THE ECOTONE

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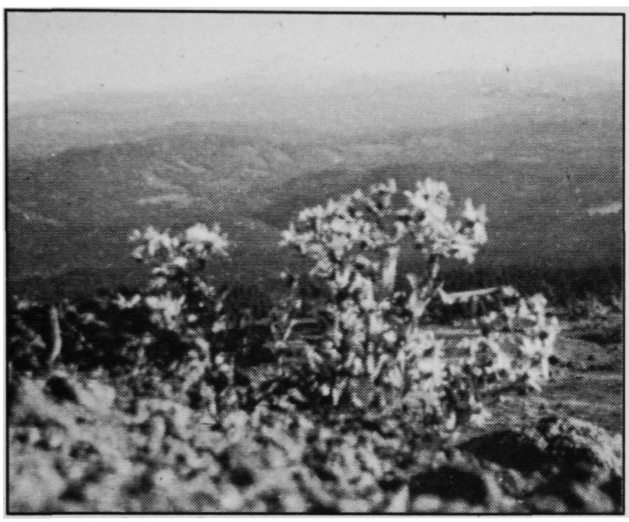

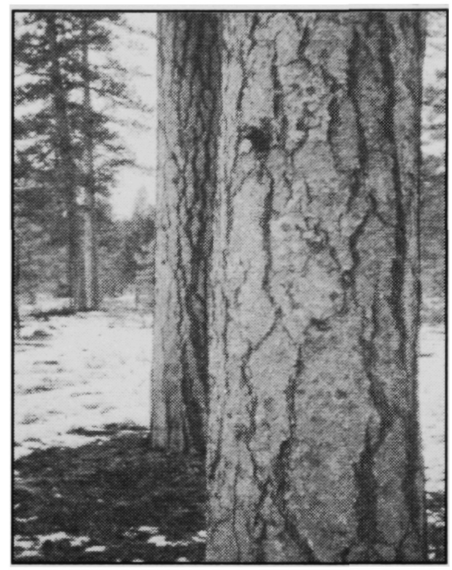

CHANGES IN PACIFIC NORTHWEST BIODIVERSITY

About The Ecotone

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ECOTONE: a transition zone between two adjacent ecological communities, such as forest and grassland. It has some of the characteristics of each bordering community and often contains species not found in the overlapping communities. An ecotone may exist along a broad belt or in a small pocket, such as a forest clearing, where two local communities blend together. The influence of the two bordering communities on each other is known as the edge effect. An ecotonal area often has a higher density of organisms and a greater number of species than are found in either flanking community.

Cover photograph credits

Clockwise from upper left:
Wildflowers on Mount Hood - Todd Miller
Ponderosa pine - Patrick Hurley
Dunn's salamander - Patrick Hurley
Finley Wildlife Refuge, Oregon- Julie Polhemus

The Ecotone

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The Ecotone
Environmental Studies Program
5223 University of Oregon
Eugene, OR 97403
E-mail: espress@oregon.uoregon.edu
Web Address: http://darkwing.uoregon.edu/~ecostudy/Resources/Publications/ecotone_index.htm

EDITORS
Melynda Coble
Loren McClenachan
Todd Miller

CONTRIBUTORS
Christy Briles
Melynda Coble
Patrick Hurley
Chandra LeGue
Eric Larsen
Loren McClenachan
Todd Miller
David Peters
Julie Polhemus
Jeremy Zhe-Heimerman

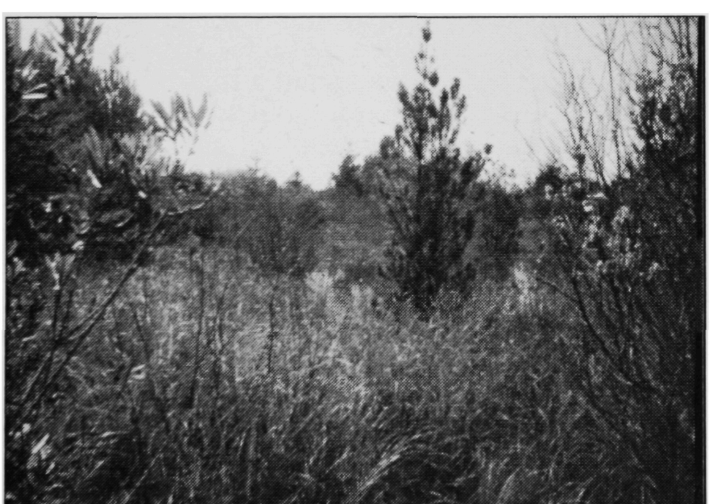
Editors' Note

What is the Pacific Northwest?

We realized that when we introduced the focus of this issue there would be some degree of interpretation with the regard to the term "biodiversity." Changes in biodiversity can occur within ecosystems, landscapes, populations, and even on the genetic level. Likewise, the term "Pacific Northwest" conjures up slightly different concepts to different interpreters. We can say precisely that the Pacific Northwest is a geographic region centered in the northwest of the contiguous United States. The boundaries of this region are debatable, however, if viewed through disparate political, geological, climatological, hydrological, cultural, or ecological lenses.

We may start by thinking of Oregon and Washington as the Pacific Northwest, being those northwest states in the lower 48 that border the Pacific Ocean. Recognizing the Snake and Columbia River basins as important components of the region, we should include Idaho. Culturally and geographically, we should add portions of northern California and southern British Columbia as well. Noting the visual, ecological, and climatological divide the spine of the Cascade Mountains creates, perhaps we should include the areas situated around the Cascades that drain to either the Pacific or the Columbia.

Indeed, the notion of the great ecoregion called Cascadia embraces all but the political lens. When we discuss biodiversity in the Pacific Northwest, it makes sense to recognize this ecoregion. Approximately, Cascadia comprises those lands that drain directly to the Pacific Ocean or into the Columbia basin, situated east of the Cascadian subduction zone (where the Juan de Fuca and Gorda Plates slip beneath the North American Plate) and west of the Rocky Mountains.



Lagoon vegetation, Oregon Dunes
Todd Miller

Balsamroot
Patrick Hurley

A Snapshot of the Past

By Christy Briles

Have you ever walked down a Pacific Northwest forest trail, with large looming trees over your head, and thought about what that forest might have looked like decades, centuries, or even millennia ago? Would you believe that the Coast Range landscape of the Pacific Northwest (PNW), which is currently dominated by Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and western red cedar (*Thuja plicata*), was once covered by subalpine parkland species (spruce [*Picea*], alder [*Alnus*], and mountain hemlock [*Tsuga mertensiana*])? Surprisingly enough, this was the case in the Coast Range 20,000 years ago.

