

Natural Notes

National Park Service
U.S. Department of the Interior

2005

North Cascades National Park
Service Complex



Parks For Science

It is an exciting time for our national parks thanks to a renewed enthusiasm for science. National parks are public treasures that offer us a chance to explore significant places throughout the country. Their natural aspects and long-term protection also make them ideal for scientific research. Park managers realize that this research is needed to confront increasingly complex environmental issues and decide how to best preserve these places for the enjoyment of future generations.

A multiyear plan called the Natural Resource Challenge began in 1999 and continues to expand and revitalize National Park Service (NPS) natural resource management through a greater reliance on scientific knowledge. The foundation of this plan is to acquire basic information about the natural resources and conditions in the parks by compiling:

- species lists of vertebrates (mammals, birds, fish) and plants
- information on the distribution and status of these vertebrates and plants
- geology, soil and vegetation maps
- data on air quality
- information on the location and classification of bodies of water
- data on water quality
- a natural resource bibliography
- basic data for generating maps

As information is compiled, it becomes apparent that some natural resources need ongoing attention. For these, monitoring is the next step of the Natural Resource Challenge. To study trends and pressures on resources, parks are working out long-term monitoring strategies adapted to specific kinds of resources and factors that may threaten them.

Overall, the Natural Resource Challenge is the Park Service's strategy to:

- inventory and monitor natural resources
- restore natural ecosystems degraded by non-native plants and animals
- encourage independent research studies by scientists
- build working partnerships among parks, universities, researchers and other agencies such as the U.S. Forest Service, the U.S. Geological Survey and the U.S. Fish and Wildlife Service
- share new findings and knowledge with the public

www.nps.gov/noca/nat.htm

www.nature.nps.gov

look for links to web-based resources throughout Natural Notes



Mount Shuksan

Anne Braaten, NPS

Inventory And Monitoring In The North Coast And Cascades Network: Partnership For The Future

The goal of the Natural Resource Challenge and its Inventory and Monitoring Program is to better meet the mission given to the National Park Service (NPS) by Congress when the agency was created in 1916: "... to conserve the scenery and the natural and historic objects and the wildlife... and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations".

For North Cascades National Park Service Complex (NCNPSC) to become a library, laboratory and classroom, it must work with other parks and other agencies to compile databases and conduct research. Across the NPS, Vital Signs Monitoring Networks have been established. A total of 32 regional networks are planned.

In all things of nature there is something of the marvelous. -Aristotle



Lupine

Anne Braaten, NPS

These networks allow parks within similar regions to share information and findings on common natural resources and ecosystem health. In the Pacific Northwest we have the North Coast and Cascades Network (NCCN) comprised of seven NPS units:

- ◆ North Cascades NPSC
- ◆ Olympic National Park
- ◆ Mount Rainier National Park
- ◆ San Juan Island National Historical Park
- ◆ Ebey's Landing National Historical Reserve
- ◆ Fort Vancouver National Historic Site
- ◆ Lewis and Clark National Historical Park

The NCCN is a cooperative effort to increase our knowledge of this amazing region to ensure the long-term protection of these significant NPS units.

North Cascades National Park Service Complex

This part of the National Park System embodies the very idea of diversity. The mountainous park includes the north and south units of the national park, as well as Lake Chelan and Ross Lake National Recreation Areas. With 684,320 acres, of which over 93% is managed as the Stephen Mather Wilderness, the park sees around 400,000 recreational visits each year.

The park's vast range of elevations, climates and life zones provides for a variety of wildlife. Over 700 glaciers and a sea of peaks and valleys form the unique Cascades ecosystem. This newsletter, the second edition of *Natural Notes*, highlights scientific findings and showcases current research in the park.

Research



Partnerships



Understanding



What's Inside?

- 2... Threatened Species
- 3... Forest Life
- 4... Aquatic Life And Science
- 5... Plant Ecology
- 6... Geology, Air Quality & Climate
- 7... Glaciers & Cultural Resources
- 8... Citizen Science & What's Next?

Exponential Extinction?

Fossil records reveal that the current rate of species extinction is the fastest in history. The status of rare and endangered species is always on the forefront of environmental issues in any ecosystem. As human impacts jeopardize rare species, the increase in the extinction rate echoes our own rapid population growth. Today, habitat loss is the prime threat to species at risk of extinction, but poaching and invasive non-native species also cause numbers to dwindle. Research, in places such as national parks, helps us recognize problems which rare species face and prevent the loss of these valued plants and animals.

North Cascades National Park, adjacent national forests and wilderness areas, and other northwestern national parks provide critical habitat for a number of species facing extinction. Since the passage of the Endangered Species Act in 1973, more than a thousand species have been listed for the special protections the act provides. One positive result has been the recovery of Peregrine Falcon and Bald Eagle populations, due in part to the banning of the pesticide DDT.

Before a species is placed on the U.S. Fish and Wildlife Service's federal list of endangered and threatened wildlife and plants, a strict legal process determines the current status of the species. An **endangered species** is one in danger of extinction throughout a significant portion of its range. A **threatened species** is one likely to become endangered in the foreseeable future. The federal listing also records plants and animals that are candidates (proposed additions) for the list. In addition to the federal listing, Washington State Department of Fish and Wildlife maintains state specific listings.

<http://endangered.fws.gov>

wdfw.wa.gov/wlm/diversty/soc/concern.htm

Threatened And Endangered Species In North Cascades National Park

Northern Spotted Owl

Federal: Threatened **State:** Endangered
This owl's body measures about 1.5 feet with a wing span of 4 feet. It relies on old-growth forests, nesting mostly in trees more than 200 years old and is a rare sight in the park.
Causes of decline: Habitat loss and (in recent years) competition with Barred Owls.

Bull Trout

Federal: Threatened **State:** Threatened
This is the fish with the polka dot back. Bull trout have white trim around each fin and no black on the dorsal fin. It prefers cold waters with temperatures just above freezing. Females build nests in the gravel and lay up to 5,000 eggs. Added to the endangered species list in 1997; bull trout are extinct in some previously inhabited lakes and streams.
Causes of decline: Habitat loss and decreased water quality.

