

Crater Lake National Park
Natural Resource Preservation
and Research



“To forever preserve the beauty of Crater Lake National Park, its unique ecological and cultural heritage; and to foster understanding and appreciation through enjoyment, education and inspiration.”

**Annual Accomplishments Report
Fiscal Year 2001**

We embarked on last year with a gathering of over 1300 National Park Service leaders, partners and scholars in St. Louis, Missouri. The Discovery 2000 Conference cultivated a vision for the National Park Service for the 21st century. I was privileged to be invited to attend the conference and I came back confident that our charted course to preserve Crater Lake's resources is on track with our leadership's shared vision.

The Discovery 2000 Conference punctuated what has become increasingly obvious over the years: that stewardship is our primary goal. It is a goal that transcends our independent divisional responsibilities, obtainable only through interdependent, interdisciplinary actions. This message was repeated throughout the Discovery 2000 Conference with each speaker offering a plea for unity around our common roles as leaders in stewardship and education. Resource preservation is at the core of stewardship and our knowledge and understanding of those resources is fundamental to their preservation.

I am proud to report that last year we continued to build and expand our knowledge of the park's biophysical resources and natural processes through inventory and monitoring. Field work on four key inventories such as soils and sensitive species were completed or expanded last year.

Monitoring resource conditions is critical to our long-term management and stewardship. We are identifying new park "vital signs": determinates of ecosystem health that will guide our current and future monitoring programs. Each year we add to our understanding of the baseline conditions of the park's resources and their natural range of variability. Information from our lake monitoring program, now in its 19th year, has proven as invaluable to world scientists as it is to our management. We believe that all of the chemical and physical parameters measured in the lake are within their expected range of variation. Last year's

follow-up surveys indicate that bull trout are responding well in the wake of their restoration in Sun Creek. Our monitoring of spotted owls suggests that they are holding their own in the park but are faced with a new threat from barred owl invasions. Last year, bald eagles took up residence in the caldera and fledged two offspring, perhaps in response to the tremendous population increase in lake kokanee. During the same time, our resident peregrine falcons returned to the lake but for reasons unknown, failed to reproduce.

Partnerships continue to play an important role in the success of our programs. We have established very effective working

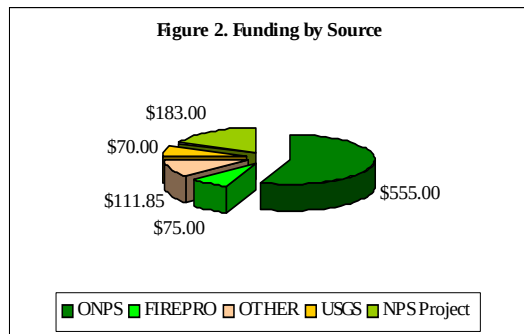
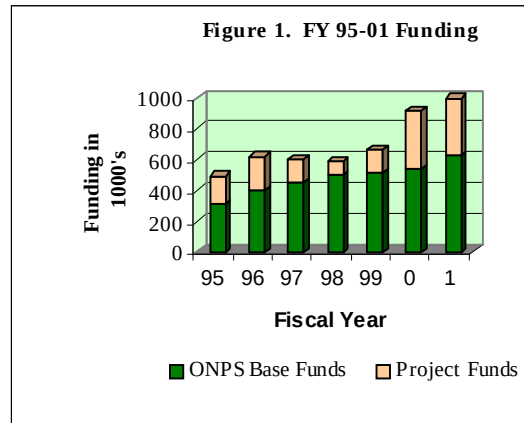
If the park is to thrive, rather than merely survive in the centuries to come, we must embrace stewardship.

relations with academia and other outside research interests. Over half of our inventory and monitoring projects rely on external partners for support and expertise. Our partnerships through the Klamath Network as well as other state and private cooperators promises to increase funding and support for continued inventories of vertebrates and vascular plants in the coming years.

There is still much to do, within as well as outside our division. We are redoubling our efforts internally to support park planning and other park operations toward an end of overall resource protection. Preserving and protecting natural resources requires the interdependence and cooperation of our staff, sister agencies, academia and our publics. If the park is to thrive rather than merely survive in the centuries to come, we must embrace stewardship. I think that the Discovery 2000 Conference raised the bar. It challenged us to a new height. Together we can clear it.

William M. Brock
Chief, Resource Preservation and Research

Once again we started this year on a solid financial footing (Figure 1). Our base funding for FY 01 was \$630,000, a significant increase over FY 2000. The increase included \$75,000 to hire and support a park Fire Ecologist as well as a \$12,000 increase to cover a 3.57% cost-of-living increase for personal services. Project support from soft dollars was also very strong in FY 01. Through nine competitive NPS funding sources we secured almost \$183,000 for project work last summer. In addition we were awarded \$210,000 (\$70,000 for FY 01) in NRPP research funding to initiate a terrestrial ecology study in cooperation with Oregon State University. Finally, through collaboration with outside partners, we obtained \$111,848 in outside grants. In total, soft dollar funding accounted for 37% of our total funding support in FY 01 (Figure 2).



We were fortunate to add a new Program Management Assistant and Fire Ecologist to the permanent staff. The Program Management Assistant position was identified to provide support for day-to-day division management as well as for environmental review and air quality monitoring. The position was designed as a strategic tool to target recruitment of minority candidates through the Student Career Experience Program (SCEP). Last year, we successfully recruited and hired Wendy Wayne into the position. Wendy is a student at the University of Washington and was a former seasonal employee at Crater Lake. Wendy is pursuing a Master's degree in Restoration Ecology. This combined with her excellent work habits, cooperative nature and a strong desire to work permanently in the National Park Service made her an excellent candidate for the position.

Last year we were truly fortunate to receive support from the Boise Interagency Fire Center for a new Fire Ecologist. We are very excited about the opportunities that this new position affords. We recognize that the future management of wildland fire in Crater Lake National Park will require higher levels of sophistication in planning, implementation, monitoring and evaluation, as well as research and adaptive management strategies to ensure a program which is safe and environmentally sound. Mary Rasmussen was selected to fill this new position. She will provide the necessary expertise in ecological planning and implementation, evaluation and effectiveness monitoring, GIS modeling and forest health, as well as professional links to the fire science/research community to help manage the wildland

fire program under new National Park Service directives.

