed temperature of any of the caves studied.

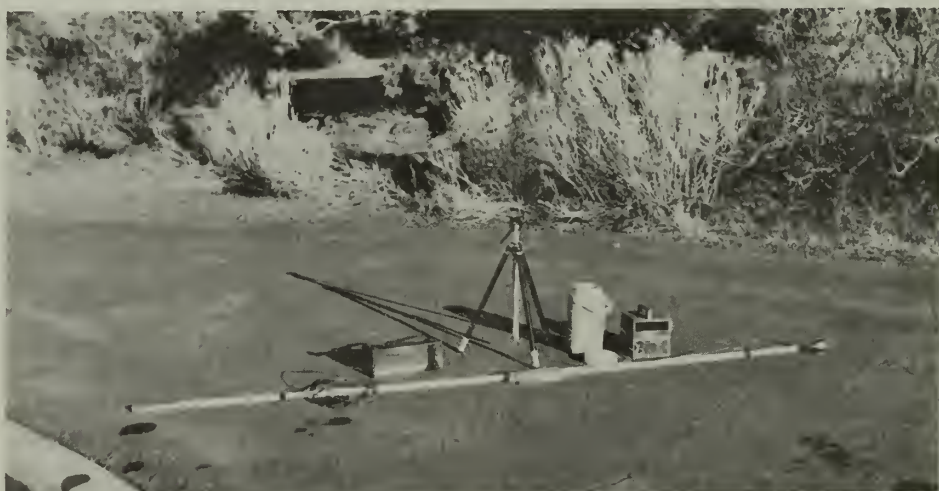
Skull and Merrill are ice caves that have a continuous, but restricted, air circulation. Each of these ice caves is believed characteristic of the other ice caves in the Monument, and each has a small passage that limits the rate at which air can enter or leave the cave. The source of heat causing the circulation evidently is the surrounding rock, which a short distance from the cave would be the same temperature as Valentine. An oddity appears where Skull was observed to reach a colder temperature than Merrill, but Merrill's average temperature is colder than Skull's. This may be explained in part by the fact that the restriction to air circulation in Merrill is located at the top of the steps into the lower level, while the restriction in Skull is beyond the steps into the lower level.

The average daily mean temperature for the Lava Beds NM is 47.3 degrees Fahrenheit. Comparing the temperatures of the caves to the annual average daily mean temperature suggests that Valentine must be controlled by the surrounding rock temperature and the other caves by the air that circulates through them.

Arnold is a permafrost engineer from Albany, Calif., studying ice caves as unique examples of permafrost. Presently Arnold is on assignment in China for the Bechtel Corporation.



Temperature indicator shown here is reading a thermocouple imbedded in cave rock. The ice bucket is used to calibrate each thermocouple reading.



Here's what it takes to take a cave's temperature. Back row, left to right, flashlight, tripod to support pole with thermocouple for roof temperature, ice bucket for calibrating thermocouple reading, and temperature indicator. Front row: Pole with thermocouple for roof temperature and pocket sling psychrometer.

Book Review

THE IMPERIAL LION, *Human Dimensions of Wildlife Management in Central Africa*, by Stuart A. Marks. Published in 1984 by Westview Press, 196 pages. Cost \$18.00.

Reviewed by Dr. James A. Sherburne, Advisor, Interagency Task Force on Biological Diversity, Bureau of Science and Technology, Agency for International Development, Washington, D.C.

Editor's Note: This review was written for Horizons, the U.S. AID magazine for the developmental professional.

Marks promotes one overriding theme in this monograph, which is largely derived from his work in Zambia coupled with documents relating to wildlife conservation and management in central and eastern Africa: That development is a totality which cannot be properly understood by its separation into convenient parts; and that development objectives of large(r) organizational units must be based on initiatives organized at the local level.

This is not a novel theme, particularly as it regards wildlife management in Africa. The problem, however, is that neither is it a practice. Marks spends a considerable amount of effort and space in taking to task the colonial approach to wildlife management introduced and practiced in most African countries, i.e., protection, regulation, establishment of national parks, curtailment of local rural utilization of game species, government controls, and political and economic interests prevalent at central administration and management levels. He points out that such practices do not consider the well being of the majority of people, the dependence upon wildlife resources by rural people, or the reason for such practices other than that they "work" in Europe and North America.

Mark's main contention is that unless social and cultural concerns are integrated with biological economic and political considerations, wildlife management as currently practiced will not succeed. He argues that "decisions affecting wildlife survival and the welfare of small-scale rural societies, often existing on the same terrain, are increasingly made in bureaucratic institutions far removed from the consequences of their actions;" what I call technology transfer by armchair ecologists, who usually neither visit with nor listen to Africans who are affected by their ideas, plans, and programs, and when they do, listen to the wrong ones.

To support his theme, Marks goes into considerable detail which may be of interest to the serious scholar or development expert regarding such topics as the art of scientific knowledge, the wildlife management paradigm, the process of paradigmatic change, resource systems and change, and problems associated with interdependence in a changing world. He also describes the evolution of wildlife management practices in Zambia, backed by discussions of resource utilization not necessarily considered by such management.