Gray Wolf

Federal: Endangered **State:** Endangered
The long legs, large feet and narrow chests of gray wolves allow them to move quickly through snow and thick shrubbery. Wolves live in open forests and tundra in families or packs.
Causes of decline: Habitat loss and efforts by some to eradicate these predators.

Grizzly Bear

Federal: Threatened **State:** Endangered
The grizzly bear can be difficult to distinguish in the wild from the black bear. Grizzly bears usually have a shoulder hump, a dishd face and long, straight claws on their forefeet. The grizzly often rears on its hind legs to get a better view of the surroundings. During the winter months it hibernates in dens or caves. In summer, grizzly bears seek out river corridors and high alpine shrubby areas. They require large territories to roam, breed only once every three to five years and produce a litter of one to two cubs. Grizzlies are very rarely seen in the North Cascades.
Causes of decline: Habitat loss and historic hunting.

Canada Lynx

Federal: Threatened **State:** Threatened
Lynx have large padded feet for snow travel and heavy coats for cold weather with long black hair on the tips of the ears. When snowshoe hares are abundant (about every 10 years) the lynx produce larger litters and when the hares are scarce, this cat's population declines. A small number of lynx live in the Pasayten Wilderness east of North Cascades NPSC.
Causes of decline: Trapping, hunting and reduction of prey.

Marbled Murrelet

Federal: Threatened **State:** Threatened
This robin-sized diving sea bird has wings that allow it to fly underwater. Marbled murrelets lay only one egg each season. The parents travel to and from the ocean to bring food back for their chick. This sea bird migrates from the sea to nest high in the trees of old-growth forests. It has been sighted near the west boundary of the park.
Causes of decline: Habitat loss and marine fish declines.

Bald Eagle

Federal: Threatened **State:** Threatened
As adults these large raptors can grow to 3 feet tall with wingspans of more than 7 feet. Adults have brown bodies, yellow beaks and white heads and tails. The Skagit River Watershed, which drains from the park, supports one of the largest wintering populations of bald eagles within the contiguous United States.
Cause of decline: Toxins from pesticides that accumulate in fish and mammal food sources.



Western Gray Squirrel

Federal: Species of concern **State:** Threatened
A bushy tail, as long as the body, is used for balance when jumping. The squirrel lives in wooded areas, building nests of sticks and shredded bark about 20 feet above the forest floor. A small population lives in the Stehekin Valley. **Causes of decline:** Habitat loss.

Fisher

Federal: Species of concern **State:** Endangered
This carnivore belongs to the weasel family, but can grow to over three feet and weigh over 30 pounds. These elusive hunters once occurred throughout Washington, however, extensive surveys have been unable to confirm the existence of a population in the state. Sightings of fishers are very rare in the park.
Causes of decline: Habitat loss and trapping.

www.nps.gov/nocaltreas.htm



Western Gray Squirrel

Threatened Gray Squirrels Get Attention

Though we may take squirrels in our neighborhoods and forests for granted, there's nothing common about the western gray squirrel. While this native of mixed conifer and oak forests was once widespread over nearly half of Washington, it now survives in only three small, isolated populations. The western gray squirrel's situation is so dire that it is an unlucky member of Washington State's threatened species list.

One remnant population of western grays lives in the Stehekin Valley of Lake Chelan National Recreation Area, managed by the National Park Service. This valley's ponderosa pines provide the squirrel's required banquet of conifer seeds, mushrooms, insects, and berries, plus tall trees for safe resting and nesting. In times of plenty, the squirrels cache seeds for winter. Seeds not retrieved can grow to renew the forest and provide food and shelter for other members of the community.

Despite their protection by the park and the state's Endangered Species Act, western gray squirrel numbers are probably declining. Several characteristics make them susceptible to extinction. They rely on increasingly rare large, old, conifer forests, traveling in the tree tops to move around and to escape from predators. Their small and isolated populations are sensitive to human disturbance. High susceptibility to disease and a low reproductive rate (one litter per year) mean slow recovery from population reductions. These are not the rapidly spreading eastern gray squirrels introduced to the Northwest by humans and now abundant in some developed areas of Washington.

Scientists from North Cascades National Park propose a three year study with cooperators (University of Washington and United States Geological Survey) to investigate the causes of the alarming drop in population numbers in Washington. If funded, researchers will study the squirrels and their habitat in the Stehekin Valley in relation to management practices in the area. By searches on the ground and tracking radio collared squirrels, scientists will gather data on the numbers and health of this isolated group, their foraging and nesting activities and their reproductive status. This information will help identify what land managers need to do to maintain a viable population of western gray squirrels in the Stehekin Valley and maybe in other parts of Washington too.

Forest Carnivore Study: Missing Lynx?

Forest carnivores such as the American marten, lynx, wolverine, fisher and bobcat reign at the top of the food chain along with bears and wolves. Because information about their presence in the North Cascades is limited, park biologists have a vested interest in the study of these rare and secretive animals. Inventories relating to these species are part of the plan to document to the 90% level mammals, birds, reptiles, amphibians, fish and flowering plants found in the park.

A two-year survey of forest carnivores has revealed information about their status and distribution in North Cascades National Park. From late January through mid May of 2003 -2004, biologists and volunteers set up temporary study stations within carefully chosen areas of the park. Motion-triggered cameras captured images of animals lured to the sites by scent attractants and bait.

Biologists overcame challenges presented by winter weather and remote study stations - they collected 2,067 color



Spotted Skunk

images of 13 mammal and 5 bird species. Though bobcat, cougar, and American marten are among the species caught on film, others are disturbingly absent: the wolf, wolverine, fisher, and lynx were not detected.