In FY 01 we hired seven seasonal employees, far less than in previous years. The fact that seasonal staffing in FY 01 did not keep pace with our successful soft dollar campaign was due to a change in focus toward using outside partners and contracts to accomplish some highly technical project work and research. Most of last summer's projects were successfully completed using a number of partnerships that we have cultivated over the years and precluded the need for increased seasonal staff.

Overall, we had 29% minority representation in our division's workforce last year. Diversity among our permanent staff increased to 43% from 29% in FY 00. This was due to our successful minority recruitment for the division's Program Manager Assistant. Last year, we filled four of our seven (57%) seasonal vacancies with returning employees. None of the returning employees, however, were minority candidates. As a result, diversity among our seasonal staff was lower (14%) than in previous years. However, through our recruitment of new employees we were able to hire one new minority candidate (33%) out of three new hires. This suggests that our methods to recruit and enhance our minority pool are successful even though we had limited opportunities last year to increase seasonal diversity. We had no reports last year of any incidents of discrimination or harassment in our division's workplace.

Our sustained safety campaign resulted in achieving our divisional goal of zero accidents last year. We will do our utmost to maintain this record.

Over the past few years we have recognized that the physical isolation of the park is an emerging issue for our division as well as the park as a whole. Our distance from town precludes many opportunities for our resident employees and their families. Isolation, limited dual career opportunities and social outlets, limited school alternatives and no day care options all place demands on our employees and their families. Many of these issues are cited as reasons for limited recruitment and low employee retention at Crater Lake. It is obvious that these issues are not merely personal issues but park management issues.

As of last year, all of our division's permanent employees have moved outside of the park. While some are able to maintain secondary quarters in the park, most are faced with a daily one-way commute of up to an hour or more.

In our division, work-site fidelity is very seasonally dependent and focused in the summer months. With the advent of technology, many of us could work almost anywhere in the winter. With that in mind, we have experimented with alternative work schedules and work places. A longer-term solution to meet employee family, housing and office needs will be needed as we add staff without increasing park infrastructure.

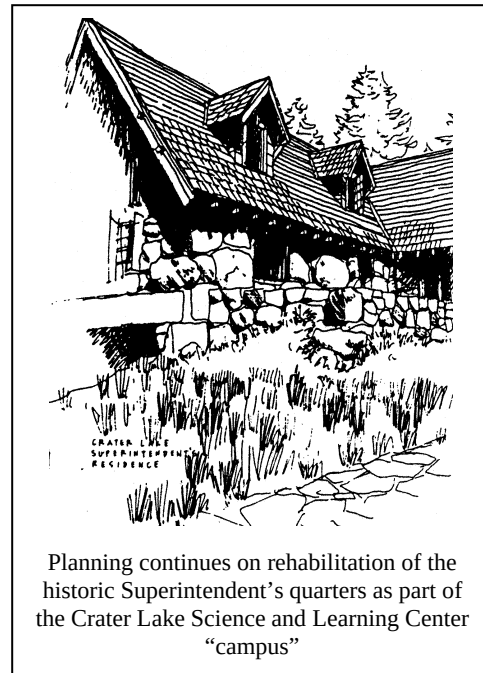
As we have expanded our places of work we have also broadened our collaboration with academia. In one

case, we have established a cooperative agreement with Southern Oregon University through which one of our employees is designated as adjunct faculty and has office space at the University. The agreement not only provides an alternative work place but also affords new opportunities to partner with students and faculty on projects of mutual interest. We are pursuing a similar agreement at the Oregon Institute of Technology.

Last year we embarked on a new General Management Plan (GMP) for the park. Through the GMP we have an opportunity to rebuild the foundation of planning in the park. We can make clear our purpose and mission and to hold that as the measuring stick to all that we do. This conceptual plan will be grounded in preservation and dedicated to our public's understanding, appreciation and enjoyment of some outstanding and relatively pristine resources. Our division assisted in developing the desired future conditions of the park's natural resources and helped developed a series of alternatives that will preserve those resources. We will continue to play a central role in the development of this long-range plan.

May 22, 2002 marks the 100th anniversary of the establishment of Crater Lake National Park. Numerous centennial events are being planned. Our division's most significant contribution will be to organize and host an Interdisciplinary Centennial Conference to recognize the park's role in human enrichment. The conference, entitled "Crater Lake: a Tapestry of Inspiration," will focus on the park's past, present and future role in science, education, art, spiritual and inspirational

enrichment as well as recreation and tourism. We have been cooperating with Southern Oregon University and the Oregon Institute of Technology to plan the event for October 2002.



In 2001, we made additional progress toward funding the dream of a Science and Learning Center in the park. The mission of the Crater Lake Science and Learning Center is to contribute toward the protection of the outstanding natural and cultural resources of Klamath Network Parks through an integrated program of scientific research, education, and management. Through public and private partnerships this center will support research activities, accumulate and synthesize information, and directly transmit that information and understanding to the public. Funding was secured to rehabilitate the former Superintendent's residence as a focal facility for the new center.

Inventory

An understanding of what species occur within a park, as well as information on their current status, distribution and condition is essential to making informed management decisions concerning park natural resources. In 1998, Congress appropriated servicewide funding for a “program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the conditions of National Park System resources”. As part of this new program, 32 networks of parks containing significance natural resources nationwide were asked to develop detailed study plans for biological inventory.

Crater Lake is a member of the Klamath Network. Last year, in cooperation with the other five parks in our network, we developed a successful proposal for \$743,800 to complete basic inventories of vascular plants and vertebrate animals for parks within our network.