As one who supports Marks' theme, and would go beyond it to question whether many current wildlife management practices are either necessary or sound (how often were traditional "management" or uses of wildlife examined before imposing the colonial systems?), I feel this book is important reading for the serious student of African wildlife, for development assistance experts who will affect wildlife resources by their decisions, and for anyone who feels he can depend upon traditional wildlife literature to under-

RMPs Identify Baseline Data for Midwest NPs

By Gary D. Willson and Judy A. Skipski

The basic concept of National Park Service resource management centers on approved resource management plans (RMPs) that are based upon park management objectives. Since the mid-1960s, the Service has required RMPs to be completed by parks prior to initiating research or management actions. Compliance, however, has been sporadic. By early 1980, deficiencies in the resource management planning process were creating adverse impacts on the resources the Service was charged with protecting. New RMP guidelines therefore were released in December 1980, prompting a major move by the Service to: 1) better quantify the current status of each park's natural resources and resource management problems; 2) identify the research, monitoring and/or management actions needed to resolve these problems; and 3) rank individual research, monitoring, and management-action projects for funding consideration. As a result, each park in the Midwest Region (MWR) completed an RMP according to these new guidelines by Dec. 1, 1981.

With the RMPs complete, we had, for the first time, a basis on which to determine baseline information needs for parks in the MWR. As a test, we conducted a review of the RMPs in early 1982 to assess the status of contemporary vegetation information for 22 parks with significant natural resources. We also reviewed Regional contract research reports for addi-

stand how the classical North American wildlife management objectives can be appropriately applied in Africa. This monograph clearly points out that that cannot necessarily be done. The book also has a clear message regarding the importance for resource managers and development experts to begin development assistance plans that incorporate natural resource conservation at a local level, and not in their bureaucratic institutions.

While Marks makes these points quite clearly (and frequently), and while he strongly argues for the consideration of local-level, social, cultural, and economic concerns (especially as to who really benefits from wildlife management) in any effective conservation approach, his points are often left after defining the problems without offering solutions.

There may not be any easy answers or simple solutions to effective wildlife management in Africa. It is clear though that unless development assistance efforts take local concerns and uses of wildlife into account, the socioeconomic factors unique to individual rural communities will be overlooked in favor of "mining" the wildlife for the few and not "harvesting" it for the commons. Further, it is becoming increasingly obvious that this "mining" of wildlife resources is, overall, detrimental to the resource itself.

Within the context of biological diversity conservation we now hear discussions concerning the need to examine the possibilities of transferring traditional (i.e., effective) agricultural technology. Perhaps it is time to reexamine the "accepted" wildlife management approaches and take a good look at traditional use of wildlife by integrating socioeconomic as well as ecological perspectives.

tional baseline information documentation which either added to or confirmed that found in the RMPs. We recorded several subcategories of vegetation information as complete or nearly complete (yes), incomplete (inc.) or lacking (—) for each park. In addition, we also counted the number of vegetation research contracts let between 1973 and 1982 for the 22 parks.

Sound management of a park ecosystem must be based on adequate baseline information. Except for Isle Royale National Park (NP), we found a pervasive lack of vegetation data for parks in the MWR (Table 1). This was especially pronounced in the small parks (those with less than 2,000 gross acres). We believed Isle Royale's unique situation was due, in part, to its wilderness national park status and the heightened scientific interest shown in such areas. Specific subcategories where information gaps were pronounced included nonvascular plant collections and permanent vegetation plot monitoring. In the others data were incomplete.

In response to this need, the Regional Science Office initiated the following comprehensive studies directed toward filling information gaps:

1. Vascular plant collections at Agate Fossil Beds National Monument (NM), Scotts Bluff NM, Homestead NM, Effigy Mounds NM, Fort Larned National Historic Site, George Washington Carver NM, Grand Portage NM, Pipestone NM, Sleeping Bear Dunes National Lakeshore and Voyageurs NP. New or updated collections, vegetation maps and exotic and endangered plant identifications will result from these studies. Also, long-term monitoring programs will be established as a part of these studies to provide an early warning system for impacts by visitors, exotic animals and plants, pollutants and other threats.

2. A Regionwide endangered plant survey by the U.S. Fish and Wildlife Service. A literature search is underway and fieldwork will commence in 1984 for 19 parks in the Region. The ultimate goal is identification and protection of all rare plants and their habitats within the Region's parks.

Our initial review of the RMPs showed much more was known about vegetation in larger parks than smaller parks. Subsequently, an accounting of the number of vegetation studies contracted between 1973 and 1982 in the 11 small parks versus the 11 large parks showed large parks being favored by a 7:1 margin (28 to 4 in number). Beginning in 1982, special funding categories were established by the Regional Science Office to ensure a more equitable distribution of research funds. Using this system, small parks received increased funding emphasis, primarily for vegetation baseline inventories. This was accomplished without a significant decrease in research funding commitments to large parks.