Park biologist, Roger Christophersen, offered an explanation for these missing links: "We have to remember that carnivores are very rare, elusive, and generally are far-ranging, making them very difficult to study". Extreme terrain and winter conditions made what may have been ideal habitats inaccessible. Roger also added, "It's possible that some of these species have suffered severely from habitat alteration, trapping pressure, and maybe even recreational impacts and have never been able to fully recover (to historic levels)." Some of these species may be gone from the park or even the region.

Researchers were also able to compare results from North Cascades NP with similar carnivore surveys from Mount Rainier and Olympic National Parks. Interestingly, American marten, a member of the weasel family, was the most commonly photographed species in North Cascades and Mount Rainier, but was not seen in Olympic. Also, while numerous images captured red foxes in Mount Rainier, photos of this species were absent in the other two parks. Researchers are careful to point out that some species could be more attracted to the lures than others,

and this could also be true for the same species across different regions. However, regional differences and the apparent absence of some species raise important new questions for future research.

Park biologists in North Cascades NP will continue this investigation with new sites and a change in season. Using available information on ideal habitats of the more rare species, combined with records on where they have been observed in the past, researchers will focus on promising new study sites. To address the fact that these sites may be at higher elevations, where terrain and conditions have been problematic, they are planning to conduct the survey during the summer months. The heartfelt hope is that at least one of these elusive animals will smile for the camera.



Pine Marten

More Than Just A Pretty Song - Landbird Inventory

Don't plan on sleeping late during a summer camping trip in North Cascades National Park. Each dawn breaks with a concert of birdsong - winter wren, Swainson's thrush, olive-sided flycatcher, and dozens of other songbirds project their voices skyward to attract mates and defend territories. Some of the singers live here year-round; others migrate thousands of miles to spend a short breeding season in the park.

North Cascades encompasses a wide range of elevations and precipitation gradients which provides a variety of habitats important to birds. They are the most visible animals in the North Cascades Ecosystem. The high body temperature of birds, their rapid metabolism, and their high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. Because birds are fairly abundant and most are active during the day, it is very feasible to inventory and monitor their populations.

In 2001 the National Park Service, the Institute for Bird Populations, and Western Washington University joined resources to conduct a two-year inventory of terrestrial (land-based) birds and analyze their distribution across the park. Similar inventories have been done or are planned for other National Park Service areas in the northwest. The North Cascades National Park inventory was carried out over a broad range of habitats - from low elevation west side Douglas fir forests up to sub-alpine heather meadows and down to east side lodgepole pine forests. Scientists carefully chose the sample plots both along and away from trails. Field crews began bird



Swainson's Thrush

inventories in the plots right after sunrise and continued for 3.5 hours, identifying and recording all birds heard and seen.

To help understand the food and shelter needs of birds within each habitat, the crews also recorded details about the vegetation and other characteristics of the sample plots. They measured the average height of vegetation and noted the plant species present and the aspect of the plot, its slope, and the presence of water.

116 species of birds were detected during this study. 105 were seen or heard at least once at survey points, while 11 were recorded only during early season training

sessions or at other times of the field season when crews were not conducting inventories. Perhaps the most profound and thought provoking findings of this work have to do with the relationship between the number of species detected and the total number of birds - only half the species were detected at least ten times. A mere five species appear to comprise just over half of the total number of birds inhabiting the park during the breeding season. Those species are the pine siskin, chestnut-backed chickadee, dark-eyed junco, golden-crowned kinglet, and winter wren.

The morning chorus across the park provides information beyond bird identification. Scientists are analyzing the inventory data to address several scientific and management questions. The findings will help determine:

- ◆ if the diversity of species present varies with elevation
- ◆ if habitats with more species also support larger numbers of birds
- ◆ how management decisions, such as removing dead trees or fire management, affect species diversity and abundance
- ◆ how human activities within the park affect the diversity of bird species and their total numbers

The concert of bird song doesn't last long in the North Cascades. By September, the intense and diverse songs have faded into another season of quiet. However, the data gathered about these well-traveled wonders help build our understanding of this complex ecosystem and will assist land managers in making decisions that affect future generations of birds.



Silver Lake

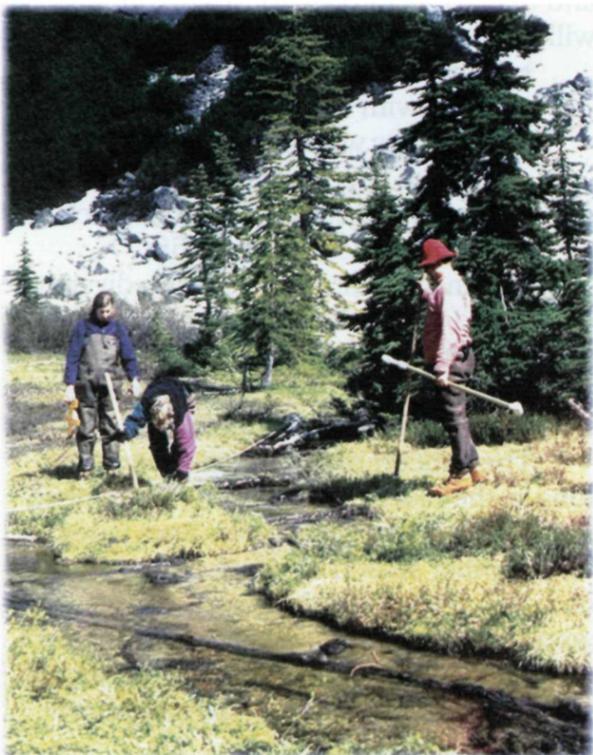
Stream Habitats

After any rainfall, the surge of rushing water can be seen and heard just about anywhere within North Cascades National Park. The park's dynamic glaciers and steep mountains feed over 4,000 miles of streams and rivers. The status of these streams is the focus of a number of projects in the Inventory and Monitoring Program.

Aquatic resource program activities have included stream amphibian and fish inventories to determine what species are living in the park's streams. Working with other parks in the North Coast and Cascades Network, as well as the U.S. Forest Service, data sets can be established that outline what aquatic life inhabits streams across the region. These inventories can be used to ask further research questions and establish monitoring programs.