Patrick Hurley

During the last glacial maximum (approximately 20,000 years ago), the high elevation mountain ranges of the PNW, including the Cascade Range, Olympic Mountains, and the Siskiyou Mountains, supported alpine glaciers as a result of colder (around 5-7°C) conditions than at present. The seasonal cycle of solar radiation has fluctuated as the Earth's relationship to the Sun has changed through time (known as the Milankovitch cycles). The decrease in summer radiation led to the build-up of the Laurentide and Cordilleran ice sheets, covering most of Canada as well as much of the Northern US. The ice sheets were so massive that they shifted the North American jet stream south of its current position, displacing storm tracks and depriving the PNW of moisture. The ice sheets decreased the latitudinal temperature gradient and created a high-pressure area over the ice sheets. This circulation feature brought strong easterly winds and cold, dry air to the PNW. Under such conditions, only plants that could tolerate cold and dry conditions fared well. For example, Englemann spruce (*Picea engelmannii*), which today is found on and east of the Cascade crest, grew further west in the PNW. One puzzle that has yet to be solved is where Douglas-fir lived during the last glacial maximum. Douglas-fir did not become established in the Pacific Northwest until conditions became warmer and wetter about 14,000 years ago.

As the amount of summer radiation increased between 16,000 and 10,000 years ago, alpine glaciers retreated and ice sheets became smaller. As a result, the jet stream shifted north to its present position and warmer and wetter conditions prevailed. At Little Lake, in the central Coast Range, pollen data record a shift from parkland vegetation to a closed forest of spruce, lodgepole pine (*Pinus contorta*), mountain hemlock, and fir (*Abies*). By the early to mid-Holocene (10,000 to 5,000 years ago) summer radiation was higher than at present and consequently summer temperatures were warmer than today and drought was more severe. Charcoal records indicate that fire frequency was higher than today, and fire/disturbance-adapted species such as Douglas-fir, red alder (*Alnus rubra*), and oak (*Quercus*) dominated the landscape. As summer radiation decreased between 5,000 and 2,000 years ago, cool and moist conditions resulted in mesophytic forests with fire/disturbance-sensitive taxa, such as western red cedar and western hemlock. The forest became more closed and fire frequency decreased. The modern forest in the Coast Range today became established around 2,000 years ago when the present-day cool and wet climate developed.

The changes seen in the paleoecological record of the PNW have important implications for understanding present-day biodiversity. First, and probably most important, species move individually in response to climate change. Plant species have unique environmental

Vegetation history can aid ecosystem managers with nature reserve design by providing valuable insights on vegetation response to past climate change and its potential response to future climate change.

The environmental history of the PNW is reconstructed from fossil pollen and plant macrofossils (i.e., conifer needles and cones, twigs, seeds, and charcoal) preserved in lake sediments. Paleoecologists use these fossils as evidence of past vegetation and fire change through time. Past climates are also studied by the use of general circulation computer models (GCM) that describe climate conditions under different large-scale controls, and help us understand PNW climates at different times in the past. Using these two techniques paleoecologists can determine the sensitivity and adjustment of vegetation to past climate changes.

requirements that determine where they can persist. Since the last glacial maximum, vegetation communities have been continually changing as species adjust to find their ideal environmental conditions. Therefore, the paleoecologic record suggests that forest communities in the PNW are ephemeral and relatively young. As a result of the ephemeral nature of plant communities, conservation plans need to focus on preserving a variety of environments (including elevational gradients and corridors) so that species can adjust their ranges locally and regionally in response to future climate change.

Secondly, the number of species per area was greatest during periods of rapid environmental change as individual species invaded other communities. Conservation efforts that focus on reserves need to consider that the mobility of plants and the ephemeral nature of plant communities may result in either a reduction or gain in biodiversity (if species richness is determined by the number of species occupying the reserve).

Finally, rates of species movement (rate of migration or adjustment) to climate change can be estimated. For example, some species had to move 300 meters per year to reach their current location as ice sheets melted and climate became warmer over the last 20,000 years. With the prospect of a 1.4 to 5.8°C increase in global temperatures in the next century, those same species will have to move much faster to keep up with future climate change. If species are unable to track climate change then their likelihood of surviving is low.

Designing nature reserves for future climate change will require ecosystem managers to set aside different ecosystems for species migration. Reserves incorporating elevational gradients will allow vertical shifts in vegetation and help maintain species in locally contained reserves. Establishing a series of corridors connecting ecosystems in areas of less topographic relief will allow latitudinal shifts in species ranges. Reconnecting ecosystems is an idea that is gaining strength in ecosystem management. The Wildlands Project, for example, recognizes that recovery of our environment will likely result from reconnecting essential ecosystem processes. The insight gained from paleoecological research reinforces the need for connected ecosystems to allow for species migrations in response to future climate changes.

Christy Briles is a M.S. candidate at the University of Oregon.

Notes

For more information on The Wildlands Project see http://www.twp.org/.

For more information about the PNW environmental history and current research activities of the Environmental Change Research Group at the University of Oregon's Department of Geography see http://geography.uoregon.edu/envchange/.

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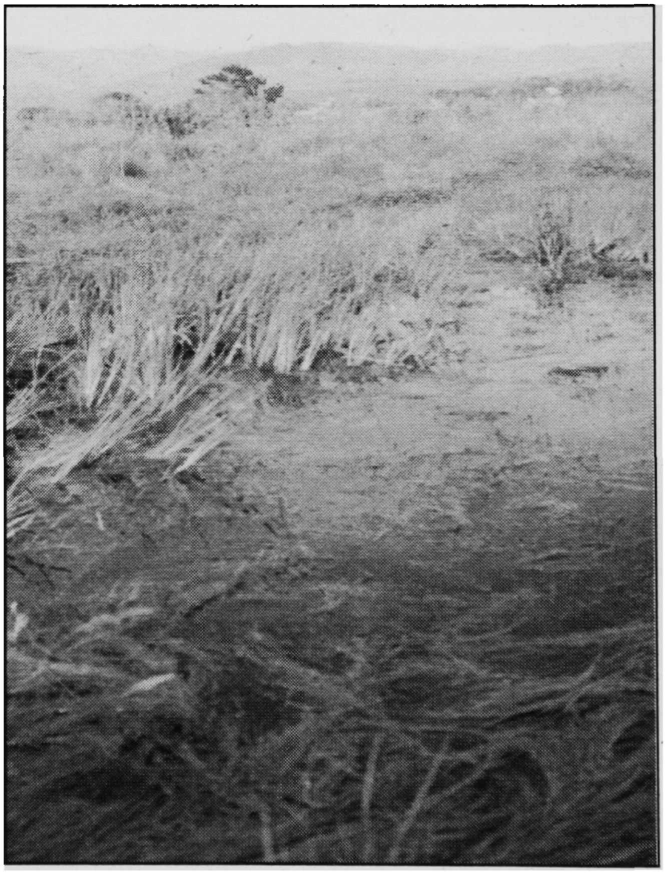

Vernal Pool, Loren McClenachan

Exotic Infiltration

Defending the southern Willamette Valley against invasive species

by Melynda Coble

Mt. Pisgah rises between the Middle and Coast forks of the Willamette River, just above the confluence of the two tributaries. On a Sunday in January, a donut of fog lolls around the base of the mountain and a light rain dampens the needles of Douglas-firs and dried oak leaves. Five volunteers, clad in rain gear and heavy work gloves and led by Kyra Kelly, Volunteer Coordinator for Friends of Buford Park and Mt. Pisgah (FBP), slowly work their way up the southeast flank of Mt. Pisgah. They cut six-foot high Scot's broom and blackberry, revealing stunted, suffocated oaks they didn't even know were there.

