agroborealis

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summer 2005

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Morels & fire

School of Natural Resources and Agricultural Sciences
Agricultural and Forestry Experiment Station

University of Alaska Fairbanks

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Bucket of morels from 2004.
—PHOTO BY TRISH WURTZ

Amy Craigen in the rainforest of Belize. See story on page 10.
—COURTESY AMY CRAIGEN

Vicia cracca *(bird vetch) growing along the Seward Highway in Anchorage. This is one species of concern to park resource managers.*
—PHOTO BY CHRIS MCKEE, U.S. NATIONAL PARK SERVICE

Portable sawmills, like this Log-Master 5, may help reduce labor costs. See story on page 22.
—PHOTO COURTESY LOG-MASTER PORTABLE SAWMILLING MFG., INC.

Michael Gibson studied the relationship between avalanche knowledge, experience, and behaviors in winter backcountry users for his senior thesis (see page 25). Above: A cornice on the Snowslide Gulch avalanche path near Juneau started an avalanche when it fell, releasing a slab estimated at 0.4 to 1.0 meters deep and 600 meters wide. Cornices, overhanging wavelike curls of snow deposited on ridges by drifting winter snow, make very effective avalanche triggers. A piece of cornice the size of a couch can weigh a ton.
—PHOTO © BILL GLUDE, SOUTHEAST ALASKA AVALANCHE CENTER

About the cover:
Japanese knotweed, Polygonum cuspidatum, *an exotic plant that poses a potential threat to southeast Alaska ecosystems. See story on page 18.*
—PHOTO © BARRY RICE, THE NATURE CONSERVANCY

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UAF UNIVERSITY OF ALASKA FAIRBANKS

Dean Carol E. Lewis

letter from the dean and the associate director:

Associate Director G. Allen Mitchell

The University of Alaska Fairbanks offers 160 degrees in 100 disciplines ranging from one-year certificates to the doctoral degree. In keeping with the hallmark of land-grant universities, it also integrates teaching and research with learning and public outreach. University of Alaska Fairbanks recruiting literature shows that students may prepare for careers that range from agriculture to energy to biotechnology to rural education. Interestingly, agriculture as we define it here at the School of Natural Resources and Agricultural Sciences and the Agricultural and Forestry Experiment Station encompasses energy, biotechnology, rural education—and much more. Our unit is the only one at the University of Alaska and one of few among land-grant universities nationwide in which research, teaching, and outreach encompass the social sciences as well as the biological and physical sciences. Program experience also includes written and oral communication, which are important skills in our students' chosen fields.

Our current students and our graduates are wonderful examples of the benefits of an education that includes a breadth of perspectives and the opportunity to pursue specific interests of their own. This issue of *Agroborealis* focuses on their work, which would not be possible without our involved and dedicated faculty who mentor students as they complete their required senior thesis projects. Without their incredible efforts and broad perspectives in resource management, the products you see in the section featuring senior thesis projects would not be possible.

Ethical considerations are an integral part of the sustainable management of natural resources. Our students have the opportunity to explore the history of modern Western views on human relationships with the environment. During their coursework and work experiences, they also formulate or revise individual environmental ethics. Because their programs emphasize the physical and biological sciences, their views are firmly grounded in scientific principles. Students are also trained in economics, law and policy, and land and resource planning, which contributes realism to their perspective as they explore their visions.

We are very proud of our students and of the faculty who inspire them and bring them the excitement of the world of agriculture, forestry, and natural resource management. Our graduates bring their knowledge into a variety of careers. Chris McKee chose to be an exotic plant detective working for the National Park Service in Alaska and discusses his pursuit of 'aliens in the north.' Others are working in fields such as biological consulting, forestry, public land management, and horticulture. Some have become entrepreneurs, basing innovative businesses on their fields of expertise. As the university accelerates its effort to develop innovative industry partnerships, students will be provided not only exciting career opportunities, but also with opportunities for hands-on experience in their chosen career paths.

Agriculturalists often think of food. There are not many areas where an environmental disturbance like a forest fire can lead to a delicious product. Feel free to use our article on morels as a field guide for collecting this tasty mushroom. To learn more about forest fires and their positive and negative effects in Alaska, refer back to our last issue of *Agroborealis*, which is available on our website at www.uaf.edu/snras/afes/pubs/index.html.

Have a wonderful summer. I know our twenty-six new graduates will!