Program activities have also included benthic macro-invertebrate (BMI) monitoring in streams. BMIs are organisms that have no backbone and spend a portion or all of their life living along the bottom of streams. Many BMIs are the larval forms of flying insects like mayflies and are an important food source for fish, birds and amphibians. Their abundance, diversity, sensitivity to environmental changes and inability to travel far distances make them ideal for monitoring stream conditions.

In addition to looking at aquatic life within streams, researchers also monitor physical and chemical attributes of streams to see how natural and human-caused disturbances affect these waterways. Currently, streamflow variability in small streams at North Cascades and Mount Rainier is being assessed by a graduate student from the University of Washington.



Aquatic Life In The Mountains

The abundance and diversity of aquatic habitats in the North Cascades ecosystem is one of the characteristics that makes this area unique. In North Cascades National Park (NP), over 500 lakes and ponds are scattered throughout the mountain landscape. These natural environments are home to native aquatic life including plankton, aquatic insects, frogs and salamanders. To visiting onlookers, the natural backdrop of these lakes and ponds makes them appear pristine, but ongoing stresses may be affecting the health of these ecological systems.

Park resource managers are monitoring these lakes and ponds to determine their chemical and physical status. Acidic deposition (acid rain) and nutrient-laden atmospheric deposition may be altering the chemical composition of lakes and ponds. This could be causing acidification and

nutrient enrichment harmful to the sensitive balance of aquatic life. The physical and chemical properties of lakes and streams can also be affected by direct human influences. Trampling and destruction of vegetation around shorelines lead to erosion, sedimentation and changes in nutrient inputs. Introduction of non-native species causes environmental disturbances, and historic mining activity may have led to the contamination of some water sources.

Aquatic resource managers from North Cascades NP are working with the North Coast Cascades Network, the United States Geological Survey and the National Park Service's Water Resources Division in developing a long-term ecological monitoring program for lakes and ponds. This will allow them to determine if acid rain and visitor use are affecting the health of these fragile but valued environments.

www.nps.gov/noca/Ltem/index.htm

Weeding And Wetland Restoration Around Ross Lake

Non-native plants and animals threaten natural ecosystems around the world. National Parks are no exception, though they exist in part to preserve natural environments. Introducing non-native plants, often in gardens or on farms, can have unintended consequences. Reed Canary grass is just one of the problem plants that threaten biodiversity in the North Cascades. Vegetation surveys around Ross Lake identified many infestations of this non-native grass, ranging from individual plants to 5-acre patches. Seattle City Light's Ross Dam inundated 26 miles of the Skagit River and created a seasonally fluctuating lakeshore where there was once over 11,000 acres of riparian and wetland habitat. This habitat had served as a resting stop for over 150 species of migratory birds and winter range for many mammal species. It was a breeding ground for approximately 75 species of birds that wintered south of the United States, many of which are declining in population.

Reed Canary grass, an aggressive non-native that invades disturbed areas, is pervasive throughout the western United States and extensive in the lower Skagit Valley. Its thick shoots and root systems begin growing early in the season, excluding native wetland plants and preventing natural establishment of riparian forests. The grass thrives in nutrient rich stream outlets where water levels fluctuate; the same conditions found around Ross Lake. Native fish and other animals are not well adapted to spawn or reproduce in Reed Canary grass thickets. The grass threatens the habitat of animal and plant species on federal or state rare and endangered species lists including Bull Trout, Cascade Frog, Harlequin Duck and Bald Eagle. Reed Canary grass also directly affects habitats that support 27 Washington State listed plant species.

Non-native invasive species like Reed Canary grass need to be removed in order to protect the rivers and streams of the North Cascades National Park Service Complex. If the park staff used just chemical treatment, it would likely need to

be repeated every few years, and success would probably be minimal. Instead, the Park Service is trying a creative, multi-faceted approach combining the efforts of a plant ecologist, exotic plant management crew and plant propagation employees to restore wetlands around Ross Lake. They are using the logs, root wads and other woody debris which wash into Ross Lake annually to re-create nutrient rich wetlands. In the past, Seattle City Light (SCL) crews collected this wood and burned it. In 2004, the park crew instead used some of the wood (1,320 cubic yards) to mimic naturally occurring wetlands and riparian areas still found in adjacent drainages. These new riparian areas allow planting a diversity of native plant species and the shading out of the Reed Canary grass.

Agency cooperation will expand this alternative wood use. Rather than burning woody debris, Seattle City Light will deliver it to restoration sites on Ross Lake to cover areas devoid of vegetation or occupied by Reed Canary grass. Native plant species either salvaged on site or propagated in the Park nursery, will be planted to create native plant communities which mimic those lost to the reservoir. Community volunteers will help monitor and maintain the native plantings in the years ahead.

In summer 2004 the park's resource management staff also began treating Reed Canary grass around Ross Lake with glyphosate herbicide. Areas near Big and Little Beaver, Dry Creek and Lodgepole Camps were sprayed. The park staff believes that the key to preventing re-infestation or future invasion by other non-native species is the placing of woody debris and then planting native species. Few exotic plant removal projects include this revegetation component. The project is developing methods which may serve as a model for other areas such as the U.S. Forest Service's nearby Baker Lake, the National Park Service's Lake Chelan, Lakes Ozette and Crescent at Olympic National Park and neighboring areas in Canada such as Manning Provincial Park.

Botanical Foray 2004

By Steve Hahn, NPS Biological Technician

The mountains of the North Cascades are home to well over 1,000 species of vascular plants, but no one knows just how many, not even in the national park. This summer marked the third year that the North Cascades National Park Service Complex has worked with the Herbarium staff at the University of Washington to collect vascular plants in the park. Vascular plants are those which have structures that conduct water, nutrients and photosynthetic material. Plants that reproduce by seeds are vascular plants, while things such as mosses are not. We have dubbed these collecting expeditions "botanical forays".