A primary goal of the inventory project is to provide park managers in the network with scientifically sound information on the nature and status of selected biological resources. Organization of a network based inventory and monitoring program offers several benefits through increased efficiencies in designing and conducting inventory work, and improved opportunities for exchange of ideas and information across parks. The fieldwork for these baseline inventories is scheduled to begin next field season and will augment our inventories currently in progress.



Lynx Surveys.

Wildlife technicians and a student volunteer from Southern Oregon University spent 12

weeks of the summer installing and monitoring hair pad stations designed to detect the presence of wild felines, especially the elusive and solitary Canada lynx (*Lynx canadensis*). The USFWS listed the Canada lynx as threatened throughout its range in 1999. Threats to the species include habitat destruction or fragmentation from human activities and competition from other carnivores including the coyote and bobcat. The park has over 34,000 acres of Canada lynx habitat, but little to no empirical evidence as to its current abundance or distribution. There is evidence from the past suggesting that lynx previously foraged in the park. The Smithsonian Institute has a Canada lynx pelt in its collection that dates back to 1898. It was trapped along the Wood River just south of the park. Lynx sightings have been reported in the Klamath Basin as recent as 2000, but have not been verified with other substantive evidence such as photos, tracks, or hair. State and federal land managers throughout southern Oregon face the same dilemma of little to no information about a federally listed species. Park managers requested and received \$12,000 this year to conduct field studies to determine if lynx are present in the park. The USFWS provided technical support and paid to have the field samples analyzed.

Each survey station consisted of a visual attractant and a scented rub pad. The goal was to get the cats to rub their cheeks on the pads and leave samples of

their hair. From hair samples, geneticists can determine species, sex, and parental lineage using DNA analysis. After 750 hours of effort, our technicians collected 71 hair samples from a total of 136 monitoring stations, where each station was monitored for 30 days.

Of the 71 hair samples collected, zero were found to be from Canada lynx or cougar. Six samples were identified to bobcat and two to domestic cats. The majority of the samples came from black bear (27), with the remainder from coyote (6), wolf/dog (1), elk (6), deer (14), cow (1), red squirrel (1), rabbit (1), and 6 samples were found to be inadequate for analysis. Based on this year's results as well as negative results from two prior survey seasons, scientists conclude that it is unlikely that a viable population of Canada lynx resides in or near the park.

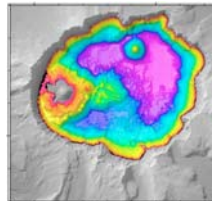


Landbird Surveys.

Park staff worked cooperatively with the Klamath Bird Observatory to collect information on the presence, abundance and distribution of landbirds that occur in the park. The focus of last year's effort was on low-elevation park sites that include ponderosa pine and mixed-conifer habitats. Avian biologists used a non-destructive, non-intrusive sampling technique known as "point-count" surveys to assess species richness and relative bird abundance for a particular habitat. At each sampling point along a transect, biologists identified birds by their calls or by visual sightings and recorded the number observed in a given radius from the

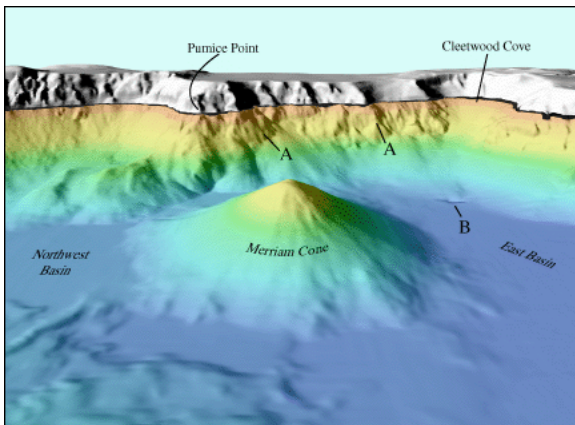
sampling point for a set amount of time. The habitat information collected included vegetative life form and species, size, and vertical and horizontal arrangement. The results of this year's surveys are not yet available, but will guide staff as they make recommendations for conserving the many dwindling species of landbirds known to the park.

Soils Survey. The Natural Resources Conservation Service (NRCS) completed its third and final season of fieldwork to inventory and map the soils of Crater Lake National Park. They identified 12 soil types that fall into six general categories. The categories are: 1) soils on uplands, formed in air-fall deposited ash and pumice; 2) soils on uplands, formed in air-fall deposited ash and pumice over glacial deposits; 3) soils in valleys, formed in ash flow deposits consisting of ash, pumice and cinders; 4) soils on cinder cones; 5) soils on upland meadows with intermingled forests; and 6) soils in seeps and on stream terraces. Park staff participated in reviews of the databases, manuscripts and descriptions that will accompany the digital and hardcopy maps. Such descriptions will be useful to management by identifying areas with high to low soil strength, water capacity, frost hazard, erosion susceptibility, biomass productivity, etc. Final products will be delivered in June 2002.



Bathymetry. Exciting products from the summer 2000 bathymetry survey of Crater Lake are now available. The USGS published a two part detailed map, including multiple perspective views and

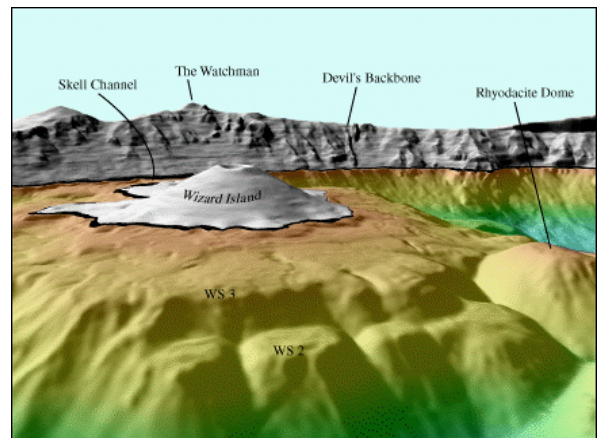
interpretation of significant features. The map set is available in the park visitor centers. Because greater than 16 million depth measurements were recorded, amazing detail of the lake floor is visible like never before. The new images reveal details of ancient lava flows, huge landslide debris fields, previous lake levels, and other fascinating geologic features.