Sincerely,

Carol E. Lewis
Dean and Director

G. Allen Mitchell
Associate Director

MORELS:
a morsel after the fire

Deirdre Helfferich

The 2004 fire season, which burned more acreage and produced more smoke in the Interior than any season in the last fifty years, may, if the weather in summer 2005 is favorable to fungi, produce a bonanza of one of the world's tastiest mushrooms: the morel. Morels (genus *Morchella*) are eagerly gathered from the wild and are prized in French and U.S. regional cuisines. The flavor is described variously as earthy, smoky, nutty, or meaty, but fans of this spongy-looking fungus are unanimous in their assessment of it as unique and delicious. One species has even been named for this quality: *Morchella deliciosa*.

In Alaska, morels fruit (produce the aboveground stem and cap) in June and July, most prolifically in areas burned in the last one to three years. Trish Wurtz, affiliate research professor of forest sciences for SNRAS, has been researching the ecology and economics of post-fire morel mushrooms in Alaska and western Canada. Wurtz is a USDA Forest Service researcher who works for the Boreal Ecology Cooperative Research Unit at UAF, a major federal partner of SNRAS. A recent paper, "Harvesting Morels After Wildfire in Alaska," explores the life cycle and ecology of Alaska morels, how wildfire affects their productivity, the market for morels, commercial harvests in the Pacific Northwest and Canada, and the potential for this industry in Alaska. The paper is authored by Wurtz, Amy Wiita (Institute of Social and Economic Research, University of Alaska Anchorage), Nancy Weber, and David Pilz (Department of Forest Science, Oregon State University).

Blond and gray morels in Trish Wurtz's cap, showing the variability in color and shape of these mushrooms.
—PHOTO BY TRISH WURTZ

Alaska morels field-drying in the sun, June 2004.
—PHOTO BY TRISH WURTZ

Morels and harvesting: a primer

Edibility

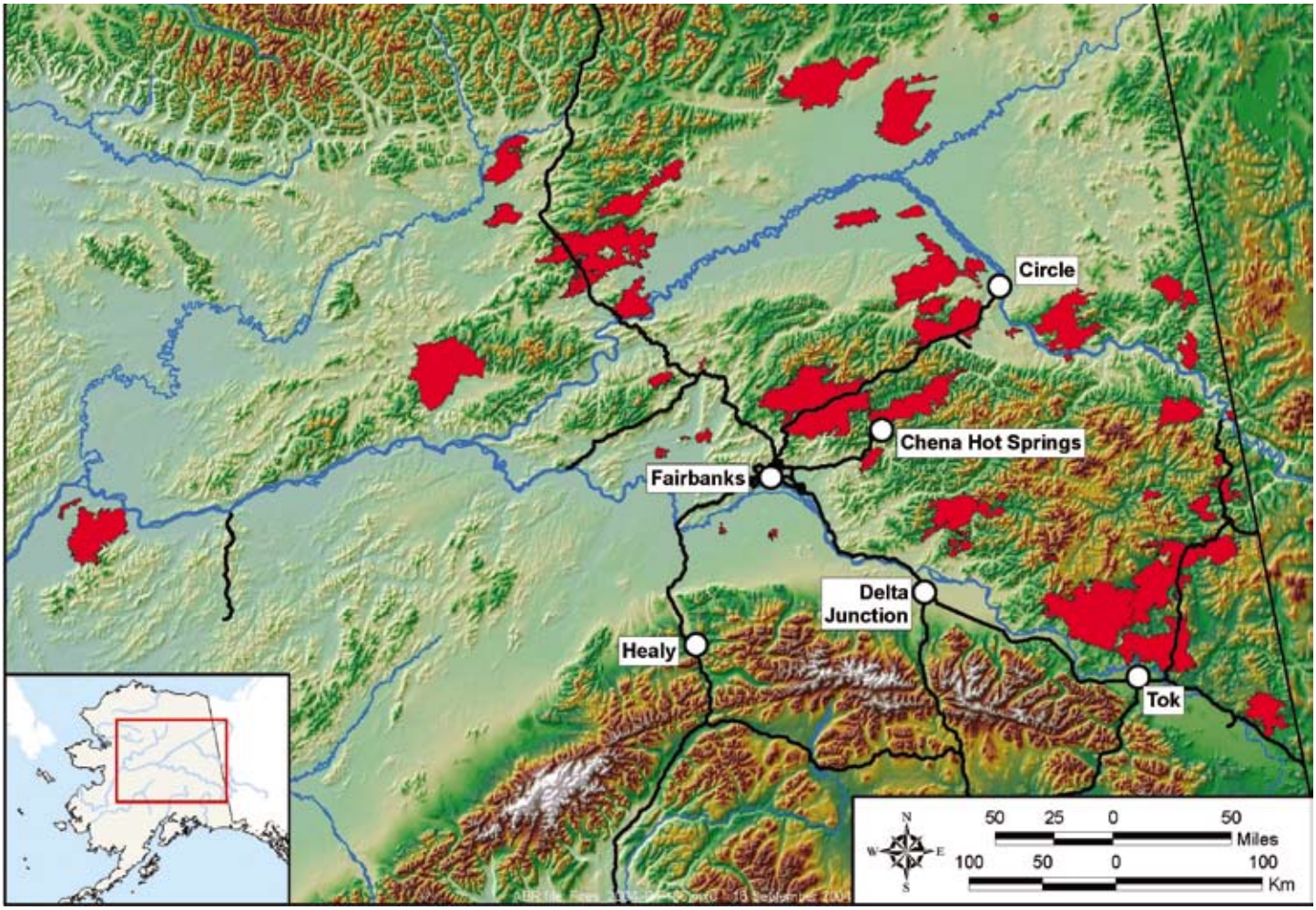
Morels are eminently edible mushrooms, but there are species similar in appearance that are poisonous or can cause adverse reactions. The genera *Verpa* and *Gyromitra* include species commonly known as early morels and false morels. These may fruit at the same time as *Morchella* in Alaska, and in the same areas, but are fairly easy to distinguish from true morels.