The Natural Resource Challenge requires national parks to verify that at least 90% of the vascular plants on their existing plant lists are, in fact, present in the park. Before now there was no quality standard for these important inventories of the plants which national parks are to protect. The botanical forays began as part of an effort to provide this verification at North Cascades National Park. The first year we surveyed 3 areas: Colonial Creek Campground/Lower Thunder Basin, Lightning Creek/Desolation Trail/Little Beaver and Cascade Pass/Pelton Basin. In 2003 the surveys focused on the Fisher Basin area.

Key High Elevation Pine Threatened Across The West

By Regina Rochefort, NPS Science Advisor

Whitebark pine is a species of central importance in the high-elevation ecosystems of Western North America. It begins growing on windswept ridges and in subalpine areas (5,000 – 7,000 or more feet) after fires. Its establishment in this harsh environment creates a micro-habitat for other species of plants and animals, as well as providing a food source for many species including grizzly bears and a bird called the Clark's Nutcracker.

Today, the long-term survival of this tree is uncertain due to the introduction of a Eurasian fungus called *blister rust* to North America in 1910. As the rust spreads through the tree, it produces cankers which restrict the flow of sap and can girdle the tree. The sweet cankers also attract unwanted visitors such as harmful rodents. In the late 1980's whitebark pine surveys in Glacier National Park, documented mortality from blister rust exceeding 90%. While the future of whitebark pine does not appear as bleak in the Cascades as in Glacier National Park blister rust does pose a serious threat to the survival of our whitebark pine populations.



Whitebark pine with dead tops from girdling by blister rust cankers.

This year's foray was conducted in the southeast portion of the park complex and included McAlester Mountain, Dee Dee Lakes, McAlester Lake, High Pass and Rainbow Ridge. This area was chosen because we knew that very little botanizing and no plant collecting had been attempted there in the past. Two botanists representing the Park Service and the University of Washington led 8 talented and dedicated volunteer botanists in the field work. We established a base camp at McAlester Lake for the 4 days of collecting and plant pressing. For the first time, we had the help of the park's pack horses and mules to carry the heavy and awkward drying presses into the remote backcountry.



Steve Hahn (writing) with volunteers pressing botanical samples in Fisher Basin.

Between 1994 and 1999, we surveyed Mount Rainier and North Cascades National Parks to determine the status of whitebark pine populations. Although the evidence is that infection and mortality rates are highly variable in both parks, blister rust was present in 97% of the stands we examined. On average, 22% of all the whitebark pines had blister rust and 34% of them were dead. We also found that about 25% of all seedlings and saplings were infected, and 10% were dead. Interestingly, infection rates increased from west to east and with increasing elevation.

In 2003, National Parks in the Pacific Northwest received funding for a two year project to survey the genetic diversity of whitebark pine, begin investigating resistance of local populations to blister, and establish permanent plots to monitor the status of the tree's population over time. Monitoring permanent plots will help us determine if rates of mortality are changing, what percent of the trees might be resistant to blister rust, and if seedlings are surviving. This information will help develop long-term protection strategies for this important high-elevation species.

Over the past two years, we collected pine needles for genetic analysis from 9 whitebark populations in North Cascades National Park, 10 populations in Mount Rainier National Park, and 5 populations in Olympic National Park. The U.S. Forest Service's National Forest Genetics Laboratory in Riverside, California, is doing the genetic analysis. These data will give us an idea of how much populations differ within and between the national parks. If it is determined that restoration (planting of trees or seeds) is necessary to

In 4 days the group collected approximately 335 specimens from 31 plant families, 70 genera and a wide variety of habitats. Preliminary results indicate that we found 3 very noteworthy specimens, including 2 new locations for plants designated as "Sensitive" and one range extension. The Washington Natural Heritage Program lists the 2 species of Sensitive Plants as "S1", which denotes a critically imperiled population with 5 or fewer known occurrences in the state! The finding of the third species represents its furthest known southern occurrence. All 3 of these plants are more common north of the park complex, suggesting that the park may be home to the southernmost known populations of these plants. Populations at the edge of a plant's range often harbor unique and important genetic variation relative to the main populations. These discoveries highlight the importance of surveying for vascular plants and of organizing a group of knowledgeable botanists to complete the task. These plants are part of what make North Cascades National Park so special and significant. A more complete understanding of their presence helps park managers to ensure their long-term protection.



Whitebark pine with blister rust cankers.



protect this species, we will use the data to develop guidelines for how far seeds can be planted from collection sites.

During summer 2004, we established permanent monitoring plots in North Cascades and Mount Rainier National Parks. After discussion with staff from Crater Lake and Yellowstone National Parks and using methods developed by the Whitebark Pine Foundation, we are designing monitoring methods. Crews from North Cascades and Mount Rainier worked together on sites in each park to ensure consistency.

Long-term survival of the Whitebark pine population will depend on the production of seeds and blister rust resistant offspring, the presence of safe sites for regeneration, and the general health of the ecosystem. Long-term monitoring and research will provide us with an accurate picture of the status of populations and a better understanding of the ecology of this important high-elevation species.

Rapid and Gradual Change In The Pacific Northwest

Volcanic eruptions, landslides, floods and earthquakes remind us that this landscape is dynamic and ever-changing. These dramatic events can change habitat and ecosystems instantly.

- ❖ Landslides triggered by heavy rains or earthquakes deliver sediment and large wood to streams. Landslides can also block valleys and form new lakes.
- ❖ The Cascade volcanoes Mt. Baker, Mt. Rainier, Mt. St. Helens and Glacier Peak are active, and geologically speaking, very young features. Glacier Peak and Mt. Baker had significant cone-building eruptions 12,000 years ago.
- ❖ Colossal ice sheets covered all but the highest peaks in the North Cascades as recently as 16,000 years ago, and blocked north-draining valleys at Olympic NP.

More gradual changes occur over decades or centuries. Changes in air quality, growing season, temperature, precipitation and solar radiation can also be influential in altering ecosystems.