Scot's Broom Carcasses *Photo by Author*

Undeterred by the soft winter rain and the approaching fog bank, Kelly and the volunteers snap the trunks of the non-native Scot's broom with loppers and throw carcasses into rapidly growing piles. Kelly pushes back her wet, blond hair, leans on her loppers and looks upslope at the unbroken forest of Scot's broom forming a wall between the work party and an oak savanna. In spring, this shrub blooms a delicate yellow pea flower and covers some slopes on Mt. Pisgah with a brilliant yellow blanket, but in January it is flowerless and leafless except for the few three-parted leaves clasping the ridged stems. Dried, empty seedpods dangle from the stalks.

Mt. Pisgah is one of the several buttes surrounding Eugene, Oregon. With 2,363 acres it is important to the community as a place to hike, ride horses, attend a mushroom or wildflower show and to relax. But it's not valued merely for its recreational uses; Mt Pisgah is also rich in biodiversity. According to Kelly, maintaining and restoring biodiversity on Mt. Pisgah is crucial. "There are so many different kinds of ecological systems and structures, depending on where you are on the mountain," she says. Mt. Pisgah's summit, 1,000 feet above the Willamette River tributaries, is wrapped in one of the most pristine Willamette Valley upland prairie communities. This ecosystem is classified as "globally endangered" by the Oregon Natural Heritage Program as only a fraction of one percent of the Willamette Valley upland prairie community remains. Ed Alverson, of The Nature Conservancy, says one half to one third of the park is open prairie and oak savanna and woodlands—the largest remaining site for these communities, making Mt. Pisgah the home to one of the largest oak habitat remnants in the Willamette Valley.

While habitat loss and degradation are clearly the greatest threats to biodiversity in the Willamette Valley and throughout the world, invasive, nonnative species play nearly as an important role in the loss of biodiversity. Nonnative species (also termed exotic, alien and nonindigenous) are organisms that occur outside their natural range because humans have aided in their dispersal or created a suitable environment for their establishment. The problem arises when nonnatives become invasive or noxious, displacing native species and altering the environment. "The greatest concern with noxious species," says Jason Blazer, the Restoration Coordinator for FBP "is they reduce biodiversity and simplify ecosystems."

When alien species establish in an area like Mt. Pisgah, they have a competitive advantage over native organisms. The alien species have left behind most or all of the predators and diseases they evolved with. Take Scot's broom, for example. It was imported from Europe to Washington as an ornamental plant in 1888 and later planted around and under the power lines on Mt. Pisgah for erosion control. In the British Isles, Scot's broom is associated with numerous herbivores, but in western North America, only a small fraction of these species were detected in a 1963 study. Without predators to keep the shrub in check, Scot's broom has taken over.

From the top of Mt. Pisgah hikers and equestrians look out over the southern Willamette Valley. Development and urbanization sprawl below. The Interstate 5 corridor, lined with nonnative Scot's broom, dissects the valley and connects Portland, Salem, Albany and Eugene to each other and additional, smaller towns. But the

Willamette Valley did not always look this way.

Prior to Euro-American arrival in the early 1800s, the Willamette Valley was a matrix of fire-influenced habitats—upland prairies, open savannas and forested woodlands. Spanish explorers arrived in the 1770s and estimated there were about 16,000 Native Americans living in the Willamette Valley. Scientists disagree whether this matrix of habitat types was maintained by lightning set fires or the Kalapuya Indians, actually independent bands of people in the Kalapuya language group. Either way the Willamette Valley has been a fire-dependent habitat for a long time.

While the climate was moist enough to support forests, frequent fires kept the trees back and opened prairies and savannas. The Kalapuya probably set fires to encourage food plants such as camas lily, tarweed and yampah. In fact, Lewis and Clark reported cresting a hill and seeing a sea of blue-flowered camas lilies blanketing the valley floor.

The Kalapuya were forced onto a reservation in 1956, but by then the vegetation was already beginning to change as a result of Euro-American settlement activities. The settlers suppressed fire, plowed wet prairies, planted crops, grazed cows and introduced invasive European weeds.

Like most of the United States, immigrants from Europe and Asia are supplanting native plants and animals at Mt. Pisgah. Some, like the Scot's broom, were brought over as ornamental plants or for erosion control. Other invasive species hitched rides in ship ballasts or on imported logs. In addition to the more than twenty-four invasive plants at Mt. Pisgah, non-native animals such as bullfrogs and feral cats feed on native species.

That's where restoration efforts come in. Jason Blazer's job as Restoration Coordinator is to create and implement a habitat management plan for Mt. Pisgah that considers long-term stewardship goals. One of those goals is to rid Mt. Pisgah of certain invasive species. "Nonnative species that are not noxious, those that don't disturb biodiversity aren't our biggest concern." That still leaves plenty of aggressive nonnative species such as Scot's broom, Armenian blackberry, ox-eyed daisy, tall fescue, meadow knapweed, Queen Anne's lace, English ivy, teasel, false broom, myrobolan plum and tansy ragwort. And those are just some of the plants.

After Blazer decides where and when work should be done it is up to Kelly to organize volunteers to keep Mt. Pisgah's invasive species in check. One to five work parties a week work to rid Mt. Pisgah of its exotic plants and animals and to plant native species. Almost weekly, volunteers cut Scot's broom and toss it into piles to be burned. Armenian blackberry is mowed—four to six times a season—until it is without reserves of energy to grow. Ox-eyed daisies and Queen Anne's lace are smothered with black nursery cloths. Soon, volunteers will hunt bullfrogs with flashlights and spears in the middle of the night and destroy their eggs; they will bag the seed heads of teasel and bull thistle before cutting them off, and trap and euthanize feral cats.

A major problem with noxious species removal is that the exercise addresses only the symptoms of the problem, not the cause. The rapid movement of people and goods in the world today allows invasive species to continually advance into and take over new habitats. And while it may be possible, with constant attention, to eradicate many nonindigenous organisms from small areas like Mt. Pisgah, working at a regional or global scale is an entirely different proposition.

The ultimate goal of the projects at Mt. Pisgah is to preserve essential ecological functions of the native communities. Places such as this are deemed "natural" areas, but they can never be left alone. Exotic species will continue to float down rivers, hitch rides on hikers' socks, travel through the intestines of horses, be transported on road construction trucks and eventually be deposited into areas where they are not wanted.