Although the major features of the floor of Crater Lake were known prior to the survey, their shape was not known with sufficient detail to permit accurate interpretations of their origin or the relative ages of different geologic units. The greatly increased detail of the new data more clearly defines the character of these features and provides a sequence of events for the filling of Crater Lake and volcanic activity following collapse. After the collapse, Crater Lake apparently filled relatively rapidly (200-300 years) until reaching a permeable layer in the northeast caldera wall identified by the new survey. The Wizard Island, central platform, and Merriam Cone volcanoes and a newly discovered lava flow on the eastern floor of the lake apparently formed within a few hundred years after collapse, whereas the small dome on the flank of Wizard Island formed more recently.

Details of these features and a thorough in-depth geologic analysis and interpretation of the new data will soon be published in the Geological Society of America Bulletin by Bacon et al. (C.R. Bacon, J.V. Gardner, L.A. Mayer, and M.W. Buktenica. Morphology, Volcanism, and Mass Wasting in Crater Lake, Oregon).

The bathymetric and acoustic backscatter data are available to interested scientists through the USGS. Our NHA has adopted the map as a sales item and we have plans to use these data in an interactive interpretive display in the newly renovated Sinott Memorial Exhibit.



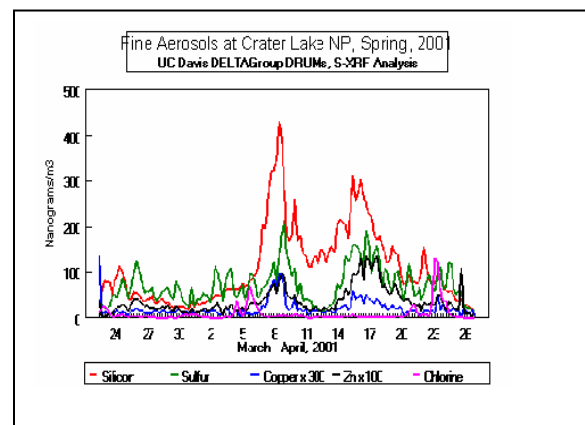
Vital Signs. Vital signs are indicators of key ecological processes that, collectively, capture the function of a healthy ecosystem. They may include keystone species and habitats that have profound effects on ecosystem organization and function; dominant species; or key processes such as nutrient cycling, patch dynamics, or hydrologic regimes. The vital signs concept for natural resource monitoring was initiated in the Western Region of the National Park Service and has been adopted servicewide. It is a key strategy in the servicewide monitoring program.

Last year we began to develop our vital signs for park monitoring through a peer workshop led by Kathy Joep, Team Leader for Natural Resources from the National Park Service Seattle Support Office. Kathy has developed a stressor based methodology that helped guide us in the identification of ecosystem health indicators.

Through this process we discussed the current and future stressors to Crater Lake's ecosystems and the changes they may cause in our systems. Through our discussions, we tried to identify which key linkages, interactions, and driving processes are vulnerable to stressors and would result in profound effects on the ecosystem. Based on the results of the workshop we will be developing specific monitoring questions and identifying appropriate indicators for future long term monitoring.

Air Quality. Our Class I airshed enjoys some of the cleanest atmospheric conditions in the nation. In spring, 2001, Crater Lake National Park assisted with a large international study to evaluate the effect of Asian aerosols on the climate of

the North Pacific region. This study was the 4th in a series of such studies but the first to specifically target Asian aerosols. Over 100 investigators were involved from about a dozen countries, with ship (2), plane (3), satellite (4), and ground station (25) experiments deployed. This study was designed to follow the Asian aerosols across the Pacific Ocean. For this purpose, aerosol samplers were deployed by the UC Davis DELTA Group in Hawaii (Mauna Loa Observatory, Hawaii), Alaska (Poker Flat and Denali NP), Washington (Rattlesnake Mountain), and Oregon (Crater Lake NP). Crater Lake was chosen because of its high elevation, remote location, and a splendid 13 year comparable record of aerosols as part of the IMPROVE network.



Preliminary results of samples analyzed at the Lawrence Berkeley Nuclear Lab are available for the major elements silicon (a soil tracer) sulfur (natural and man made sources), chlorine (to check for sea salt intrusion and local surface derived aerosols), and copper and zinc (tracers of industry and urban influence). The data show that for these species Crater Lake had long periods of very low levels punctuated by episodes of increased fine soil, sulfur, and the unambiguous tracers of industry. The

absence of chlorine indicates that local sources are not involved. The fine soil signature indicated transported Asian dust. During this period, trajectory analysis showed strong Asia to US. transport and was verified at Crater Lake by aerosol domination from Asia. The extent of the Asian influence at other times in the year is still unknown. Further studies by the UC Davis group will likely include Crater Lake as the primary location for the study of Asian air pollution transport to the US.



Crater Lake Long-Term Monitoring.

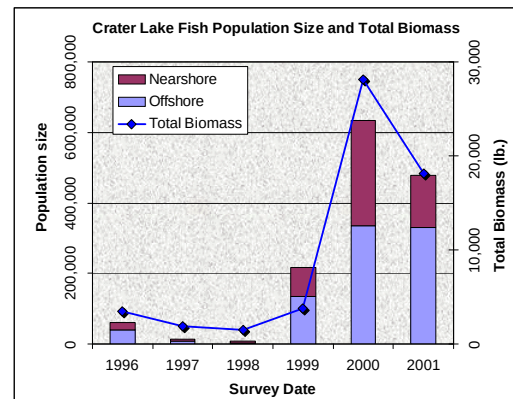
Results of the ongoing monitoring program and special lake research projects indicate that Crater Lake is a complex and dynamic system. No unidirectional change in any of the parameters monitored (lake and spring water chemistry, nutrients, chlorophyll, primary productivity, phytoplankton, zooplankton, fish, water clarity, light penetration, and temperature) has been detected.