A true morel is hollow, as Figure 1 on page 6 shows, and the cap is fused with the stem, the cap having a deeply pitted, somewhat sponge-like appearance. Verpas, or early morels, have a wrinkled or wavy rather than pitted cap, which is attached only to the top of the stalk so that the cap forms a skirt. Gyromitras have lobed, almost ruffly or brain-like caps. Both verpas and gyromitras have solid stems. Michael Kuo of MushroomExpert.com provides four basic rules to distinguishing edible true morels:

> One: When in doubt, throw it out!
> Two: If it ain't hollow, don't swallow!
> Three: If it's wavy, don't make it gravy!
> Four: If it's reddish, you could be dead-ish![1]
> (many gyromitras have a reddish cap color)

When gyromitrin, the active toxin in gyromitras, is ingested, the body's digestion process produces monomethylhy-

1. Kuo, M. (2002, December). Cardinal rules. Retrieved from the MushroomExpert.Com website: http://www.bluewillowpages.com/mushroomexpert/morels/cardinal.html



Fires in the Interior, summer 2004.
— Matt Macander, ABR Inc.—Environmental Research & Services, Fairbanks; reprinted from "Harvesting Morels After Wildfire in Alaska," USDA Forest Service Research Note PNW-NRN-546 February 2005

drazine (MMH). This chemical is a chief ingredient in rocket fuel—not a substance known for its culinary desireability.

> Though MMH is not understood completely by scientists, there is no question about whether it is poisonous or not. It appears that MMH may occur in different quantities in different false morels (even members of the same species), that its presence may vary according to geography, that its effect on people may vary between individuals, and that its toxicity may be cumulative…[2]

Poisoning symptoms include headache, a bloated feeling, nausea, lack of muscular coordination, diarrhea, muscle cramps, or abdominal pain. Severe symptoms are high fever, convulsions, coma, and death. Symptoms can start to appear as early as two hours and as late as 24 hours after eating the mushrooms, depending on the quantity and the individual's sensitivity. Even cooking false morels can create fumes that are poisonous if inhaled. Gyromitrin is a known carcinogen, so even if you don't experience poisoning symptoms on eating them (not everyone does), you risk long-term health problems from eating false morels.