- ❖ Pollution is carried by prevailing winds into the Olympics and Cascades from Puget Sound and Asia. Winter storms and cold temperatures in the mountains scrub some of this pollution from the air and deposit it in lakes, streams and glaciers.
- ❖ Changes in air and water temperatures are lengthening the growing season, melting glaciers and shrinking the subalpine and alpine zones.

Critical knowledge of these rapid and slow processes is needed to manage the parks and understand results from plant and animal monitoring programs. Our ability to protect and preserve ecosystems hinges on an understanding of soils, air quality, geologic processes, climate change floodplains and other abiotic factors. The program we are developing consists of three levels:

- ❖ Inventories of important resources including soils, landslides, and glaciers.
- ❖ Monitoring of key variables such as air and water quality, glaciers, climate, and streamflow.
- ❖ Research linking inventory and monitoring observations with events and processes that are constantly changing.

Soils

Soil is the foundation for life, key to nutrient cycling, the hydrological cycle and energy capture and transfer.

Inventory:

- ◆ Develop digital data on soils types, characteristics and distribution.
- ◆ Relate soils types to landforms, habitat, organisms, and other ecological conditions. Ebey's Landing and San Juan NHP have been mapped in the past two years, while the focus shifts to North Cascades in 2005.

Monitoring:

- ◆ Erosion of soils on Ross Lake.
- ◆ Human impacts in wilderness areas.

Research:

- ◆ Assess methods for mapping soils in rugged, remote parks. This effort is being led by the Natural Resources Conservation Service and Washington State University faculty. A pilot project was completed for Thunder Creek Watershed at North Cascades in 2004.
- ◆ Determine which soils types and organisms in soil are most vulnerable to climate change.
- ◆ Quantify the level of pollutants, such as mercury, pesticides and herbicides in soils, and their impact on soils chemistry, processes and organisms.

Air Quality

North Cascades NP has some of the clearest air in the lower 48 states, ranking ahead of many other national parks in the west. Air quality is monitored at two locations and there is a web cam located at the North Cascades Visitor Center with views of the southern Pickets.

Monitoring:

- ◆ At Marblemount, acid deposition and ozone are monitored.
- ◆ At Ross Dam, visibility, nitrogen and sulphur aerosols are monitored.
- ◆ Ozone concentration at low elevations is rising at North Cascades NP, while trends for sulphur and nitrogen are less clear.
- ◆ Rainfall is slightly acidic, which is a concern in high lakes ecosystems.

Research:

Three research projects are assessing impacts of air quality on park resources. The first study is examining lakes and fish tissue for the presence of mercury and pesticides. These pollutants are found in most alpine ecosystems in western North America - initial results indicate that some lakes in the North Cascades have elevated levels of mercury. Two linked studies are looking at sulphur and nitrogen deposition in snowpack and stream water.

Climate Change

The Pacific Northwest region is sensitive to global climate changes because of its latitude, proximity to the Pacific, and mountainous topography. Research about past climate fluctuations can help determine the magnitude and pace of future climate changes that may occur as a result of global warming. We have learned that during El Niño years, this region's weather is dry and glaciers shrink. Also, the regional climate cycles between dry/warm and wet/cool over 10-15 year periods.

Monitoring:

Weather conditions at North Cascades are monitored at 13 sites by the NPS and hydroelectric utilities through cooperative agreements with the Natural Resources Conservation Service. In 2003, a weather station was installed in Marblemount that is part of the national long-term Climate Reference Network of stations designed to observe climate change across the country. Variables that are monitored include precipitation, snow depth, snow water content, temperature, relative humidity and wind speed and direction. Glaciers are excellent indicators of climate change, and evidence indicates that glaciers' area has decreased more than 30% at North Cascades in the last 150 years due to longer, warmer summers and drier winters.

Research:

- ◆ Several research projects are assessing the impact of global climate change on park ecosystems. A recently completed study assessed the impact of shrinking glaciers on summer streamflow and determined that if present trends continue, summer streamflow in Thunder Creek watershed will be significantly reduced by 2005.
- ◆ An ongoing research project headed by the US Forest Service and US Geological Survey is examining impacts of climate change on broad, landscape-level ecosystem changes.
- ◆ Research is being conducted in the North Cascades into glacier, climate and environmental changes spanning the last 30,000 years. This project is studying the massive Cordilleran Ice Sheet and fluctuations of alpine glaciers during rapid climate change at the end of the last great ice age.

NPS Nature and Science:

www2.nature.nps.gov/air/features/climatechange/parks.htm

NASA Global Change Master Directory:

gcmd.gsfc.nasa.gov/Resources/pointers/glob_warm.html



NPS Ranger Charles Beall surveys flood damage to State Route 20 at Pyramid Creek. Heavy rainfall in October 2003 led to historic floods that caused widespread damage to roadways, hiking trails and campgrounds.

NPS Nature-Net:

www2.nature.nps.gov/geology

NPS Views of Parks Publications:

www2.nature.nps.gov/synthesis/views/System/Help/Help_Pubs.htm

Mass Wasting

Landslides are common on steep slopes in mountainous areas and along coastlines. These avalanches can be very large and have pronounced effects on natural resources. For example, a landslide dam created Lake Crescent at Olympic National Park (NP). As recently as the fall of 2003 a lake was created along Goodell Creek in North Cascades NP. NPS surficial geology mapping is producing inventories of all landslides to:

- ◆ Determine the causes, ages and ecological implications of large landslides. Are large landslides triggered by earthquakes, and if so, which kind?
- ◆ Determine what ponds, lakes and wetlands in the state's three national parks were created by landslides and when.
- ◆ Evaluate and monitor the effects of ground water on different types of landslides.