In summary, Resource Management Plans were written to document the extent and condition of park resources and provide overall management direction. We have used the RMPs in the Midwest Region to point out vegetation baseline information gaps. We also have shown, through RMPs, the contrast between large and small parks in terms of what is known about park resources. This has led to an increased emphasis by the Region to acquire adequate baseline information for all parks with significant natural resources. This information was needed to ensure a sound basis for management planning and resource protection in the parks.

Willson is Midwest Region Ecologist; Skipski is Outdoor Recreation Planner with the NPS Midwest Region.

Bald Eagle Feeding and Breeding Ecology

By Karin D. Kozie and Dr. Raymond K. Anderson

The Apostle Islands National Lakeshore, located in northern Wisconsin along the southwest shore of Lake Superior, 47° N and 90° 45' W, is comprised of 20 islands and a 10-mile section of mainland shoreline. Islands range from 3 to 10,054 acres. The farthest island is 14.4 miles from the mainland. Their unique composition and habitat support populations of many endangered flora and fauna.

Conspicuous in its absence, however, has been the bald eagle. Aerial surveys conducted by the National Audubon Society from 1960 to 1969 documented 28 historic nest sites. Because previous data are limited, it cannot be assumed that each nest represented a breeding territory, but they do suggest that bald eagles were a fairly common breeder here in the past. Unfortunately, at the time of these surveys, eagle nesting in the Lake States already had begun to decline as a result of organochlorine pesticide use.

With the ban on DDT in 1972, inland populations in Wisconsin began to recover. The islands, however, remained devoid of eagles until 1980, when a pair attempted to nest on Madeline Island, an island adjacent to, but not included in the Apostle Islands National Lakeshore. Although this attempt ended in failure, breeding pairs over the next several years began establishing territories among the other islands. All nesting attempts were unsuccessful, however, until 1983 when, for the first time in nearly 20 years, an eagle fledged from the Apostle Islands National Lakeshore.

While this event was encouraging, the cause of unsuccessful nesting remained unknown. C. Sindelar, who had been monitoring Wisconsin eagles since 1974, reported that addled eggs from the Apostle Islands National Lakeshore and Lake Superior south shore nests contained many times more organochlorine compounds, PCBs, and mercury than eggs from inland Wisconsin. As the source of contamination was unknown, this study was initiated in the summer of 1984 to identify foods and feeding areas of nesting Apostle Islands National Lakeshore eagles. Other objectives included collection of relevant life history and behavior data and identification of potential factors that may affect productivity.

Methods

Active nests were located from the air in mid-April during the annual Wisconsin Bald Eagle Breeding Survey; a second aerial survey was conducted in mid-May to determine reproductive success. Three active nests were present; two were monitored by boat and the third was observed with a high power scope from atop a lighthouse tower. The latter nest situation provided an opportunity to make intensive observations of brood rearing behavior and food habits.

Prey remains were collected from in and below each nest during banding of young and from below nest and perch trees periodically afterwards until three weeks post-fledging. Food remains at the base of nest trees accurately reflected food habits of bald eagles in Maine although fish tended to be slightly underestimated since most parts, including bones, are digested. Direct and continuous observation of nests provided additional information on food types and behavior. As feeding areas were located, gill nets

were set to collect fish samples for contaminant analysis. Disturbance factors were recorded as they were observed.

Results

A preliminary analysis of observation and food collection data indicates that more than 90 percent of Apostle Islands National Lakeshore eagle diets consist of fish. Species include the longnose and common sucker, burbot and whitefish. Birds were the next most common food item and included bluejays, flickers, herring gulls and yet to be identified ducks. Mammals comprised an extremely small portion of the diet. During nesting and early post-fledging periods, eagles fed predominantly along the shores of respective nesting islands. Numerous sightings by park employees indicate that eagles may also feed along shorelines of other islands.

Feeding areas are most likely to change in response to food availability. Eagles also are highly mobile and may have used mainland sites in early spring before we began our observations. Feeding patterns of inland eagles in Minnesota were established at dawn and late afternoon. Apostle Islands National Lakeshore eagles brought food to the nest throughout the day.

Human disturbance by park visitors appears to be minimal during the critical periods of incubation and early hatching as tourism does not begin to increase until late June. Disturbance is minimal even then, as nests are located in isolated areas that do not invite

beaching of boats. Hiking trails are either nonexistent or more than .5 miles from the nest.

As with most eagles, tolerance to disturbance varied among individuals. One nest could be observed from a boat without disturbance at a distance of only 50 yards. The other nesting pairs required observation from distances of 100 to 150 yards. This year, two young were hatched in each of the three active nests. Of these birds, four fledged and two died in one nest of unknown causes. Current nest success may be related to decreased contaminants in food sources or it may be a product of younger birds, with low contaminant levels, dispersing from inland populations. In either case, trends of reproductive success are more accurate indicators of environmental quality than productivity of individual years. It is hoped that the current trend will continue.

Future Research

A more detailed study of movements and feeding behavior within the Park by radio-telemetry is planned. We expect to mount radios on tail feathers of two adult eagles. This also will allow us to follow the birds to their wintering areas to identify and collect food items there.

Recordings of eagle vocalizations were collected to identify individual eagles. This will permit future identification of individual birds without having to capture and mark them.