The early snow melt this spring allowed the annual lake monitoring program to begin earlier. Monitoring trips were conducted in May, June, July, August, and September, with the assistance of personnel from OSU and Rogue Community College. Additional research and monitoring projects conducted this year included global climate change monitoring (Dr. Robert Collier), ultra-violet light penetration studies (Dr. Bruce Hargreaves), and a study on the optical properties of the lake (Dr. Emmanuel Boss).



Crater Lake Fish.

Fluctuation in the populations of kokanee salmon and rainbow trout continue to be the most dramatic human caused anomaly observed in Crater Lake. Between 1998 and 2000, the fish population skyrocketed both in terms of total number (7500% increase) and biomass (1800% increase). These wide fluctuations in fish numbers appear to control various aspects of the zooplankton community structure and abundance through the periodic elimination of the dominant crustacean



zooplankton *Daphnia pulex*. Using the population and biomass data from the annual acoustic fish surveys in conjunction with additional data from the monitoring program, we are presently examining quantitative effects of the introduced fish population on various aspects of lake ecology.



Spotted Owls.

The park's survey and monitor program for the northern spotted owl (*Strix occidentalis caurina*) entered its 10th season in 2001. This year, 24 adult spotted owls were detected, the most adults ever found in a single season. However, spotted owl recruitment for

2001 was zero. The number of barred owl detections has increased from previous years, which we speculate to have negative impacts on the CRLA spotted owl population.

Field surveys were based on the USFWS standards and guidelines for determining pair, nesting, and reproductive status of spotted owls in national parks. Each site was visited until a spotted owl was detected or the site had been surveyed three times without owl detections. Once an owl was located, mice were offered to determine reproductive status. Technicians made a total of 72 visits to 27 sites. Survey results yielded 11 owl pairs and two singles. Twenty-two of the owls detected have been found in previous years. A new pair was found near Spruce Lake. Many of the owls found this year have not been detected in several years, such as the Crater Creek pair last detected in 1995. No juveniles were detected this season. All owls, except for a single owl at Sand Ridge, were visually located and offered mice. Although many of the pairs cannot be categorized as non-nesting according to protocol, all pairs are believed, with high confidence, to have failed based on observations of behavior when mice were offered.

Wildlife technicians coordinated with the Oregon Cooperative Fish and Wildlife Research Unit from Oregon State University to exchange owl data and to receive training in avian banding techniques. A special permit from the USFWS is required to handle T&E species like the spotted owl. This year a total of six park owls were banded. The last banding effort in the park was in 1995. For banding to be successful, each bird must be coaxed to the ground

using live mice or a decoy. Then the bander using their hands or a noose controls the bird. The sex and weight of each bird is determined before two bands are applied to the legs for identification. To minimize stress to the bird, all data collection and banding efforts must be completed within 3 minutes or the bird is released. Banding owls is crucial to future monitoring, providing high confidence in individual owl identification as well as a wealth of demographic information.



Bull Trout. The park's bull trout restoration program entered into a monitoring and research mode in 2001 after 12 very successful years of restoration efforts. These restoration efforts cumulated in the elimination of non-native brook trout from Sun Creek the previous year. Because the elimination of non-native fish from bull trout streams has only recently been attempted, the effects on dispersal and repopulation of the remaining bull trout are unknown. The park is using this opportunity to monitor the movement and habitat utilization of bull trout following brook trout elimination in order to assist other restoration efforts getting started elsewhere in the Pacific Northwest. Sun Creek once again supports its native fish assemblage and the restoration efforts at Crater Lake National Park are leading the way for preservation of this federally threatened fish species throughout the Klamath Basin. Bull trout, the only known native fish species to Crater Lake National Park, is on the road to recovery.



Timber Crater Prescribed Burns.

Fire and resource staffs worked side by side to burn 630 acres of fire dependent ponderosa pine ecosystem in the northeast corner of the park. Under a relatively natural fire return interval of 9-15 years, canopy gaps are created and areas of mineral soil are exposed – conditions that are favorable to the establishment and growth of ponderosa



pine forests. Such a fire cycle also promotes the growth of native bunchgrasses and sedges and discourages the growth and establishment of shrubs including manzanita and ceonothus. The burns were designed to have a low intensity, with flame lengths of 3-5 feet, rates of spread not to exceed 300 feet per hour, and scorch heights less than 24 feet. Immediate post-burn observations indicate that the burn was on the cool side, such that total fuel load and especially litter and duff consumption was on the low side of the desired range of conditions. Additional first, second, and fifth year postburn observations will provide managers a more quantitative

assessment of the fire's effects to vegetative structure and composition.

Exotic Plants. The park's YCC staff spent several days eradicating unwanted, non-native plants along the highway 62 corridor. The target species include Klamathweed (*Hypericum perforatum*) and spotted knapweed (*Centaurea maculosa*). Each year the YCC crew uses manual rather than chemical techniques to keep these weeds in check.

Vidae Falls Picnic Area. Several hundred grass, forb and shrub starts were planted in and around the newly rehabilitated Vidae Falls picnic area this fall. The picnic area now boasts a paved roadway, vault-style restrooms, and new picnic tables. Seeds from native plant species were collected in the autumn of 1999. Plants were established and grown by the Natural Resource Conservation Service (NRCS) plant materials program center in Corvallis Oregon, with funds from the Recreation Fee Demonstration Program.

We have a history of scientific collaboration at Crater Lake National Park. We strive for highly integrated research through close working relationships with universities, other public and private research institutions, non-profit conservation organizations and federal and state agencies.

Research Administration. Beginning in calendar year 2001, the Washington Office unveiled the NPS Research Permit and Reporting System. This system uses a standard Scientific Research and Collecting Permit and associated application materials coupled with internet based automation. The system enables scientists to apply for permission to conduct studies in parks and research coordinators to process and track their applications. We were able to attend one of the first training courses on the new system and have implemented it fully in the park.