Today most "natural areas" are heavily managed. Leaving a natural area alone to heal itself seems reasonable, but this idea, Alverson believes, is based on the dualistic notion that people are separate from nature. There are natural areas and there are human areas. "In the Willamette Valley the historical legacy has been management," he said. First by the Kalapuya, then by the Euro-American settlers and now by contemporary Oregonians.

In the Willamette Valley, where more than 100 nonnative plants grow, where air photos show a streak of yellow Scot's broom from southern British Columbia to central California, and where the croaking of lovelorn bullfrogs fill the night air during mating season, is it worth it to attempt to remove nonnative species? Is it even possible? "The pessimists say the clock is too far past to stop it," Blazer says, "but I'm an optimist and I can't just do nothing."

On Mt. Pisgah volunteers are working hard to turn back the clock. After a few hours on this January day, the work party heads down the muddy slope to the backpacks they left under an Oregon white oak. The roots of the Scot's broom are left in the soil to prevent erosion of the hillside the volunteers cleared, but it is still muddy and slippery. Kelly chugs water out of a Nalgene bottle and the work party looks back up the slope. They are dirty and wet but rewarded by the site of a clearing where three hours ago there was only Scot's broom.

MELYNDA COBLE IS A M.S. CANDIDATE AT THE UNIVERSITY OF OREGON.

Using Satellite Imagery for Vegetation Mapping and Biodiversity Planning in Oregon's Coast Range

By Eric Larsen

Monitoring changes and impacts on biological diversity at a landscape scale is a difficult task, requiring working over large areas and keeping pace with the rapid rates of change associated with modern society. Within the past 30 years, mapping with satellite imagery has increasingly become an important tool for studying biodiversity and ecological change over large areas. Satellite imagery has been used to study deforestation rates in tropical forests, the bleaching of coral reefs, the shrinkage of the Greenland ice cap, and desertification along the southern edge of the Sahara. Closer to home, satellite imagery has been used to quantify changes in forest composition and characterize natural vegetation patterns in Oregon's Coast Range.

Much of this work in Oregon's Coast Range has been motivated through the adoption of the Northwest Forest Plan and the increased emphasis on the preservation of the late-successional forests and their dependent species such as the northern spotted owl and marbled murrelet. On a landscape scale, the identification of remaining tracts of ancient forest habitat large enough to support old-growth dependent species is only part of the task. Travel corridors are also needed so animals can disperse, find new home territories, and expand their gene pools. In the early 1990s, identifying the landscape pattern of remaining ancient forests and possible dispersal corridors in Oregon's Coast Range became a priority for the U.S. Forest Service, Bureau of Land Management, and other Coast Range land managers. However, characterizing the pattern of forest cover over an area 300 miles long and 50 miles wide is not an easy task, especially given the multitude of landowners in the Coast Range. To accomplish the task, imagery from the Landsat Multi-Spectral Scanner (MSS) and Thematic Mapper (TM) satellites were used to characterize timber harvest patterns and vegetation structure from 1972 to the present. By overlaying satellite images taken in 5-year intervals over the Coast Range, timber harvest patterns were analyzed by geographic area and land ownership class. Current vegetation was characterized as deciduous, coniferous, or mixed forest types and models were developed to predict tree diameter size class. The largest blocks of remaining Coast Range ancient forests were identified and connectivity between patches of old-growth was analyzed. Image maps based on the satellite data were developed and are now being used as a part of a spatial data base of conditions in the Coast Range. Combined with a geographic information system (GIS), this data is currently being used to develop spatial policy evaluation tools, develop habitat suitability models for threatened and endangered species, and guide federal and state efforts to protect and enhance biodiversity in Oregon's Coast Range.

Eric Larsen is a Ph.D. candidate at Oregon State University in Corvallis.

The Environmental Studies Program hosts a speaker series. The following is a sampling of the lectures that will be held on campus this spring. Keep an eye out for these and other speakers. All lectures are held at four o'clock in 110 Willamette Hall.

May 7, 2001: Wang Zhao Qian has been working with Chinese eco-agriculture for over two decades. He is currently the doctorate supervisor of the Agro-ecosystems and Farming Systems Institute at Zhejiang University, a National Expert of China's Eco-Agriculture Construction, President of the Zhejiang Provincial Ecology Society, and on the Board of Governors of the Asian Farming Systems Association and Executive Board of the Chinese Society of Ecology. He has worked at the national and local level researching and constructing Chinese eco-agricultural systems.

May 21, 2001: Robert Lackey, U. S. Environmental Protection Agency and Oregon State University. His research interests include natural resource ecology, especially Pacific salmon and the interface between science and public policy. Dr. Lackey will present "Pacific Northwest Salmon: Divining the Future."

A Sense of Place for Oregon White Oak

by David Peters

Oregon white oak (*Quercus garryana*) is the most widely distributed species of oak in western North America. It ranges from the windward slopes of the southern California Sierra foothills to midway up the eastern rainshadow of Vancouver Island. Despite this broad distribution and the fact that Oregon white oak ecosystems are diminishing there is relatively little known about this species or the ecosystems in which it occurs.

The Silviculture Team at the Pacific Northwest Research Station Olympia Forestry Sciences Lab, with funding from the Fort Lewis Military Reservation, has begun studies to address the lack of information about Oregon white oak. In western Washington the largest remaining oak savannas and woodlands and the last western Washington remnant of a once widespread western gray squirrel population are at Fort Lewis. Fort Lewis managers needed more information about Oregon white oak to support their active program of management including prescribed burning to maintain oak savanna and prairie structure. More information is needed about how Oregon white oak reproduces and grows, how it contributes to the ecosystems in which it is found, and how it is maintained in the face of aggressive conifer encroachment. We need to know how to manage oak ecosystems to maintain viable populations of many associated native species.

Oregon White Oaks — *Chandra LeGue*

The Oregon white oak acorn production study is one of the studies the Olympia Forestry Sciences Lab is undertaking. We are trying to determine what factors affect acorn production across the range of Oregon white oak. For part of the study we recruit volunteers to survey acorn abundance on a sample of trees in their area year after year. (Our volunteers find it enjoyable, interesting and not difficult.) We share methods and results on our web site. Other studies planned or begun concern methods to improve oak culture from germination to outplanting, methods to release stressed oaks from conifer competition, understory treatments that encourage native savanna composition, and effects of fire on oak reproduction.

What makes Oregon white oak ecosystems important? To start with Oregon white oak acorns are a rich source of food for many wildlife species including squirrels, chipmunks, mice, pocket gophers, deer, elk, bear, jays, pigeons, wood ducks woodpeckers and many insects. Wildlife nearly consumes the entire acorn crop in some years. They are also very diverse botanically, but this diversity has a tenuous place in our current landscape. To appreciate the Oregon white oak/prairie ecosystem an understanding of how it has been maintained and why it is here at all is required.