Anderson is a professor and Kozie a graduate student at Wisconsin's Steven's Point.



Pride and joy of Apostle Islands personnel is this baby bald eagle, bright-eyed, banded, and surveying his world from the safety of his nest.

Atlantic Ridley Turtle Update

By Milford R. Fletcher

The 1984 season was marked again by both successes and failures in our attempt to reintroduce the Atlantic Ridley Turtle to the beach at Padre Island National Seashore (NS). The Ridley turtle *Lepidochelys kempii* is the smallest, rarest, and most endangered of all sea turtles. There are probably fewer than 1,000 adults on the planet earth. Where they spend their time when not nesting is speculative. However, tagged hatchlings from this program, released in the Gulf of Mexico, have been located on an isolated beach in France and on the northern coast of Africa.

In brief, eggs are gathered directly from turtles in Mexico and placed in Padre Island sand, and then are transferred to Padre Island NS, where they are hatched. Upon hatching, the young turtles are released on the beach to enter the surf. This exposure to the beach and surf is thought to be essential to "imprinting" the hatchlings, a process much like that of salmon, which return to the exact streams in which they were hatched. The young turtles are immediately gathered from the surf, transported to the National Marine Fisheries Laboratory at Galveston, Texas and "head-started" for approximately 9 months. The details of this process have been reported previously in *Park Science*.

In 1984, the National Park Service received approximately 1,700 turtle eggs from Mexico. About 90 percent of these eggs hatched, which is a little better than usual and about what we expect when things are going well. This year, as an added factor, approximately 800 hatchlings were subjected to a "live-tagging" procedure, which consists of transplanting a plug of shell from the light-colored underside of the animal to the dark-colored dorsal side. In theory, this will result in a graft which will grow with the animal and will provide a visible, easily identifiable mark when they are adults. Within 2 or 3 days of tagging and imprinting, we noticed a considerable mortality—up to 50 percent of the marked animals. We immediately ceased the tagging operation, finished the imprinting and transferred the remaining hatchlings to the Galveston Laboratory.

The reason for the excessive mortality is still unknown. Previous research with the tagging operation of other species of marine turtles showed little or no mortality, and the subsequent marking of hundreds of Loggerhead hatchlings revealed no mortality attributable to the marking process. In at least one incidence, there was a 50 percent mortality in a clutch in which no animals were grafted. This leads us to suspect a bacterial infection in the hatchlings and several laboratories are currently investigating this possibility. In the final analysis, approximately 1,100 hatchlings from the 1984 eggs were transferred to Galveston and will be released at sea in May or June of 1985. We will probably attempt to "live-tag" the remaining 700 or so untagged turtles next spring.

Of considerable interest is a report from the Cayman Turtle Farm in the British West Indies. In 1979, about 100 hatchlings were transferred from Galveston to the British West Indies—thus, these animals are now 5 years old. In May of 1984, personnel at the Cayman Turtle Farm noticed turtle eggs in one of the holding tanks. These animals were immediately moved to a natural beach area where one 5-year-old female weighing 44 pounds promptly crawled up on the beach, dug a nest and deposited 65 eggs. (The



Hatchling and herd: An Atlantic Ridley turtle hatchling and a whole herd of its fellow creatures race toward the surf across the Padre Island National



Seashore sands. The loner who seems to be bucking the tide is the result of a flipped negative.

mean weight of adult Ridelys is about 110 pounds—the average clutch size is about 100 eggs.) Whether the eggs were fertile or not is undetermined as yet. This observation is of great importance, since this is the first time that a Ridley turtle has been known to nest in captivity.

It has been speculated that it may take 7-10 years for these animals to reach reproductive maturity. The observation that Ridley turtles can reproduce (at least in captivity, and with a diet of high protein trout chow)

at 5 years of age is of great significance, since our entire experiment is predicated on adult turtles returning to breed and nest at Padre Island in a 10-year time frame.

This is the 7th year of a 10-year effort to establish a new nesting beach for these animals. To date, none of the "head-started" turtles have returned to Padre Island to nest. Maybe next year.

Dr. Fletcher is Regional Chief Scientist for the Southwest Region of NPS.

meetings of interest

1984

Oct. 11-12, RESTORATION ECOLOGY SYMPOSIUM. University of Wisconsin Arboretum, Madison. Contact Nancy Dopkins, 1207 Seminole Hwy, Madison, WI 53711. 608/262-2746

Oct. 25-28, RAPTOR RESEARCH FOUNDATION ANNUAL MEETING. VPI and State Univ., Blacksburg, VA. Contact Dr. James D. Fraser, Dept. of Fisheries and Wildlife, VPI and State U., Blacksburg, VA 24061. 703/961-6064.

Oct. 31-Nov. 3, NATIONAL RIVER RECREATION SYMPOSIUM. Louisiana State University, Baton Rouge, LA.

Nov. 27-29, RANGELAND AND FIRE EFFECTS SYMPOSIUM. Red Lion Downtowner Inn, Boise, ID. To transfer state-of-the art fire effects technology to field personnel and managers responsible for fire management decisions, such as selecting prescribed burn sites and fire protection levels. Emphasis will be on sagebrush-grass range types.