Seasonal Effects of Prescribed Fire. Dan Perrakis and Jim Agee (University of Washington) completed the first of three field seasons of study in mixed-conifer forests near the panhandle region of the park. The objectives of this study are to quantify the effects of spring versus fall burning on standard fire response variables such as fuel consumption and understory effects, and also to quantify the effects of such fires on vigor and mortality of large ponderosa pine, which is the most important structural element in these mixed conifer forests. We established 24 independent experimental blocks in the field and collected pre-burn data for vegetation and fuels.

Decline of Whitebark Pine in the Cascade Mountains. Dr. Greg Ettl (St. Joseph's University, Pittsburgh, PA) and

two teams of volunteers from Earthwatch Institute collected data to characterize vegetation, geography, and soils associated with the high-elevation whitebark pine communities that occur around the caldera rim. Whitebark pine is in decline throughout its range due to a non-native pathogen that causes white pine blister rust in five-needle pines. The information is being collected throughout the Cascades Range to develop a spatially explicit metapopulation model that will predict persistence and rates of decline caused by the disease. This information will help land managers to develop appropriate management plans to provide for preservation of the species.

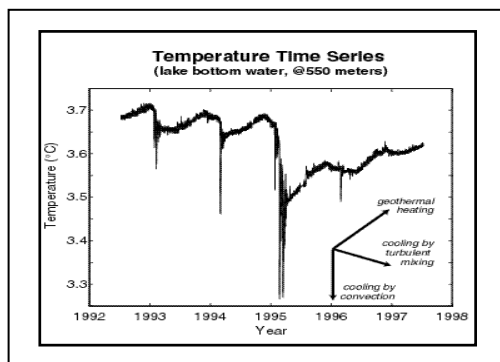
Effects of Fire and Anthropogenic Disturbance on Vegetation and Mychorrhizal Fungi. Researchers from Oregon State University finalized a 3-year study plan and began preliminary work to define the relationships between vascular plants, mychorrhizal fungi and disturbance from visitor use and fire. Over the course of the summer, 24 study sites were selected and surveyed for the presence of significant cultural resources. Above ground biomass information was collected and the first year of mychorrhizal fungi surveys were completed at 12 sites. Additional sites disturbed by fire were located this fall and will be surveyed for cultural resources next year.



Global Climate Change. Dr. Robert Collier (Oregon State University) recently received continued USGS

Global Climate Change funding for an additional five-year research project to

study the impact of climate on the physics, hydrology, and biogeochemistry of Crater Lake. This project promises to greatly expand the understanding of mixing dynamics and nutrient regeneration with regards to lake ecology. Crater Lake offers a pristine and relatively simple system to detect aquatic system changes through long-term study and provides a powerful natural laboratory to study the processes that link climate physics to the operation of nutrient cycles in aquatic ecosystems.



Results to date show how dramatic vertical mixing 'events' in the lake ventilate the bottom of the deepest basins and subsequently force nutrients upwards into the water column where phytoplankton can use the nutrients for growth. The temperature record from the deepest of 19 moored thermistors show how the annual cycle of early winter cooling followed by relatively steady geothermal heating is punctuated by spikes of colder water associated with these mixing 'events.' The climatic conditions associated with such events and the potential for global climate change to effect lake ecology are being studied.



Optical Studies. Crater Lake continues to attract top scientists due to the lake's unique conditions. Of particular interest recently are the tremendous optical properties of Crater Lake.

According to Dr. Emmanuel Boss of Oregon State University, "Crater Lake is a very interesting place optically since the clarity of its water is renown and extensive monitoring and research information on the lake is available." Dr. Boss, from the Oregon State University's Environmental Optics Lab came to study the optical properties of Crater Lake during summer 2001. "Crater Lake serves as an end member for natural optical properties, and a testing ground for instruments." Dr. Boss and his team used an array of instruments to assess the optical properties of Crater Lake. Preliminary analysis suggests that the lake has very little dissolved organic material compared to even the clearest oceanic environments (less than half the absorption of the clear waters of the Gulf of Aquaba, the Red Sea, and the Tongue of the Ocean in the Bahamas). In most lake and ocean systems, these organic materials prevent UV penetration into the water by strongly absorbing the UV light, thus protecting aquatic organisms from the harmful UV rays. The extremely low concentration of dissolved organic material in Crater Lake explains the near absence of phytoplankton in the upper 50 meters. It also helps in explaining the beautiful color of the lake, which comes from rays that do not get absorbed within the water but rather get backscattered into the eyes of the observer.

[Ultra-violet Light Penetration in Crater Lake.](#) Dr. Bruce Hargreaves from Lehigh University in Pennsylvania returned to the lake this summer to continue studying the penetration of ultra-violet (UV) light in the lake. Dr. Hargreaves was accompanied by personnel from Biospherical Instruments, a San Diego based company that designs and manufactures state-of-the-art aquatic and ground-based optical instruments for monitoring water and air quality. Results of these studies along with data collected by the park monitoring program indicate the top 15 meters of Crater Lake has greater UV transparency than the values published for absolutely pure water! Dr. Hargreaves expects the work on Crater Lake will be important in establishing new limits for UV absorption by absolutely pure water.

A recent analysis of published UV measurements by Dr. Hargreaves suggests that in some months the surface waters of Crater Lake have greater UV transparency than any other known lake or ocean in the world (Lake Vanda, in Antarctica, was a close second). We are privileged that Dr. Hargreaves will be in residence at Oregon State University during spring and summer 2002 as part of a sabbatical leave. He will work with the Crater Lake monitoring team to analyze existing optical and biological data from Crater Lake, and will continue with his own studies of Crater Lake.

[Implementation of Large Scale Methods for Monitoring Landbird Demographics and Habitat Relationships.](#) The Klamath Bird Observatory proposed to establish point count census and Rapid Ornithological Inventories in the park as part of a broader census for landbirds. The objectives of the comprehensive

program are to obtain data on species diversity and abundance in a variety of habitats, to evaluate the reproductive success and population health of neotropical migratory birds and to maintain a long term monitoring effort for tracking landbird population trends.