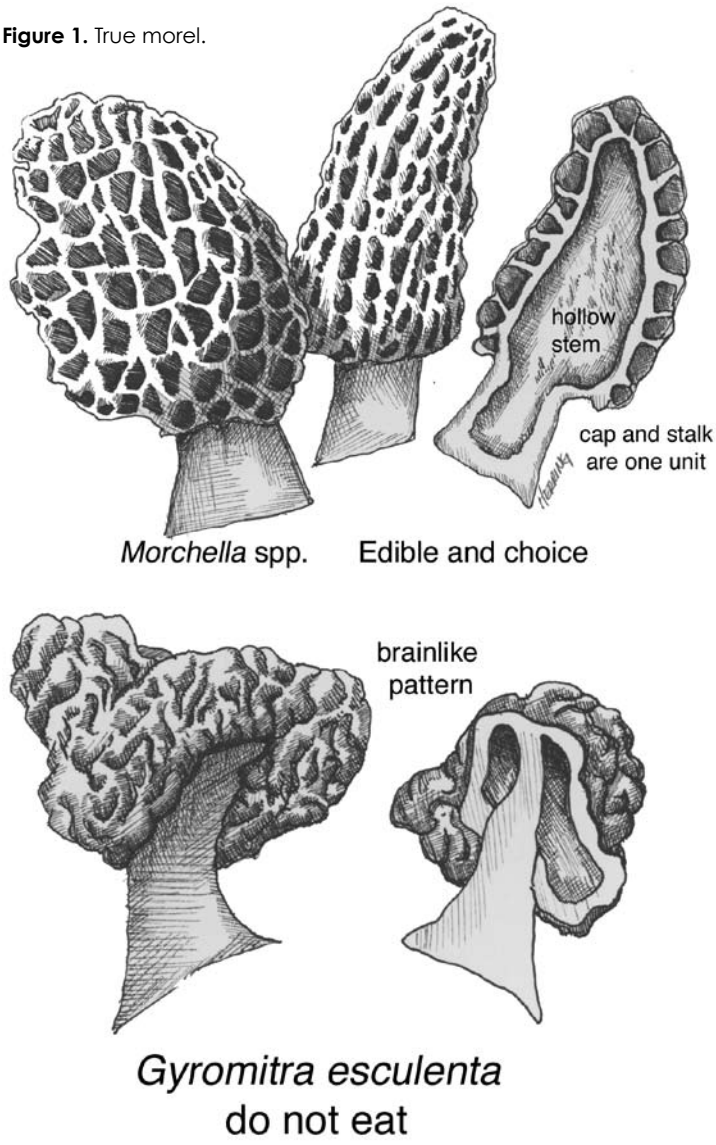
Even true morels should always be cooked before eating. Some people are sensitive to them, so if you have never eaten one, try only a little to test it the first time, and wait a day. The Alaskan Mushroom Guide for Harvesting Morels, published by Cooperative Extension Service at UAF, counsels mushroom eaters:

> Although true morel mushrooms are edible, they have been known to cause allergic reactions and gastrointestinal upset. Combining morels with alcohol can compound this.

Mushroom hunters should be extremely careful to properly identify the mushrooms they harvest. Unless you're taking a mycologist along, a good, up-to-date mushroom identification field guide is essential. It may be difficult to identify the particular species, as they vary dramatically not only between individual mushrooms within a single species, but from day to day. Morel pickers will often use an informal classification system based on color, referring to their targets as black, gray, or blonde morels, for example.

2. Kuo, M. (2002, December). Introduction: Morels & false morels. Retrieved from the MushroomExpert.Com website: http://www.bluewillowpages.com/mushroomexpert/morels/introduction.html

Figure 1. True morel.



Above: Burned area along the Taylor Highway and a potential morel-hunting spot.
— PHOTO BY TRISH WURTZ

Figure 2. False morels. Right: Gyromitra, or beefsteak "morel"; Left: Verpa, or thimble "morel". These mushrooms are considered poisonous.

Habitat

Morels grow in a variety of habitats, from sandy soils near streams to lawns to undisturbed forest, or in areas of large-scale distubance, such as wildfire, heavy insect infestation in the forest overstory, or timber harvest. The morels that grow in disturbed areas may be different species than those that fruit in undisturbed ones—this has yet to be determined by genetic testing. Morels seem particularly fond of burn areas, sometimes fruiting in tremendous number in the year or two after a wildfire. In North America, commercial morel pickers concentrate their efforts in the western states, British Columbia, and the Yukon. Now Alaska may also become a prime picking region. Wildfires are mapped and the information posted for the benefit of morel pickers. Alaska's morel hunters will also be able to view the latest fire information at the Alaska Fire Service website, http://fire.ak.blm.gov/docs/news/newsrels.asp (news releases), and at their Maps and Imaging link, available from their main page, http://fire.ak.blm.gov.

Season and life cycle

Morels fruit for about two to six weeks, with the individual mushrooms lasting one to two weeks, but different varieties may fruit in succession. Rainfall is important to morel fruiting, and can prolong the season. In Alaska, morels appear from as early as the beginning of June to as late as mid-August. The main season is from the end of June through mid-July, about three or four weeks, but the season may be drastically reduced or even eliminated in dry years.