Nov. 27-29, CONFERENCE ON MANAGEMENT OF BIOSPHERE RESERVES, Great Smoky Mountains NP Biosphere Reserve, Sheraton-Gatlinburg Hotel, Gatlinburg, TN 37738.

1985

March 15-20, 50th NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE. Shoreham Hotel, Washington, D.C. Contact L.R. Jahn, Wildlife Management Institute, Suite 725, 1101 14th St., N.W., D.C. 20005.

April 16-18, INTERAGENCY NORTH AMERICAN RIPARIAN CONFERENCE: Riparian Ecosystems and Their Management. University of Arizona, Tucson, AZ 85721. Contact R. Roy Johnson, #125 Biological Sciences East, University of Arizona. 602/762-6501.

1986

March 21-26, 51st NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE. MGM Grand, Reno, NV.

July 23-26, NATIONAL WILDERNESS RESEARCH CONFERENCE. Fort Collins, CO 20523. NPS is a co-sponsor. Contact Dr. Glenn E. Haas, Chairman; Recreation Resources, Colorado State University, Fort Collins, CO 20523.

1987

Sept. 12-19, THE 4th WORLD WILDERNESS CONGRESS. Denver, Estes Park, and Fort Collins, CO. Contact Dr. Jay Hughes, Chairman, Dean of College of Forestry and Natural Resources, Colorado State University, Fort Collins, CO 20523.

Regional Chief Scientists Heading Back to Research

With scarcely a backward glance – even with a barely audible sigh (could it be relief?), they march back to the field, these scientists who gave up their research to man the administrative bastions of the NPS science program.

It all began in 1978, when Robert Stottlemeyer, research ecologist, said goodbye to the job of Regional Chief Scientist, Mid-Atlantic Region, and went back to research at the Great Lakes Area Research Study Unit, Michigan Tech University, Houghton, Mich. More recently, like the catsup bottle that “when you want a little to come, a lot ‘I,’” the trickle has turned into a trend.

In 1984 Paul Buckley left the Chief Scientist position in the North Atlantic Region to head up the NPS/CPSU at Rutgers University in New Brunswick, NJ. In 1983, Don Field bowed out of a similar position with the Pacific Northwest Region to go back to sociological research and writing at the NPS/CPSU at Oregon State University in Corvallis.

Now come Gary Larson, Chief Scientist in the Midwest Region, and Denny Fenn, Western Region Chief Scientist, saying farewell to administrative duties and heading back to their first love – research . . . Larson to do work in the cold water lakes and streams of the Pacific Northwest (out of the OSU/CPSU) and Fenn to head up the NPS/CPSU at Texas A & M. Larson’s doctorate is in zoology; Fenn’s is in soil science.

All these good soldiers have answered the call of their first love – research; the good news is that the result is nothing but plusses. Administration has benefited, research will gain, and the scientists themselves see their administrative stints as having given them valuable experience and insights into the relationship of the overall science program to NPS management.

In conversations with these men who have opted for two-pronged careers, one recurring idea emerged – the “crossroads” syndrome. As Fenn put it: “I had had six full years of 100 percent administrative duties. I realized that I was at the point where I had to decide whether I was willing to give up my research skills and commit my whole career to administration. I found I just wasn’t ready to do that. I’m a soil chemist, and I wanted to get back to being a soil chemist.”

In addition, Fenn said he felt that he had “stayed the limit” from both a personal and a job point of view. “You might call it a left-handed and a right-handed motive for the move,” he said. “You can grow in a job for three or four years, and then it seems to me that you tend to level out. For personal growth reasons, I felt the need of a change. That was my right-handed reason.

“The left-handed motive had to do with the job. I think new, fresh ideas are needed as the needs of the position change over time. I’ve tried to get a start on that aspect of it by turning over the acting detail to a whole line-up of Regional scientists. Each of them will take a one- or two-week stint of acting as Regional Chief Scientist, doing actual substantive work in administration. In addition to the practical peek at what I’ve been dealing with all these years, they should develop a better understanding of why certain details, standards, and procedures are necessary and important.”

Larson’s story is somewhat different, but the underlying pattern might be more similar than it looks at first glance. “I’ve enjoyed what I’ve done here in the Midwest Region,” Larson said. “I’ve seen how con-

tracting and research administration work; I’ve interacted with 27 superintendents of many different kinds of park areas – parks with different mandates and different kinds of resources . . . from the Great Lakes basin to the Great Plains.

“But I’m a scientist and my field is aquatics, fisheries, limnology. I’ve always had a desire to work with cold water lakes and streams in the high mountainous regions. I genuinely miss having my hands on the natural resources. I have loved the opportunity to travel and to see the various sites, but that kind of motion doesn’t let you really ‘feel the pulse’ of things the way I need to.”

It turns out that the new assignment is the fulfillment of an old and cherished dream for Larson. “Twenty years ago, when I was working on my Master’s degree doing research at Mount Rainier, I knew that doing that kind of lake and stream work in the Pacific Northwest was what I most wanted to do with my life. Coming back to that Region, working out of a CPSU where the whole Region is my assignment, is just exactly what I want.”