[Forestry Inventory and Analyses.](#) The Forest Inventory and Analyses (FIA) program has been sustained to make and keep current a comprehensive inventory and analysis of the present and prospective conditions of, and requirements for, the renewable resources of the forests and rangelands of the U.S. The USFS Pacific Northwest Research Station proposed to expand their inventory and analyses into park lands.

[Conduit Processes of the Cleetwood Eruption, Inferred From Textural, Petrologic, and Water Content Analyses of Erupted Products.](#) In the proposed study by Katherine Wearn of the University of Oregon, water content and isotopic composition data from Cleetwood obsidian clasts, in conjunction with detailed petrologic and textural studies of phenocrysts, microlites, and vesicles in previously collected fall deposits, will be used to infer changing physical conditions with the conduit over the course of the eruption.

[Assessment of Sensitive Amphibians in Southwest Oregon.](#) Bruce Bury of the USGS Forest and Rangeland Ecosystem Science Center, proposed to develop a common database on the past and recent distribution records, and relate habitat variables that will provide better opportunities to protect sensitive amphibians in the park.

[Distribution and Flora Inventory of Sphagnum Bogs in Crater Lake National Park.](#) Mundra Bergan of Southern Oregon University gathered baseline data on distribution and diversity of high elevation sphagnum bogs in the park.

[Calibration of the \(U-Th\)/He Geochronometer by Analyses of the Mt. Mazama Ash Flow Tuff and Granodiorite Xenoliths.](#) Jeremy Boyce of the Massachusetts Institute of Technology submitted a proposal to use 7.6 ka Mazama ignimbrite as a test of (U-Th)/He geochronology as applied to very young volcanic rocks.

[Sampling within Crater Lake National Park, as part of the Environmental Monitoring and Assessment Program.](#) Shannon Hubler of the Oregon Department of Environmental Quality submitted this proposal. The objective of the study is to determine the range of conditions in the macroinvertebrate population of streams throughout the study area.

[Asian Aerosol Source Identification, Chemical Transformation, and Long Range Transport.](#) Tom Cahill from the University of California – Davis proposed to sample air quality at Crater Lake as part of a larger sampling of Asian aerosols. The proposed research proposed to use a range of technology to investigate and quantify sources and chemical character of Asian aerosols.

[A Search for Missing Plants at Crater Lake National Park.](#) Peter Zika from the University of Washington visited the park to make an attempt to relocate approximately 60 plant species that have been documented with herbarium

collections, but not collected or seen in the park after 1960.

[New Proposals.](#) The park's Fire Ecologist collaborated on three fire ecology research proposals during the last half of FY2001 that would occur at CRLA or LABE. These were submitted for funding from the Joint Fire Sciences Program. The proposals address various aspects of fire as it relates to specific plant communities or wildlife habitats. They include:

Title: Fire Knowledge for Managing Cascadian Whitebark Pine Forests.
Principal Investigator: Dr. Michael Murray, Oregon Natural Heritage Program.
Project Amount: \$ 118,000.00
Study Duration: 24 months

Title: Interactions of Burn Season and Ecological Condition on Ecosystem response to Fire in Mountain Big Sagebrush Communities: Information Necessary for Restoration and Postfire Rehabilitation.
Principal Investigator: Dr. Boone Kauffman, Oregon State University.
Project Amount: \$ 498,000.00
Study Duration: 36 months.

The Effects of Fire Suppression, Fuels Treatment, and Wildfire on Bird Distribution and Abundance in the Klamath Ecoregion of Southern Oregon and Northern California.
Principal Investigators: John Alexander, Klamath Bird Observatory and Dr. C.J. Ralph, USFS Redwood Sciences Laboratory.
Project Amount: \$ 693,000.00
Study Duration: 36 months.

Information Management

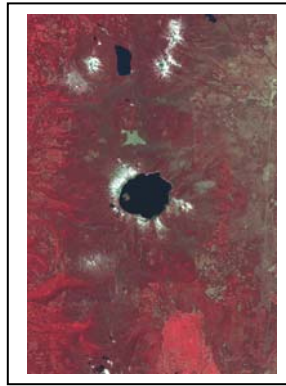
Our Geographic Information System (GIS) has proven to be an invaluable interdivisional management tool. We continued to enhance hardware, software and data acquisition in FY 01.

The GIS Lab's operations were greatly improved late in the year with the acquisition of a Dell 530 MT Professional Workstation desktop computer. Also acquired was a Hewlett-Packard 1055cm+ ink-jet plotter to replace our aging model 650c. Year-end funding assistance from the Wildland Fire program greatly assisted in these acquisitions. A Dell 2300 server computer has been transferred to the GIS Lab's inventory for reconfiguration as a park-wide relational database server. We expect to install a Microsoft SQL Server license on the server, which will enable the installation of ESRI's ArcSDE on the Lab's GIS system and the development of a comprehensive park-wide database structure that initially will include the GIS spatial database and elements from the park's curatorial database. Matching support from two awards from PWR GIS supported the acquisition of a laser rangefinding device for integration with our Trimble Pathfinder Pro XR field GPS receiver. This equipment will enable us to acquire positions from up to half a kilometer away from the point of interest.

Our GIS-related software suite consists of ESRI ArcGIS 8.1, ESRI ArcView 3.2a, Clark Labs' Idrisi32 r2 and CartaLinx 1.2, Autodesk's AutoCad r14, Adobe Illustrator and Photoshop, Macromedia Freehand, and several utility packages; all except AutoCad and Photoshop are current versions.

Among the new or extensively revised datasets acquired during 2001, the following are the most significant:

1. Six spectral band Landsat Thematic Mapper (TM) scene that includes the park and a large surrounding area.



2. Seamless contour coverage that includes the contours from the entire twelve 7.5-minute USGS quadrangle maps covering the park

3. Seamless single digital raster graphic (image of the actual printed quadrangle map) coverage that includes the twelve 7.5-minute USGS maps.

4. DRG of the park derived from the 1911 USGS map of the park at a scale of 1:62500, including the 1931 overprint showing the roads in the park.