Oregon white oak and many of the prairie species associated with it are dependent on disturbance, usually fire, for its continued existence. Nearly anywhere Oregon white oak can grow, conifers, especially Douglas-fir, can grow much faster and taller. Oregon white oak and associated species cannot tolerate much shade and are eventually replaced by conifer forest. Not only are the oaks replaced, but the entire associated flora changes as well.

In much of western Oregon, Washington and British Columbia, species such as salal and swordfern replace the native prairie grasses and flowers. What is the problem with trading one native flora for another? The kind of conifer forests that occupy former oak woodlands and savannas are already common. More of these conifer forests does not contribute to regional biodiversity, but loss of the oak ecosystem greatly impoverishes regional biodiversity. If natural succession is allowed to proceed unhindered, an entire flora associated with oaks and open spaces could be lost. This is a serious problem for an ecosystem already largely replaced by agriculture and urbanization.

Why haven't natural successional processes eliminated oak ecosystems long ago? Some ecosystems have key species that are important far beyond their representative biomass. For Oregon white oak that species is human. Aboriginal peoples in the range of Oregon white oak found life much easier and abundant in oak and prairie habitats than in dense forests. What was better was to have both, and with the use of fire they did. They burned annually, but any one place on the landscape may have burned every year or only occasionally maintaining a diversity of ages. Most of the burning occurred in the lowlands. Higher mountains were largely left unburned. This is how habitat for oak and prairies was maintained in the face of constant invasion by conifers. The benefits to the people were abundant seed and root crops from the prairie flora, including oak acorns. Game was also more abundant where both forest and prairie systems existed and was easier to hunt in open spaces.

It is probable that human intervention has been required to maintain Oregon white oak for at least 4,000 years—maybe longer. For several thousand years after the retreat of the ice age glaciers the climate was warmer and drier than at present. This period is sometimes called the Hypsithermal. Natural fire frequency during the Hypsithermal may have been sufficient in parts of the range of Oregon white oak to hold conifers at bay, but that is not certain. People were present and they may have played a role in the fire regime for at least the last 9,000 years. For the last 4,000 years the climate has become cooler and moister making conifers very competitive. Natural fire frequency has probably been insufficient for Oregon white oak maintenance throughout most of its range. What we see in Oregon white oak ecosystems are remnants of a Hypsithermal flora that were preserved from the effects of a dramatic climate change by the activities of aboriginal peoples.

Oregon white oak ecosystems are very diverse. A study in British Columbia found 20 species of bryophytes and more than 40 species of lichens living on boles and branches of Oregon white oak. There are a host of fungi from mychorhizae to pathogens to leaf endophytes associated with oaks. Insects, including gall-forming wasps, acorn consuming moths and beetles, leaf miners, woodborers and others are numerous. There are over 200 species of native plants associated with the prairies and oak savannas in the South Puget Sound area alone and different associates are found both to the north and the south. Some of these species are regionally rare and a few are seriously threatened. Most of these species have niches in other ecosystems, but many now common species would be rare if conifer forest and land development replaced the oak and prairie ecosystems.

To a large degree, the place of Oregon white oak in the landscape is with people. We no longer have the same incentives that the aboriginal peoples had to maintain oak ecosystems nor do we have their knowledge of oak and prairie stewardship. People once set fire to the landscape to maintain a productive landscape for their use. They burned as often as was needed to meet their ends and Oregon white oak thrived. Since then many things have changed in the landscape that make it more difficult to use fire and with the addition of so many exotic species the results of using repeated fire are often different than before. Fire is still useful in some situations, but we need to learn new methods of management--and for that we need to learn more about oak and its ecosystems. It is questionable whether our knowledge about oak and prairie ecosystems is keeping pace with the changes occurring in them. People were effective stewards for oak and prairie ecosystems for thousands of years, but these ecosystems have largely been forgotten in the modern landscape.

DAVID PETERS WORKS AT THE USDA FOREST SERVICE, PACIFIC NORTHWEST RESEARCH STATION.

For more information about the Oregon white oak acorn production study at Olympia Forestry Sciences Laboratory or how to become involved see: http://www.fs.fed.us/pnw/olympia/silv/oak.htm or contact David Peters at (360) 753-7654.

CAMP CREEK, OREGON *PATRICK HURLEY*

Swimming in the Shadow of Salmon

Nongame fishes and the freshwater biodiversity of Oregon

By Patrick Hurley

North America is home to a remarkable diversity of freshwater organisms. Over 800 species of fish swim in these waters, not to mention a plethora of aquatic invertebrates ranging from tiny microorganisms to the Pacific giant salamander (*Dicamptodon tenebrosus*). Many of these species are threatened. Freshwater organisms in general are more threatened than their terrestrial counterparts. The Nature Conservancy reports in its 1998 *Rivers of Life* publication that within the United States freshwater mussels, crayfishes, amphibians, and fishes represent the top four groups of at-risk species.

Perhaps nowhere is the endangerment faced by native fishes more recognized than in the Pacific Northwest where much attention has been focused on the plight of our native salmon (*Oncorhynchus* spp.). The listing of several stocks of these anadromous fishes includes most river basins in northern California, most of Oregon and Washington as well as parts of Idaho. However, with so much attention paid to our disappearing salmonids, it's hard to remember that there is a rich array of nongame or sport fishes and aquatic biodiversity found in the fresh water habitats of the Pacific Northwest. Conservation efforts that narrowly focus on salmon may likely benefit many other species, but possible differences in life history strategies as well as habitat requirements suggest that conservation strategies must explicitly include consideration of these unique species.

In this article I provide an overview of some of these species, including those who share the same waters visited by salmon but also several that inhabit portions of Oregon where salmon are excluded. For example, a large portion of southeastern Oregon is encompassed by streams and rivers that have no outlet to the sea. Instead, these streams drain to numerous interior lakes. The largest of these, Malheur Lake in Harney County, is world renowned for its exquisite migratory bird fauna. The endhoreic nature of these basins demonstrates that different basins exhibit very different aquatic faunas. It is my intent to introduce you to just a small sample of the diversity of fish, salamanders, aquatic insects, and unique snails that inhabit the different regions of the state. In most cases, these organisms are extremely restricted in their global distribution (a situation described as endemism) and like their salmon counterparts these nongame species are swimming in uncertain waters.

Oregon's streams, rivers, sloughs, ponds, lakes, marshes, and springs support a total sixty-seven different species of freshwater fish and numerous other aquatic organisms. Ten of these fish species are endemic; they are also not the types of fish that anglers normally covet. Fish like the Millicoma dace (*Rhinichthys cataractae* spp.) a subspecies of the more widespread longnose dace (*R. cataractae*) and found only in the Coos and Millicoma rivers along the coast, are not included in this total. Five of these restricted-range species, or fifty percent, are listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS).