Don Fields echoed much of what Fenn had expressed – particularly the “crossroads” overtones. “If I wanted to expand the contributions of social science research to benefit management,” said Field, “it would require fulltime attention. And I couldn’t agree more with Fenn,” he added, “so far as the Chief Scientist position is concerned. It needs many different points of view. The position itself changes greatly as time and policies change. The person who fills that slot needs to be innovative and creative and imbued with unquenchable enthusiasm for the job. Over time, anyone gets worn down. You lose some of that initial enthusiasm and with it goes the necessary ‘edge’ that

the job calls for.”

The editor’s call to Buckley, requesting his personal observations on this trend, elicited a letter so full of interesting observations (and so resistant to cutting) that it is included in the Letters to the Editor section of this issue.

As befits the man whose decision is of longest standing, Stottlemeyer had the longest-range view of the back-to-the-field trend.

“If I were asked to advise a young scientist starting out to create a viable career in both science and management,” he said, “I would tell him or her to get three to five years of solid research in first. Then do the management stint.”

And Stottlemeyer had definite ideas about the length of time a scientist can afford to invest in management today. “Three years is about the limit, in terms of efficient reentry,” he maintained. “Technology and training are changing *that fast*.” One of the most important factors so far as reentry is concerned, is the rapid advance in instrumentation.

His own area – ecological, multi-discipline research – depends on a wide variety of disciplines, and Stottlemeyer observed that “instrumentation changes the way we manage information.” Particularly when you go back to a job that entails managing a lab, “you have to be able to assess the costs and benefits of the new technologies as they come along. When do we go to the University mainframe? What type of desktop computer do we really need?”

All of the above notwithstanding, there are and will continue to be scientifically educated NPS personnel who will elect to go to the management rather than the research route. While this decision remains a personal one, rooted in the individual’s own preferences and proclivities, the Service has a stake in maintaining strong rapport between the two areas. That process, which is both individual and institutional, is well served by the kinds of “crossings over” described here.

Revegetation With Native Plants on John Day Fossil Beds NM

By Richard F. Miller and Marshall R. Haferkamp

Vegetation on our western rangelands has been altered through farming and overgrazing by cattle, sheep and horses. Current management practices and technology have helped to improve a large portion of this resource, but many acres still exist in an altered state. Harsh climatic conditions, such as limited precipitation, large fluctuations in daily temperatures and the introduction of numerous highly competitive species from other countries have made changing these lands back to their native state a big challenge. Plants such as cheatgrass, which arrived in the northwest from Europe in the mid to late 1800s, are well adapted to our environment and often out-compete native plants for space to live.

Lands surrounding the John Day Fossil Beds National Monument (NM) very much fit this scenario. Cattle, sheep and horses have grazed the Monument since the late 1800s. Poor management practices caused overuse of lands along the river bottoms, while little use occurred on the towering slopes above the John Day River. Also, abandoned farmland on the bottoms and the introduction of exotic species have placed many of the plant communities in a state of low ecological order. Grasses such as bluebunch wheatgrass, once found in thick stands on many of the lower slopes of the monument can now only be

found as scattered remnants. However, far above on the steep slopes, plant communities are probably very similar to what they were thousands of years ago.

Conventional techniques for revegetating rangelands have been fairly well established. However, successful revegetation usually is accomplished with removal of competing vegetation, and the planting of desirable but introduced grass species with a drill. Little work has been done with reestablishment of native species on rangelands, especially broadleaf plants (forbs). Due to lack of seed sources, high costs of available seed and little understanding of seed germination requirements, few government agencies or private land owners have attempted to reestablish native vegetation. However, increased awareness of the public toward our natural resources is placing pressure on many public agencies to revegetate range and forested lands to original or near original plant communities.

A project was initiated in 1979 to develop methods in reestablishing the native vegetation that occupied sites on the John Day Fossil Beds prior to man-induced disturbances. Some of the objectives defined to meet this challenge were: 1) to evaluate methods to reduce competition from increaser¹ or exotic plant species presently occupying deteriorated sites; 2) to determine the germination and establishment require-

ments of native species to be seeded; 3) to measure yearly production of healthy seed crops on or near the Monument that could be used for revegetation; 4) to define climatic conditions at or near the soil surface limiting the establishment of native plant species; and 5) to determine the best techniques for revegetating rangelands with native plant species on the John Day Fossil Beds NM.

Unless competing plant species occupying the site are removed or reduced, reintroduction of native plants will have little chance. Various methods can be used to open up the site from competition including fire. Fire at one time was a natural component of this area, probably burning portions of the Monument every 40 to 70 years. Most were probably started by lightning. Once undesirable plants have been reduced, desirable plants must quickly be planted and established to overcome the rapidly reinvading undesirable plants.