Hydrology and Glaciers

Hydrologic systems in the three mountain parks are complex and may include glaciers, hot springs, extensive surface water resources and extensive aquifers on the floors of large valleys. These landscapes collect snowfall in winter and release it to lowland areas in spring, while vast glaciers trap water as frozen reservoirs and release water more slowly, buffering aquatic ecosystems from summer and longer droughts. Most of the major rivers are prone to frequent large floods due to steep slopes, heavy precipitation and rapid snowmelt events. The US Geological Survey monitors streamflow and lake surface elevation on large reservoirs and rivers.

Volcanic Eruptions

Cascade volcanoes have shaped the ecosystems of the entire Pacific Northwest. Research is needed to improve our understanding of the chronology, magnitude and effects of the eruptions. Mt. Rainier was named a United Nations Decade Volcano Demonstration Project in the early 1990s.

Research:

- ◆ Determine the distribution and thickness of volcanic ash deposits. To date, 21 separate volcanic ash deposits have been identified on Mt. Rainier, while 4 distinct layers of volcanic material have been identified in the North Cascades.
- ◆ How have past volcanic eruptions affected soil formation, water quality, air quality, geologic processes and ecosystems?

Links To The Past - Museum and Archives

The Marblemount Curation Facility is a multi-park repository for the museum collections from North Cascades National Park Service Complex, Ebey's Landing National Historical Reserve and San Juan Island National Historical Park. The combined collections total over two million objects and are rapidly growing in direct proportion with inventory, monitoring and research activities. Resources for the three parks can be viewed at the North Cascades National Park Visitor Center in Newhalem, the American Camp Visitor Center on San Juan Island and the Burke Museum on the University of Washington campus in Seattle. To increase access to museum resources, images and information will be added to the NPS websites that showcase national park collections.

The museum collections are divided into three main areas: natural history, cultural resources, and archival collections. The natural history collections comprise biological and geological specimens. The herbarium includes vascular plants collected from alpine habitats to San Juan Island prairies. The nonvascular specimens inventory mosses, liverworts, lichens and hornworts of the upper Skagit River. Reptiles, amphibians, fish, birds and mammals

are the backbone of the vertebrate collection. The facilities also include macro invertebrates collected in the inventory of riparian areas.

The cultural museum collections include both prehistoric and historic objects. The prehistoric objects provide valuable information about Native American life in the mountains of North Cascades. The historic artifacts document early exploration and settlement of the area, fishing, trapping, logging, and mining in the mountains. The extensive archival collection includes archeological project documents, historic records, park administrative documents, resource management records, maps, drawings, documents associated with natural resource studies and inventories, photographs, reports, oral histories and electronic media.

The museum collections serve as scientific and historical documentation for the parks' resources. They provide baseline information for park planning, management activities, research and interpretive and educational programs. NPS museum collections preserve and protect the nation's natural and cultural heritage for future generations.

www.museum.nps.gov www.cr.nps.gov



Objects from collections in the Marblemount Curation Facility.

Top: Stone tools. Arranged by age, the arrowheads above show an increase in the level of intricacy over time. In the bottom row are specialized tools and to the right are larger tools made from various stone types. Below: One of many botanical samples. Arnica collected near Washington Pass in 1972.



High Elevation Site Survey

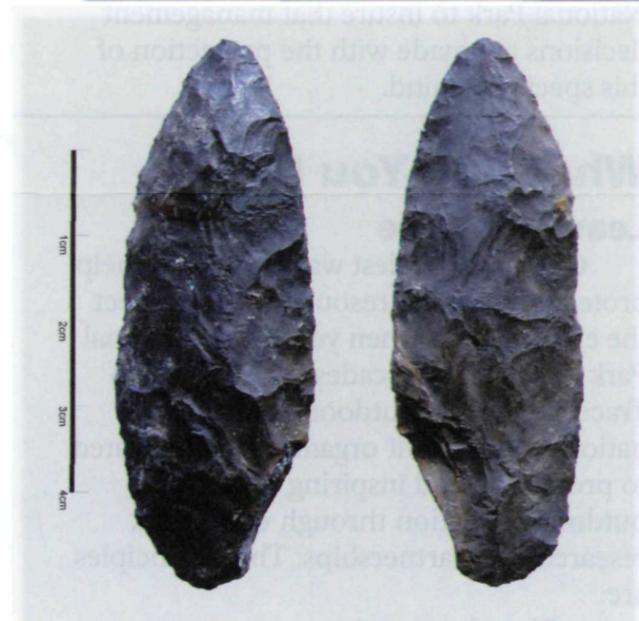
The extensive sub-alpine terrain of the Pacific Northwest high country is an attractive landscape of forests, meadows and lakes. When we visit this setting, 5,000 to 7,000 feet or more above sea-level, we might hike or camp for a short period, but it's hard to imagine living in such a harsh, remote environment.

Archeologists, however, recognize that people have been utilizing these higher elevations for thousands of years.

In 2001, archeologists from North Cascades, Mount Rainier and Olympic National Parks began working together on a three-year, high elevation archeological survey. Before the onset of this project, less than 5% of the high elevation terrain in the three Parks had been surveyed for archeological resources. The research partnership allows archeologists to compare the influence of different sub-alpine environments on sites and artifacts across the three mountain parks of the region.

This ability to share and compile databases allows the survey results to reveal how differences in locale shaped the settlement and subsistence strategies of native peoples who lived in or visited these mountainous areas. For instance, by looking at the variation in stone tool materials in relation to geological source areas, researchers can infer trade and travel routes and major resource use areas. Even the physical qualities of the different tool stone types influenced the kinds of tools made and the uses they were put to.

So far, this archeological effort has resulted in the discovery of over twenty previously unknown prehistoric sites, three historic sites, and dozens of newly discovered artifacts. Some artifacts appear to date to at least the mid-Holocene, about 7,000 or more years ago. These discoveries give archeologists a better understanding of early life at higher elevations and allow them to share with us a new appreciation of our region's long involvement with human groups.



Spear point from one of the high elevation sites which dates between about 8,000 and 5,000 years old.