"The lifespan of individual morel fruiting bodies in burned areas depends on local weather conditions and insect populations. The ideal conditions for morel fruiting in interior Alaska would seem to be moist soils coupled with overcast days of moderate temperature. Cool overcast weather will allow mushrooms to continue growing longer than will hot, dry weather. Although rainfall can prompt additional fruiting by increasing soil moisture and relative humidity, rain can also damage standing mushrooms and speed their decay." (Wurtz et al., p. 11)

For most of its life cycle, the *Morchella* fungus exists as a web-like network of underground threads, called the mycelium. The mycelium is composed of hyphae, long thin branching filaments through which the fungus feeds by producing enzymes that digest nutrients. (There is some evidence that some species of morels may form a symbiotic relationship with trees or other plants, exchanging nutrients and thus act-

The Mushroom Event

Morels often grow in clusters. As part of their mapping exercise, researchers defined a "mushroom event," based on the expected accuracy of the GPS unit used to map them (see below right). Mushroom events were defined as any and all mushrooms that were encircled by a 10cm-diameter plastic ring. Most such events at the Erickson Creek study site had a single fruiting body within them, but some had two, three, and even six mushrooms within the plastic ring. The distribution of genetic individuals is being determined from the morels' DNA.

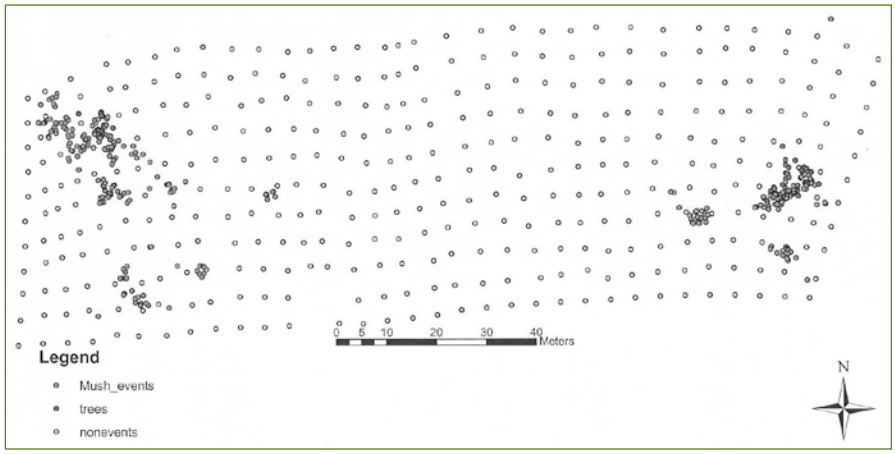
— PHOTOS BY TRISH WURTZ

ing as mycorrhizal fungi, although this is not proved.) What most people call a mushroom, the aboveground stem and cap, is only the reproductive body, and is short lived in comparison with the mycelium. Morel spores have thin walls and, when the environment is moist, will germinate readily. The spores produce mycelia, which spread through the soil. For reasons largely unknown, the mycelia form pseudosclerotia, nutrient storage organs from which the fruiting body sprouts, often after a disturbance such as fire. The cap produces millions of tiny spores.

Morels and fire

Because morels in Alaska are most abundant on lands that burned the year before (when rains are adequate), it is important to know where those fires were. Much of the burned

To make a high-resolution map of the distribution of mushrooms in a 1-hectare burned area, researchers needed to use an extremely accurate GPS unit normally used for surveying (see inset above, SNRAS graduate student Matt Macander and recent graduate Brian Riordan) This allowed mapping morel individuals and clusters (the mushroom events) to an accuracy of about 5cm. Morels were found to be highly clustered across the study site (see map below). Data were also collected on the locations of trees relative to mushrooms, and on the soil temperature, moisture, shading, and understory plants at each fruiting microsite. Analyses will determine whether there are patterns in fruiting site charactertistics.



forestland in Alaska is far off the road system, and access to prime morel country can be difficult. About 20 percent of the 2004 Interior fires were adjacent to the road system, which is advantageous for pickers and buyers both. Morels grow best near trees, in areas where a burn was of moderate to severe intensity, which can be identified by a ground covering of ash or dead tree needles on top of ash. Wurtz et al., found morels fruiting near burned black spruce, white spruce, and birch.

Morel harvesting in Alaska

Commercial mushroom harvesting can be extremely lucrative for the buyers. In some cases, mushroom harvesting can generate as much or more money than other forest products, including harvesting the trees for pulpwood. For example, in Ontario, a 1995 study found that the direct economic benefit from harvesting mushrooms was significantly greater ($197/acre/year) than for pulpwood ($138/acre/year). Morel prices can fluctuate dramatically, depending on the market availability at the time of harvest. Fresh morels may retail for $5 to $50 per pound, while buyer purchase prices vary from $3 to $10 per pound. Migrant pickers, who travel in search of likely mushroom-growing spots, may make their annual living from wild mushrooms, but it is hard work, and in the case of morels, can be dirty, due to the soot.