Currently, the plant with the greatest potential for reestablishment on the John Day Fossil Beds NM is bluebunch wheatgrass. In four consecutive years, bluebunch wheatgrass produced good crops of seed with 86 to 95 percent of the seed being able to germinate. Seeds should be harvested when fully ripened, which occurs sometime in late July. Required seeding rates are in the range of 6 to 12 lbs/acre (250,000 to 300,000 seeds/lb), so large quantities of seed will need to be harvested if significant portions of the Monument are to be seeded. Another alternative would be the use of a bluebunch wheatgrass variety developed by the Plant Materials Center, Soil Conservation Service, called Secar. After tests in both the greenhouse and field, Secar bluebunch wheatgrass has proved to be a plant well adapted to the environment at the Fossil Beds.

A primary limiting factor for successful reestablishment of native vegetation on the fossil beds is the rapid wetting and drying of the soil surface caused by low precipitation, warm temperatures, high evaporation rates and competing vegetation. A wet soil surface is critical during the early stages of seedling development. Once seeds germinate, the surface soil must remain moist long enough for adventitious roots to develop. If they don't, the seed will germinate, then die. The effective moist period can be extended with mulching or the formation of furrows, pits or microdepressions designed to catch and hold moisture for extended periods. We are currently evaluating the effectiveness of the land imprinter for forming these microdepressions.

Another limitation is the problem of available seed and breaking seedling dormancy of many forb (wildflower) species. Two forbs in the pea family (*Astragalus filipes* and *A. purshii*) occupy many of the less disturbed sites. Seeds produced from these plants will lie in the soil for many years before germinating due to a dormancy caused by the seed coat. This is common for many of the forbs. However, by scratching or scarifying the seed coat (ie. sandpaper), germination was greatly enhanced the first year. Another problem with many of the forb seed crops is predation by insects and rodents. Predispersal seed predation on the *Astragalus* sp. ranged as high as 96 percent.

The third problem to overcome is conventional equipment used for seedbed preparation and planting is not suitable for use on the steep rocky slopes occurring on many acres of the John Day Fossil Beds NM. Without equipment the reduction of competing plant species and proper placement of seeds becomes extremely difficult. Simply dispersing seeds over the surface by hand or use of a broadcaster will frequently

meet with failure. Experiments on the Monument proved this to be true. However, a test where seed was dispersed on the surface and then covered with a straw mulch met with good results.

Successfully meeting the above challenges does not occur overnight, but takes years of study, trial, and error. These problems exist not only on the John Day Fossil Beds NM but on millions of acres of rangeland in the United States. Learning how we can more effectively solve these problems will have a broad application to this resource.

Miller is an associate professor of rangeland resources at Oregon State University and Haferkamp is a research scientist with the Agricultural Research Service of USDA; both are located at the Eastern Oregon Agricultural Research Center in Burns, Ore.

¹Plant species of the original vegetation that increase in relative amount, at least for a time, under mismanagement.

Scientists Follow Rabbits In Third Wave 'Invasion'

By James K. Agee

San Juan Island National Historical Park in the Puget Sound area of Washington has been invaded again and again by "foreign agents." The first "invasion" provided the historical event for which the park was created: American and British troops simultaneously occupied the island during 1859-1872 while the final settlement of the Oregon Territory boundary dispute was negotiated. The major casualty was an English-owned pig, shot by an American settler.

The second invasion was by European rabbits (*Oryctolagus cuniculatus*) in the 1880s. They occupied the area now in the park from the 1880s until about 1980, when a significant population crash virtually eliminated them from park lands. The third invasion was in 1983, when an interdisciplinary science team invaded the 1750 acre, two-unit park to investigate the rabbit decline and provide an updated resource management framework for the park.

The team was funded for a one-year study by the Interdisciplinary Science Projects initiative from the Washington Office, based on a proposal drafted by Jim Larson, Regional Chief Scientist, PNRO. Other PNR team members included Supt. Frank Hastings and Chief Range Mac Foreman, PNRO natural resource people Dick Prasil and Dick Hoffman, PNRO cultural resource people Stephanie Toothman and Jim Thomson, and CPSU scientists Jim Agee (University of Washington), Ed Starkey (Oregon State University) and Gerry Wright (University of Idaho).

The team objectives were (1) to develop a conceptual ecological model to identify key components and processes operating in the system, (2) to increase the knowledge base on the rabbit population decline, (3) to describe the historic landscape and restoration options, and (4) to define a data base for an updated resource management plan.

The conceptual ecological model was an important first step for the team. When the rabbits' decline began several years ago, herbaceous cover started to increase, as did the problem of visitor-caused wildfires. The open fields, many of which once were forested lands cleared for cultivation and maintained in grass by rabbit grazing, became dotted with small invading trees. Many of the trees subsequently were girdled by an expanding rodent population responding to increased cover and food resources. The model showed the relationships between these and other

Differing Management Approaches Evaluated

"Strengthening Ecosystem Management Approaches," by Walter D. Graul and Gary C. Miller, both of the Colorado Division of Wildlife, Fort Collins, appears in the *Wildlife Society Bulletin's* Fall 1984 issue. The authors evaluate and compare the strengths and weaknesses of various management approaches in terms of the risk of not maintaining all species while retaining practicality for field application.