5. Park-wide coverage of wetlands data from the National Wetlands Inventory.

6. Taxable parcels and parcel ownership data for Klamath County

7. Land cover for the park and surrounding areas

8. Generalized geological data for the park and surrounding

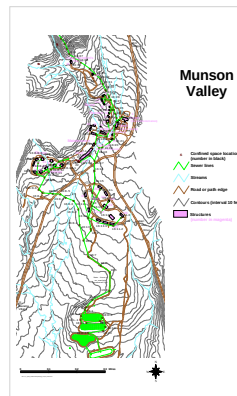
9. Generalized precipitation data for the park and surrounding areas

The GIS Lab staff devoted significant time to: original fieldwork, preparation of materials and technical assistance for

field projects and analyses of existing data in support of a variety of research.

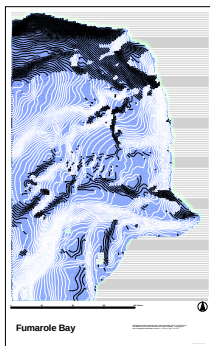
We developed a series of site maps for proposed fungi survey activity and the development of a number of maps and data analyses in support of the Wildland Fire crew's efforts, including a Fire Return Interval Departure (FRID) analysis, the development of an Albini fuels model, maps of fire regimes and fire management units.

Support was provided to the Maintenance Division's effort to develop a plan for management of confined and permit working spaces.



We developed a general-purpose reference map of sensitive resources and background information, and a cultural landscapes probability map drawn to the specifications of the park's field archaeologist.

We completed revisions of the data sets and maps describing potential lynx habitat and the results of years of survey work on spotted owl distribution.



A new and highly detailed bathymetric contour map to support operations of the park's lake research vessels was

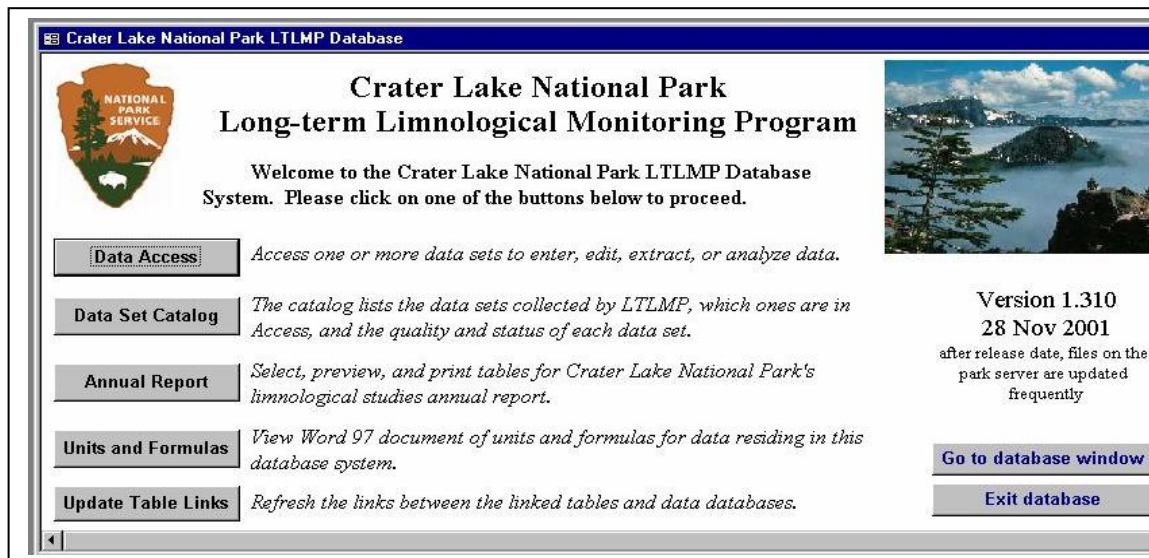
developed, derived from the results of the summer 2000 high-resolution

bathymetry project. Tangential to this effort, initial work was done on a methodology to identify small-scale pits and sinks on the lake bottom (features on the order of one to five meters in diameter), and on ways to present this information in a graphically legible manner.

Significant effort was devoted to fieldwork and map preparation in support of the centennial edition of the *Nature Notes* publication prepared annually by staff from the Interpretation and Cultural Resources Division.

We devoted a large amount of time a great variety of short-notice *ad-hoc* projects in support of activities of every operating division in the park including: trails projects, the park's Vital Signs workshop, the park's ongoing General Management Plan process, the Maintenance Division's snow-removal GPS project, incident management and prescribed burn activities for fire management and the provision of image scanning and 35-mm slide generation services and support.

Data Management. In 2001 we continued work on our data management program for the Long-term Lake Monitoring. With the financial assistance of Columbia Cascades System Support Office and the Water Resources Division, a term Data Manager was hired in January 2000 to design and develop a centralized data management program. Tremendous progress has been made. The process started by reorganizing and centralizing files into one location and



software program (Microsoft Access), checking and ensuring the accuracy of the data entry by entry, and developing a comprehensive data management plan. The Long-term Monitoring Program presently has 22 distinct data sets comprising approximately 5.9 gigabytes of information about the physical, chemical, and biological characteristics of Crater Lake. That is enough information to fill a stack of computer floppy disks six stories high! Seventeen of the 22 data sets have been incorporated into the centralized data management system based in Access. Park biologists and cooperators can access and extract selected data, all of which are accessible from one location, via graphical user-friendly interfaces. The interfaces consist of simple menus to easily enter, edit, view, and analyze data.

The final product of this program will be the development of a solid and formal data management system that ensures the integrity, security, and availability of the Crater Lake Long-term Limnological Monitoring Program data. Although base funding of the data management position does not presently exist, the present program is taking the first big and

critical steps to develop a formal data management system. This project will enable us to fully use the monitoring data for extensive analyses, which will in turn lead to a better understanding of the Crater Lake ecosystem and sound resource management decisions. We secured additional funds from the Water Resources Division to continue the development phase of the project in 2002. We hope to solidify the data management program through a future increase to base funds.