Commercial buyers purchase by weight. Fresh morels rapidly lose moisture (and weight) after picking, about 10-15 percent within the first 24 hours. Fresh morels have a short shelf life, so are preserved by drying or, for personal use, freezing. Dried mushrooms bring in more per pound than fresh (anywhere from $20 to $250 per pound), and may be saved for one to possibly three years, if properly dried and preserved, in anticipation of better market prices later. However, even dried mushrooms deteriorate. Restaurants will use fresh morels, and Wurtz et al. determined that there are at least nine Alaska restaurants with fresh morels (in season) on their menu, and more that would purchase them if made available locally. The ideal time lag between picking and final point of sale is no more than a day. The larger market would thus be outside Alaska, with air shipment required to maintain product freshness.

Fees and permits

Morels may grow on state, federal, private, or Native corporation lands, and it is important that permission to harvest is granted by the landowner. Morels have been found this year near Tok, which was the site of commercial harvesting in 1991, the only time large-scale commercial picking has occurred in Alaska. In 1990, a 98,000-acre fire along the Tok River resulted in a bumper crop of morels in an accessible area. Most of the land burned in 1990 is owned by the Tetlin Native Corporation. Unfortunately, the corporation had problems in 1991 with trespassers, difficulty in collecting royalties from mushroom pickers, and garbage left behind. Many of the Native corporations restrict usage of their lands to shareholders. For example, the Doyon Coporation, which owns land burned in the 2004 fires (between Mile 12 and Mile 27 along the Taylor Highway), is limiting morel picking on its lands to shareholders. Other private landholders may not allow picking at all.

On public lands, however, both commercial and subsistence pickers may harvest morels, although a permit is required. Commercial mushroom buyers need to purchase a business license from the State of Alaska. Through a cooperative agreement, a state permit will work on federal lands and vice versa. The permitting process set up for morels depends on whether you are picking commercially or for personal use. For commercial harvesters, the picker makes an estimate of how many pounds he or she will pick, and pays either the federal Bureau of Land Management (BLM) or the Alaska State Department of Natural Resources (DNR) 20 cents per pound up front, with a $50 minimum (250 pounds). The permit is good through Sept. 30, and the picker is expected to keep a daily log of poundage picked. If the picker exceeds the estimate, a new permit may be purchased for the additional weight, or for another estimate. Commercial picking may be done on federal (BLM) or state lands, but not on park lands.

Picking for personal use (for yourself or family to eat at home) is allowable without a permit on both state and BLM public lands outside of parks. The allowable amount of mushrooms is two 5-gallon pails per person per day. On state park lands, a person may pick two 5-gallon pails per year. On federal park lands, personal use is limited to what you will eat that day. In refuges, state or federal, no morel picking is allowed.

The morel industry in Alaska

The industry is dependent upon the world mushroom market and morel availability (morels come from India, China, Russia, Eastern Europe, and the Pacific Northwest, as well as smaller quantities in Western Europe and the rest of the United States). In Alaska, mushroom production and sale, already dependent upon weather and wildfire, becomes further constrained by accessibility: who owns the land, whether the land can be reached by boat or car, and Alaska's remove from the major morel markets in Europe. The variability in both availability and price means that the savvy Alaskan entrepeneur will have to be both innovative and flexible in obtaining and marketing these mushrooms, and will need to learn about morel processing, handling, and selling.

Whether picking them for personal use or for sale, morels potentially represent a new non-timber forest industry in Alaska, one that may or may not be the lucrative "mushroom boom" hoped for, but one that will certainly provide Alaskans a tasty dish.

Cooking and eating morels

Morels may be eaten fresh or dried and stored for later use. In either case, the mushrooms should be cooked before

eating. Fresh morels have a short shelf life, and most sources recommend eating them no more than three days after picking, preferably the same day.

To dry morels, choose fresh mushrooms in good condition, clean them, but don't wash. Michael Kuo of Mushroomexpert.com recommends using a food dehydrator, but they may be sun dried or via a convection or conventional oven. Field-drying may be an appropriate option for those picking large quantities, although buyers will usually purchase only fresh mushrooms. Some may buy dried morels from experienced pickers. Drying may be done on racks in the sun or by using a propane (not wood-fired) dryer at very low temperature to avoid cooking the mushrooms. Metal-screened racks or wood smoke will cause an off flavour. Morels are usually dried whole, although they may be sliced for faster drying. It takes about eight to ten pounds of fresh mushrooms to make a pound of dried. Dried mushrooms will keep longer if stored frozen. To rehydrate them, place them in boiling water for about fifteen minutes, or soak them in milk, broth, or water overnight.