In the Willamette River basin, the tiny Oregon chub (*Oregonichthys crameri*) is perhaps emblematic of nongame fishes throughout the country and the difficulties they face. Relatively nondescript, this species reaches maximum lengths of fewer than three inches. Once widely distributed in backwater habitats—sloughs, oxbow lakes, and beaver ponds—of the Willamette, today the chub is the focus of intensive conservation management. An all too common list of riverine alterations threaten the species with extinction. Channelization, the draining of wetlands, agricultural practices, and the alteration of seasonal flow regimes have combined to eliminate much of its traditional habitat. In addition, the introduction of nonnative species, many of them from the Eastern United States have contributed to the disappearance of this fish from its historic range. Today, populations of the chub can be found in isolated sections of some Willamette tributaries, while the U.S. Fish and Wildlife Service manages chub habitat at Finley National Wildlife Refuge outside of Corvallis.

Farther south, Upper Klamath Lake and its tributaries, the Williamson and Sprague rivers, highlight the fact that certain parts of the state and, in particular, certain rivers host a higher number of restricted-range species. For example, these drainages contain a disproportionate component of the state's endemic fish fauna. Species such as the Klamath River lamprey (*Lampetra similis*) and the Pit-Klamath brook lamprey (*L. lethophaga*) ply these waters; the former is a parasite of other fishes found here and the latter is common along sand bars. While they are not endangered, their fellow inhabitants the shortnose (*Deltistes luxatus*) and Lost River (*Chasmistes brevirostris*) suckers do find themselves under state and federal protection. Both suckers spend most of their adult lives in lakes, but migrate into streams and or nearby springs where they seek out cobble or gravel substrates to spawn. Young fish drift back downstream soon after birth. Shoreline habitats in rivers and lakes are preferable feeding grounds for these omnivorous fish; they feed on everything from algae and detritus to zooplankton and other aquatic invertebrates.

The threats to the unique fauna of the Klamath Basin further reflect common threats to freshwater biodiversity throughout the Pacific Northwest and the United States in general. According to the 1995 Sucker Critical Habitat Proposal prepared by the USFWS a host of land uses are responsible for poor water quality; harmful algal blooms result in fish kills. Habitat fragmentation induced by numerous dams restricts genetic interchange among isolated populations while instream flow diversions and other modifications to important habitat spell additional trouble for these natives.

Fish are not the only endangered inhabitants of Oregon's waters. Flowing and standing water habitats are home to rare invertebrates as well. Several of these are found in the Klamath Basin. The basin supports at least 21 species of endemic freshwater mollusks (clams, mussels, and snails), including the Klamath Lake springsnail (*Pyrgulopsis* sp.) and the Link River duskysnail (*Lyogyrus* sp.), which are both considered imperiled species. Other regions of the state support a tremendous diversity of invertebrates with relatively small distributions as well, including the lower reaches of the Deschutes Basin and the Columbia River Gorge area.

Among Oregon's rare invertebrates are several that survive in extreme environments. Snails in southeastern Oregon are two examples of freshwater organisms living in harsh habitats. The Harney Lake springsnail (*Pyrgulopsis hendersoni*) tolerates the alkaline waters of its namesake lake. Interestingly, an endemic fish, the Borax Lake chub (*Gila boraxobius*), occurs in similar environments in this part of the state as well. The turban pebblesnail (*Fluminicola turbiniformis*), formerly extensive in parts of the Great Basin, still persists in extremely nutrient-poor (oligotrophic) springs in Catlow Valley.

Fish are not the only vertebrates that spend all or most of their lives in freshwater environments. Oregon is home to numerous species of amphibians: frogs, salamanders, and newts. Similar to the snails of southeastern Oregon, the various species of torrent salamanders (*Rhyacotriton* spp.) in western Oregon prefer extreme habitats; they spend much of their time in extremely cold streams or seeps, often in the splash zone of waterfalls. Their preferred habitat makes them susceptible to a threat faced by many fish: temperature. Consequently, the same types of land use practices common to their montane habitats, such as logging, that endanger native salmonids also place them at risk.

Snails and freshwater clams are not the only invertebrate taxa with pronounced endemism in the state's waters. Not surprisingly, many unique genera within the common orders of aquatic insects (Coleoptera, Odonata, Plecoptera, Ephemeroptera, Tricoptera) are found in different portions of the state; again, the southeastern portion of the state appears to harbor a high level of unique taxa. Although not rare in Oregon, the state supports only one native species of crayfish, the signal crayfish (*Pacifasticus leniusculus*). North America is the global center of crayfish diversity and it is fitting that Oregon's streams support at least one species. Concern is mounting over introduced swamp crayfish (*Procambarus clarkii*) from Louisiana out-competing our native species.

In many basins in Oregon, native nongame fishes, mollusks, aquatic salamanders, and insects share the same streams, rivers, marshes, and seeps as disappearing salmon and trout. Together these species reflect a rich diversity of aquatic organisms that are the freshwater biodiversity of the Pacific Northwest. In our quest to save the salmon, we should not forget the plight of these less visible fishes and organisms, particularly those that have highly restricted distributions and may not share the umbrella protection that salmon conservation might otherwise provide. In many cases, what may be good for salmon is also good for these species, but there may be instances when special action is needed to protect non-salmonids from extinction.

PATRICK HURLEY IS A PH.D. CANDIDATE AT THE UNIVERSITY OF OREGON.

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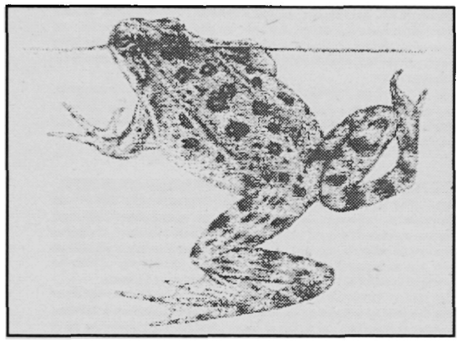
Unsound Dams, High Explosives and Rare Frogs

Creating new habitat for an endangered species

By Todd Miller

This winter, approximately thirty-five Oregon spotted frogs were trapped beneath the ice in a small channel high up in the Cascade Mountains. This overwintering strategy is normal for this species, *Rana pretiosa*, which survives in the near-freezing, near-anoxic water below the surface. What is unusual is that a leaking and potentially unsound dam impounding 200,000 acre-feet of water is looming over their channel refuge. Even more remarkable is the three recently-detonated holes in the marshland less than one-quarter mile downstream from these frogs. To top off this list of oddities is the fact that those holes have been specifically blown out of the wetland to accommodate the thirty-five frogs beneath the ice at the foot of the leaky dam. And the government is footing a quarter-million dollar bill for a multi-agency group to accomplish this bizarre feat.