Glacier Monitoring

Glaciers Mirror Global Climate Change

The North Cascades ecosystem has the highest concentration of glaciers in the lower 48 states. Studying climate response and changes in glaciers can help predict future climate changes. Since they are important to the health of the region and sensitive to fluctuations in climate, monitoring their status is a priority.



Wiley Lake, North Cascades National Park

Over 700 of these slow moving giants, formed of rock and ice, play a critical role in natural processes and life of the entire region. At Thunder Creek in North Cascades National Park, glaciers contribute as much as 47% to total summer runoff.

The National Park Service began monitoring glaciers in North Cascades National Park in 1993 and in Mount Rainier National Park in 2002. The partnership between parks and the United States Geological Survey, which also monitors glacial trends, allows data to shed light on the global implications of climate change.

In North Cascades National Park, researchers Jon Riedel and Rob Burrows lead the monitoring of four glaciers that are at the headwaters of watersheds containing hydroelectric operations. Silver Glacier, which drains into Ross Lake, and Sandalee Glacier, which drains into the Bridge Creek watershed, are both east of the park's hydrologic crest.

Noisy Creek Glacier, which drains into Baker Lake, and North Klawatti Glacier, which drains into the Thunder Creek watershed, are both on the west-side.

To gauge the dynamics of these glaciers, researchers use stakes to measure snow accumulation, radar to estimate thickness and aerial photos to study boundaries. Mass balances are the net amount of gain or loss glaciers experience each year. Current findings show a varied trend toward diminishing glacial mass balances. Glaciers east of the crest have not shrunk as quickly as their west-side counterparts in the first decade of study. Reasons for the differences might include higher elevations and more northerly aspects of the east-side glaciers.

Besides telling us about the health of these glaciers, the studies show how glacial runoff contributes to watersheds and regional ecology. This year, a 10-year data summary will be published on this ongoing research. www.nps.gov/noca/massbalance.htm

Possible Future Research Projects

Along with ongoing research and monitoring, North Cascades National Park resource managers are always thinking about the next step. What starts as a general area of study, becomes a research question and eventually turns into a plan to study specific natural resources. The following are two projects to look at the status of resources for which there is limited information. These studies could begin within the next few years.

Status and Distribution of the Marbled Murrelet

North Cascades National Park is a last chance habitat for a handful of federally listed animal species. Of these species, the Marbled Murrelet is one for which baseline inventories have not been conducted to determine the presence and status of the species within the park. For the park to participate in recovery efforts, it must first assess the condition of the species. Marbled Murrelets are seabirds that nest in the canopy of mature, old-growth forests up to 50 miles (80 km) or more inland. In Washington State, much of the remaining Marbled Murrelet nesting habitat is on national park lands in the North Coast and Cascades National Parks. As suitable habitat outside parks continues to be lost or altered, habitat within parks becomes more valuable. This proposal suggests a 3 year study to gather information on the status of the Marbled Murrelet in North Cascades National Park to insure that management decisions are made with the protection of this species in mind.

Status of Insect Pollinators in Subalpine/ Alpine Zones

Insect pollinator species are important in providing ecosystem function. In the subalpine and alpine zones of North Cascades National Park, pollinators play a key role in these fragile ecosystems. Many species of birds and mammals depend on plant production for foraging in high elevation zones and the insects themselves provide a significant food source for foraging vertebrate and invertebrate species. While these pollinators are threatened by many sources, climate change is potentially the most severe threat to pollinator diversity. Mounting evidence demonstrates that there have already been biotic responses to relatively small climate changes. This proposal suggests a 2 year study to collect baseline information to assess the diversity and abundance of pollinator species and their relationships to vegetation in the subalpine/ alpine zone of the park. This would allow for the tracking of future trends in insect pollinators.



Pollinator busy at work

Web Based Resources

National Park Service
www.nps.gov

NPS Nature and Science
www.nature.nps.gov

North Cascades National Park
www.nps.gov/noca

North Cascades Natural and Cultural Resources
www.nps.gov/noca/nat.htm

Natural Notes (First Edition)
www.nps.gov/noca/NatNotes/nn2002.htm

Current Research
www.nps.gov/nwresearch

Homeward Bound
www.nps.gov/noca/journey/home.htm

What Can You Do?

Leave No Trace

One of the easiest ways for you to help protect our natural resources is to respect the environment when you visit a National Park like North Cascades. The Leave No Trace Center for Outdoor Ethics is a national non-profit organization dedicated to promoting and inspiring responsible outdoor recreation through education, research and partnerships. Their principles are:

- ◆ Plan ahead and prepare.
- ◆ Travel and camp on durable surfaces.
- ◆ Dispose of waste properly.
- ◆ Leave what you find.
- ◆ Minimize campfire impacts.
- ◆ Respect wildlife.
- ◆ Be considerate of other visitors.

For more information on Leave No Trace and these ideas visit these web sites:
www.lnt.org
www.nps.gov/noca/lnt.htm

Become Involved

Helping to protect natural resources may be easier than you think. By reading this newsletter, you are already more aware of issues involving the environment. Learning is a great way to start. To further your involvement, join us for the 2005 Science Days in the North Cascades where researchers present their projects. For the 2004 Science Days Abstracts visit:
www.nps.gov/noca/sd2004a.htm

With a little more effort, you can help a great deal, learn a lot and have fun by volunteering your time. Volunteers are key partners in many natural resource projects. North Cascades Institute assists both the Park and Forest Service with educational volunteer programs like Eagle Watchers and Skagit River Stewards:
www.ncascades.org

For information on the Skagit Stream Team and Watershed Masters volunteer programs visit:
www.skagitcd.org

For North Cascades NPSC sponsored volunteer opportunities e-mail Volunteer Coordinator Charles Beall at:
Charles_Beall@nps.gov



Above right: NPS Environmental Educator Paula Ogden-Muse involves students in a web of life activity.



Left: Two Skagit River Stewards take stream measurements during a program coordinated by the North Cascades Institute. Volunteer monitoring programs often teach valuable skills and offer participants a hands-on approach to learning about local ecosystems and community stewardship.

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