Some people recommend freezing fresh morels by slicing them in half, soaking them in salted water and then freezing them. They can be dipped in egg batter and patted in flour before freezing also, ready for frying later.

Recipes

The simplest way to cook mushrooms is to sautée them in butter. The following recipes have been adapted from different websites.

Morels fried in butter

fresh morels
flour
breadcrumbs or finely crushed cracker crumbs
well-beaten eggs
salt and pepper
oil

Clean and trim morels. Soak in salted water to remove insects, drain well, pat dry. (Different recipes recommend diffferent soaking times, from a few hours to a day.) Slice morels in half lengthwise, or in quarters if especially large. Mix flour, salt, and pepper. Heat one to two tablespoons oil and approximately four tablespoons of butter in a cast iron skillet. Take care not to overheat lest the butter burn. Dip morels in beaten egg, then dredge with flour mixture. Dip again in the egg, and then coat in crumbs. Place in skillet and fry on medium heat until golden brown, approximately two to three minutes per side, turning to evenly cook both sides. Add butter as needed. Serve, with additional salt and pepper to taste.

Morels with cream sauce

15 to 20 fresh or reconsituted dried morels, cut in half or in bite-sized pieces
1 large shallot or medium leek, finely chopped
large clove garlic
2 tablespoons unsalted butter
2 tablespoons olive oil
3/4 cup chicken broth
1 cup heavy cream
Parmesan or Romano cheese, grated (optional)
salt and pepper

Heat pan over medium heat, add olive oil and briefly heat. Add garlic and shallots or leek, stir and sauté until softened but not brown. Add butter and melt. Add morels. Stir and cook until mushrooms start to brown, about four or five minutes. Add broth and cook for two to three minutes. Add cream and simmer until reduced and thickened, then stir in grated cheese. Add salt and pepper to taste. Serve on toast, steaks, asparagus, with pasta, or as a side dish. Sprinkle more cheese on top.

Resources

Publications:

Alaskan Mushroom Guide for Harvesting Morels. Cooperative Extension Service. Available on line at www.uaf.edu/coop-ext/programs/lrpro.html. This pamphlet includes listings for Alaska agency contacts, guidebooks, useful articles and websites, and guidelines for identification, picking, preserving, and cooking morels.

All that the Rain Promises and More…: A Hip Pocket Guide to Western Mushrooms. David Arora. Ten Speed Press, California. 1991.

Harvesting Morels After Wildfire in Alaska. Research Note PNW-RN-546, February 2005, by Tricia L. Wurtz, Amy L. Wiita, Nancy S. Weber, and David Pilz. Available on line at www.fs.fed.us/pnw/pubs/pnw_rn546.pdf.

A Morel Hunter's Companion: a guide to the true and false morels. Nancy Smith Weber. Thunder Bay Press, Michigan. 1995.

Morels. Michael Kuo. University of Michigan Press. In press (2005).

Permitting and information:

Bureau of Land Management: 474-2200 (Fairbanks)

Department of Natural Resources: 451-2705 (Fairbanks)

Websites:

A search on the Web will bring up thousands of sites on morels. A few are listed here:

The Great Morel Site. General resource. http://www.thegreatmorel.com/index.shtml

MushroomExpert.com. General resource. http://www.bluewillow-pages.com/mushroomexpert/index.html

Mushroom People. Resource on growing mushrooms. http://www.mushroompeople.com/morel.htm

North American Mycology Association. General resource. http://www.namyco.org/

Students and Environmental Ethics

Environmental Ethics and Actions, a 300-level natural resources management class, is taught every spring by SNRAS professor John Fox at the University of Alaska Fairbanks. The course is an exploration of the history of modern Western views of the relationship between people and nature, and examines alternative foundations for an environmental ethic such as utilitarianism, spiritual activity, rights-based and respect-based ethics, and the practice of such ethics in modern life. Papers by three students from the spring 2005 class are reprinted here.

Towards a Personal Environmental Ethic

Amy Craigen

Belize, Central America; April 2004

Waking up to the sound of black howler monkeys is one of those experiences you share with only a select few people in this world, and I am one of the lucky ones. It won't matter how long I am here, it could be four months or four years, I know this feeling will never change.