Washington Dpt. of Fish and Wildlife

These Oregon spotted frogs live at the base of Wickiup Reservoir on the upper Deschutes River of Oregon. Jay Bowerman speculates the frogs have been living there exclusively since the late 1950s. Bowerman is a locally-respected naturalist with the Sunriver Nature Center, a spotted frog expert, and a hired guide to the Bureau of Reclamation for the Wickiup relocation project. He believes that the frogs initially displaced upon completion of the dam in the 1940s found prime habitat in the reservoir's warm-water margins. However, an introduction of game fish in the 1950s may have wiped them out. The fish tend to prey on the tadpoles.

The golden-eyed, salmon-bellied, three-inch long Oregon spotted frog once thrived in the Pacific Northwest. Prime habitat existed in the Willamette Valley and the Puget Trough in the abundant, warm-water wetlands that dominated much of the landscape. Yet another victim of the draining and filling of wetlands, the spotted frogs faced extermination in remaining lowland areas from voracious bullfrogs (introduced from the East as a delicacy), invading reed canary grass (which chokes out native vegetation), and a host of other complications, potentially including sensitivity to agricultural runoff and increasing dosages of solar radiation.

Whatever the reason, this population may represent the last of the spotteds to endure the climate this high up in the Cascades — Wickiup crests at 4,300 feet above mean sea level. An extremely water-dependent frog, *Rana pretiosa* doesn't spend much time out of water – overland migrations are minimal. Heidy Peterson, a graduate student studying the frogs at the University of British Columbia, notes that unlike other species that metamorphose and move off into nearby forests or fields, the frogs spend their entire lives in water. Adults are rarely seen foraging away from water. Peterson thinks that the small populations may actually be a survival strategy. She notes that Oregon spotted frogs are more sensitive to competition, and survive and grow better in smaller numbers.

The remaining spotted frogs, perhaps twenty populations in Oregon, tend to be located in mountain lakes. Fewer populations exist in British Columbia and Washington, where, along with Oregon, they are listed as endangered. The listings came shortly after the confirmation in 1997 that the Oregon spotted frog was indeed a unique species, separate from its look-alike cousin, the Columbia spotted frog (*Rana luteiventris*). Columbia spotted frogs inhabit the intermontane northwest (east of the Cascades and west of the Rockies).

Wickiup Dam sits on soils subject to liquefaction and failure during an earthquake. Loss of the dam would not only be a human catastrophe, it would wipe out the Wickiup frogs as well. Any opposition that has been voiced questions the economics of a quarter-million dollar budget allocated to saving thirty-five frogs. That is the concern of people who don't really understand the issue, says Sandy Ackley, a wildlife biologist with the US Forest Service at the Bend-Fort Rock Ranger District. It's not just the thirty-five frogs. Ackley in part refers to the genome of this population of frogs, which the project team hopes to preserve at the newly deepened Dilman Meadows (the blast site). But what is really at stake is the fate of future mitigation efforts like this. The Wickiup relocation is not just a one-shot attempt at saving these frogs, but a test program for similar relocations of rare populations.

No action at Wickiup is a no-win situation – mitigation is the only option. But will it work? Bowerman hopes so. He confesses there is much yet to be learned about the Oregon spotted frog, but he is optimistic that critical requirements are well-enough understood. Hence, when Dilman Meadows proved to have excellent water quality and habitat characteristics the relocation team was aware that it still wasn't viable for one reason: it lacked open pools of deeper water. These pools are necessary for overwintering, when the frogs ride out the colder season beneath the ice. That is when the detonation plans were drawn.

"The creation of deeper, open water areas can be a significant habitat enhancement, proclaims Kelly McAllister, a spotted frog researcher with the Washington State Department of Fish and Wildlife. McAllister is not involved with the Dilman Meadows project, but has done extensive study of the situation with Washington's own protected populations. This sentiment is echoed by project team members.

The tricky part will be getting the frogs to adopt their new home. Biologists believe that birth waters are imprinted on tadpoles; Oregon spotted frogs return to nearly the exact locations to breed and overwinter season after season. In early spring, around the first thaw, the Wickiup frogs, if typical, will lay eggs in communal clusters. These clusters will be transported to the Dilman site to hatch in the new home water. The adults, which tend to remain submerged until summer, will be captured and introduced to the meadow later. They may just attempt to return to the dam site, however; the homing instinct is very strong with Oregon spotted frogs.

And if the experiment at Dilman Meadows fails? Although hopes are high, project coordinators have faced the possibility that the frogs won't survive. Extinction of the Wickiup frogs would not only be a project failure but a complete disaster. This isn't a pilot project, emphasizes Chuck Korson of the Bureau of Reclamation. This is it.

As a contingency, some of the eggs will be reared in captivity at the Portland Zoo to preserve the gene pool of the high-altitude population. Perhaps others will be introduced at a location nearer the dam. The latter site is completely artificial, being crafted in a "borrow area," and area where builders remove earth for dam work but may have more favorable geography. The excavation work in a borrow pit allows designers to craft a landscape tailored to the spotted frogs needs. Three small islands are to be crafted before the naturally high water table is allowed to flood the site. Regardless of these contingencies, failure ultimately would send everyone back to the drawing board.

"This is a first of a kind operation," says Korson. These thirty-some frogs have resulted in a broad-based coalition of the Bureau of Reclamation, the US Fish and Wildlife Service, the US Forest Service, the Oregon Department of Fish and Wildlife, the US Geologic Survey, and others to wrack its collective brain. Success means more of these collective efforts to ensure biodiversity. Failure may mean feelings of futility and further criticisms of the Endangered Species Act as being too restrictive and costing taxpayers and private companies too much.

Todd Miller is a M.S. candidate at the University of Oregon.

A Contested Place: ANWR, ENVS 411 and Representitive Reggie Joule

By Jeremy Zhe-Heimerman

About a week after the election last November, I walked into class ready to hear a guest speaker from the Alaska State Legislature. One of my students, an Alaskan, had earlier written a paper on the Arctic National Wildlife Refuge (ANWR) and was interested in informing our class discussions on environmental issues surrounding the presidential election. When he asked if his uncle, who was in the legislature and very knowledgeable on the topic, could visit class, I could not turn him down. I purposely asked very little else about our guest in the days leading up to class, though I knew he supported drilling for oil in ANWR. I will admit that I entered the room expecting to hear a typical white, male Republican with close ties to the oil industry telling us not to worry about oil drilling hurting caribou in ANWR.

I realized I was wrong after meeting Representative Reggie Joule of Kotzebue. A Democrat, and House Minority Whip, Rep. Joule introduced himself as a Native Inupiat who represents the district in which ANWR lies. Rep. Joule's district is the size of Indiana and Minnesota combined, yet only 15,000 constituents reside there. He described his constituents and his people as still living in a largely traditional hunting society and then continued to speak words that many of us in the nearly exclusively white, middle class, environmentalist classroom expected to hear from a Native American. Rep. Joule spoke of ties between generations and living in harmony with the natural world. He told us of his people's connection with the animals they hunt, the land they share, and the history of that land over the last thirty years.