"Which and how many factors do we target for management? What are the objectives (population size, diversity index)? How do we monitor our success?" These questions are used as a basis for comparing the following management approaches:

(1) The Management-Indicator approach; (2) the Ecological-Indicator approach; (3) the Habitat-Diversity approach; and (4) the Special Features approach.

variables and which ones could be affected by management actions.

Studying the rabbit decline proved to be a difficult task. Earlier baseline studies by Fred Stevens and A.R. Weisbrod (NPS biologist now in the Midwest Region) had shown high reproduction rates in the mid-1970s. Although reproduction rate declined in the early 1980s, considerable young should have been produced; almost none appeared. While disease and nutrition have not been totally ruled out, predation seems to be the most plausible working hypothesis. The ferret (another introduced animal) is common in the park, and will indiscriminately kill rabbits in their underground warrens prior to their emergence above ground. Voles and mice can provide an alternate prey base that will allow ferret populations to subsist, even in the face of rabbit decline, and thus continue to exert significant influence on the rabbit population. Considerable additional research will be required to test these working hypotheses. In the interim, monitoring of rabbit population levels will continue.

The historic landscape problem was easier to approach. Although much of both English Camp and American Camp was logged, a few trees were left uncut, and some stumps could be roughly dated through time comparison of historic photographs. The analysis showed English Camp to be close to historic character at present. Some replanting of cultivated fields and vista clearing in the vicinity of historic Officers' Quarters were management options proposed. American Camp has more prairie, of which some is natural and some has been maintained in grassland by rabbit grazing pressure. Options here include replanting trees, and protecting the plantations from rodents or perhaps from a rebounding rabbit population.

Since this historical park was created, more attention has been given, understandably, to cultural resources than natural resources. The cultural resource input to the team was in the nature of fine-tuning: some parade ground fencing at American Camp, consideration of "ghost structures" where accurate building reconstruction cannot be done, limited building rehabilitation, and some archeological work.

The goal of all the restoration work is to provide visitors with a sensory ambience of the historical period, rather than a precisely restored landscape. Visitors to English Camp should see a largely forested

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setting with natural openings in rocky areas. Visitors to American Camp should be able to sense why the site was chosen – it was protected from wind and was nestled up against a forest, not positioned in the midst of a rabbit-infested grassland. The team provided a quantum leap for the park data base, which should serve as the core of a rewritten resource management plan.

This team approach to resource management in small areas is being extended in the Pacific Northwest Region. The next area to be "invaded" is Whitman Mission National Historic Site, where the team leader will be PNRO Cultural Resources Chief Dr. Allan Comp. This type of approach – an integrated problem analysis by interdisciplinary teams – may have value in other small NPS areas across the nation.

Agee is an NPS Research Biologist. Limited copies of the interdisciplinary report, "Rabbits, Redoubts, and Royal Marines," and the technical report, "Historic Landscapes of San Juan Island National Historical Park," are available from Dr. Agee, NPS CPSU, College of Forest Resources (AR-10), University of Washington, Seattle, WA 98195.

LATE ARRIVAL:

NATIONAL WILDERNESS RESEARCH CONFERENCE, July 23-26, 1985, at Colorado State University, Fort Collins, CO. To interpret and integrate what research has found related to protection and management of the wilderness resource and its uses, provide a forum for current research, and identify major research themes for the next 20 years. **Abstracts due Oct. 15, 1984** (6 copies) at National Wilderness Research Conference, College of Forestry and Natural Resources, Colorado State University, 80523.

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Regional Chief Scientists

Anderson, William H.
NATIONAL CAPITAL REGION
1100 Ohio Drive, S.W.
Washington, D.C. 20242
8-426-6660 (202) 426-6660

Gogue, G. Jay
SOUTHEAST REGION
75 Spring St. S.W.
Atlanta, GA 30303
8-242-3643 (404) 221-3643

Karish, John R.
MID ATLANTIC REGION
Ferguson Bldg, Room 209-B
Pennsylvania State University
University Park, PA 16802
8(814)865-7974

Position Vacant
WESTERN REGION
450 Golden Gate Ave.
P.O. Box 36063
San Francisco, CA 94102
8-556-4968 (415) 556-4968

Willson, Gary, Acting
MIDWEST REGION
1709 Jackson St.
Omaha, NE 68102
8-864-3438 (402) 221-3438

Reid, Neil J. (Jim)
ROCKY MOUNTAIN REGION
P.O. Box 25827
Denver, CO 80225
8-234-2764 (303) 234-6171

Larson, James W.
PACIFIC NORTHWEST REGION
Room 1920 Westin Bldg.
2001 Sixth Ave.
Seattle, WA 98121
8-399-1355 (206) 442-1355

Soukup, Michael
NORTH ATLANTIC REGION
15 State Street
Boston, MA 02109
8-223-7765 (617) 223-7765

Fletcher, Milford
SOUTHWEST REGION
P.O. Box 728
Santa Fe, NM 87501
8-476-6412 (505) 988-6412

Lovaas, Allan L.
ALASKA REGION
2525 Gambell St., Room 107
Anchorage, AK 99503-2892
8 (907) 271-4212

Please address requests for information to appropriate Regional Chief Scientist.