Under the Alaska Native Claims Settlement Act (ANCSA) of 1971, Natives agreed to give up their aboriginal claims to Alaskan lands in return for 44 million acres of land and $962.5 million dollars to be owned by newly formed regional, urban, and village corporations. All Alaskans with at least one-quarter Native blood were eligible to enroll and receive one hundred shares in both the regional and the local corporation of their residence. In order to receive these lands, Natives agreed to give up any claims to other land held by the federal government, including hunting and fishing rights on that land. Of course, many were not happy with this compromise and wondered why they should ask Congress to give them the land Natives rightfully had a claim to. The political climate and the history of Native Americans losing their land to the federal and state governments ultimately caused Native leaders to agree to ANCSA.

Later, Congress protected much of the public lands that it received in ANCSA. When President Carter signed the Alaska National Interest Lands Conservation Act (ANILCA) before leaving office in January of 1980, national parks, wildlife refuges, and wilderness areas were all added or expanded in Alaska. Acceding to Native demands, ANILCA also gave rural peoples practicing subsistence the first priority for hunting and fishing on public lands. It was under ANILCA that ANWR was created and the Bureau of Land Management (BLM) charged with studying the potential of resource extraction. In 1987, BLM recommended that Congress open ANWR to oil drilling.

Following his history of Alaska Natives and their dealings with Congress, Rep. Joule shocked the class by revealing his support for drilling in the Refuge. Was this man the same Native American who minutes ago extolled the virtues of living harmoniously with the natural world and thinking of the well being of future generations? Even though I knew before class where Rep. Joule stood on ANWR, I could feel the dissonance in the classroom. As good, white, urban environmentalists in Eugene, we had been taught to revere the traditions of Native American cultures. Now, we were listening to a Native tell us how the majority of his nearly all Native constituents—and 80% of those in the town nearest ANWR—favored drilling for oil in this ecological cathedral.

To explain his support for drilling, Rep. Joule cited the need for development in his impoverished district where most towns have no running water. He claimed they have no other possibilities for development besides offshore drilling which would result in much more environmental degradation. He told us that he and his people realize that the oil companies will take as much as they can from the land before leaving it in whatever state is convenient as soon as the oil runs out. Yet he assured us that his people care for the land. They rely on hunting for subsistence and wish to strike a deal with the oil companies that would ensure drilling in as clean a manner as possible.

The response from the class was impassionate, but respectful. How does drilling follow your philosophy of living in harmony with the earth? How can you go along with the oil companies knowing they have no real concern for your people or your land? Rep. Joule answered these, and other questions, by explaining the very real and understandable desire of his people to climb out of poverty. All in all, it was an incredibly moving class as our preconceived environmental myths about Native Americans and the wildlife refuge were shattered.

Regrettably, the term was coming to an end and our schedule for the remaining classes was overflowing. We could not "debrief" from the session in another class. But looking around the room that day, talking with students one-on-one, and reading journals later revealed the effect Rep. Joule's visit had. Several students were moved to tears during or after class. Some students were questioning how suitable their own personal and political strategies for change were, considering what they had just learned. Others learned a valuable lesson that debunked their stereotypes of Native Americans. While a teaching moment was lost in my inability to find later class time to discuss our guest speaker, I hope my comment in class that day was not forgotten. If environmentalists are to be successful in creating meaningful change in American society, we must build coalitions with native people, poor people, and people of color and address issues of social justice.

My point is not a ground-breaking or unique one. Greens and ecofeminists have been making such a critique for about twenty years now. An informal glance of Sierra magazines over the past year indicates that the Sierra Club may just be starting to at least give lip service to the way environmental issues connect with social and economic issues. Further, the growth of the environmental justice movement in communities of color, urban areas, and reservations gives us much hope that the previously narrow boundaries of environmentalism are being expanded. However, much more work needs to be done.

The limitations of the current movement should be pointed out. Environmentalists are overwhelmingly white, educated, middle class, urban dwellers. The most well-funded domestic environmental organizations still direct the bulk of their resources and energy at the federal level, ignoring local communities, and focus on wilderness protection and population at the expense of other environmental issues. Such an approach does not go over well in impoverished rural communities. Likewise, people of color often do not see their interests served by such organizations. Meanwhile, ecofeminists, who have made real attempts at building coaltions with these communities, have struggled to overcome gender and racial essentialisms that, though used strategically and with good intentions, often hold us back. This essentialism, which fixes the identities of peoples based on what are actually socially constructed and fluid characteristics, dominates the discourse around Native Americans among many environmentalists and could be witnessed in our class' first impressions of Rep. Joule. By essentializing all Native Americans as "closer to nature" and "living in tune with the earth," we can lose sight of their specific historical, political, and economic situatedness—knowledge that will allow environmentalists to work in genuine partnerships with peoples who have other perspectives on the world.

Noel Sturgeon, a prominent ecofeminist scholar, writes, "Discussions of Native Americans as the 'ultimate ecologists' tend to generalize across tribal cultures and obscure the specific problems and varied solutions that occupy Indian struggles for cultural survival." The recent push by environmentalists to preserve ANWR has included a tour across the lower 48 by Gwich'in Athabaskan Indians who live south of the refuge and oppose the Inupiat push for drilling. Without a complex understanding of the political and economic reasons behind the conflict between the Gwich'in and the Inupiat, I fear we are setting ourselves up for framing it in racist terms of "good Indian vs. bad Indian." Such a blunder would be disastrous for environmentalists hoping to work with Native communities.

It appears a coalition of Democrats and northeastern Republicans in the United States Senate will act as a firewall to the Bush administration's desire to open ANWR to oil drilling. My hope is that they will succeed and the biodiversity unique to the region will be spared for now. This does not mean, however, that environmentalists should not continue to critically examine their rhetorical and political strategies. It also does not mean that we should forget or ignore the Inupiat desire for a better life. How can we build coalitions with labor, people of color, Native peoples, and rural peoples? How can we communicate cross-culturally to struggle for social, economic, and environmental justice? How can we protect biodiversity in ways that respect the legitimate claims of local peoples to the land? These questions are difficult ones and can only begin to be answered by examining histories, economics, and politics at the grassroots level.

JEREMY ZHE-HEIMERMAN IS A M.S. CANDIDATE AT THE UNIVERSITY OF OREGON.

Notes:

1. For more information, visit the Alaska Native Claims Settlement Act Resource Center at http://www.lbblawyers.com/ancsa.htm.
2. See http://www.r7.fws.gov/asm/anilca/toc.html for the text of the ANILCA legislation.

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