I notice Robin is awake so I get dressed, put on mosquito repellant and open the tent. It's a little after 5:30 AM. Breakfast is the usual granola bar, but this time eaten on the run. It is a thousand times easier to find the monkeys when they are howling so we walk, as fast as we can, in the direction of the noise. The sun is beginning to penetrate the thick canopy. I begin to notice that the trails we follow are ingrained into my memory. Every vine, every tree stump, every anthill or humming bird nest is noted and, I hope, never forgotten.

For me the forest never grows old. It is a world that never stands still, forever changing and evolving into environment we know so little about. A quote I was first introduced to at the Belize Zoo (the only zoo I have visited) crosses my mind:

> We patronize them for their incompleteness, for their tragic fate of taking form so far below ourselves. And therein do we err. For the animal shall not be judged by man. In a world older and more complete than ours, they move finished and complete, gifted with the extensions of the senses we have lost or never attained, living by voices we shall never hear. They are not brethren, they are not underlings; they are other nations: caught with ourselves in the net of life and time, fellow prisoners of the splendour and travail of the earth.
>
> —***Henry Beston,*** The Outermost House

It made me think.

We continue south, following a call that I will never tire of hearing, the sound of wild animals in their natural habitat. Fifteen minutes later we find them at the Thumb, a nearby rock outcrop jutting from the canopy. The male is making all the noise whilst the others sit at the very tops of the trees warming their bodies in the morning sun, shaking off the coolness of the night. The troop seems to have accepted Quiver, which is a relief. Quiver is a two-year-old female we released just a week ago after being in the care of Robin for almost six months. The release didn't go as planned, but it seems to have worked. We originally released another monkey, Pancho, at the same time but he was too young and wasn't able to keep up with Quiver, who was desperate to find a troop and a mate. Pancho just wanted to play and was not attempting to find any food, so he had to be brought back to the wildlife care center. It took Quiver just a day to find a wild troop and, after a few fights and screaming matches, she seems to have been accepted by all of the monkeys.

For three weeks after the monkeys are released Robin tracks them, collecting data on their direction of travel, the foods they are eating, and their interrelationships as a troop to make sure they are adapting to their new life in the wild. This is where my help comes in, camping in the field, getting up early and looking for the monkeys, while cutting and mapping any new trails we make. So, as we stand and observe the monkeys I begin to wonder how I ever got here, in the middle of the Belizean rainforest, releasing this endangered species back into the wild. I think back and remember the time I first came to this country, two years ago now, in 2002, on a six-month volunteer conservation placement. After months of preparation, endless hours of hard work, and what felt like a lifetime of traveling, I had made it. I remember sitting on what seemed like the edge of the earth, watching the sunset across the lagoon, in the place that was to be my home for the next six months. And I remember a feeling of pure happiness and contentment. I knew from that moment on that I would have no regrets about my decision to come to Belize.

I spent my time in the north, working in a rainforest reserve called Fireburn. The journey to the reserve took at least two hours, driving along a mud track and crossing a lagoon. Our home, three miles from the boat, was a wooden field base that we shared with a variety of bats, mice, scorpions, cockroaches, and sometimes snakes. I woke each morning to the

constant buzz of nature reaching me through the mosquito net. The parakeets were always the loudest, squawking above the rest. Most mornings I would wake up and sit as the sun began to rise, watching a jungle of creatures come to life in front of my eyes, praying that somebody else somewhere in the world was doing exactly the same as I was, experiencing this 'other' world.

My time in Fireburn was incredible. Never before had I lived in an environment where man's footprint was indistinguishable from the rest, and never before had I felt so close to nature. Then somehow things just kept getting better. I was asked to go down to Monkey Bay and help construct a pre-release enclosure for the black howler monkeys. Myself and two others were working on the project, which took around four weeks to complete. Robin then asked me to stay on through April and May, as she needed another female volunteer to help with the release of the monkeys. The howlers are a lot less stressed around females than males and, as it is the welfare of the monkeys that comes first, Robin only ever requests females.

Robin took a leap of faith with me and for that reason I will be forever indebted to her. At the age of eighteen I was the youngest volunteer she had ever employed, and I made sure that I did not let her down. She had set up this care centre eight years ago, and at the time all it consisted of was her cabin and the enclosures for the monkeys. She was, and still is, an amazing woman for whom I have the utmost respect and admiration. She runs this center by herself devoting every single day to caring for the animals, so that was where my help came in.

While Robin and her other volunteer released and tracked four monkeys (known to us as Iris, Lenny, Squiggy, and Max) across the river, I stayed at the care center and looked after all of the animals. There was on ocelot, a marguay, four parrots, two dogs and two howler monkeys. One was called Newton, who was six months old, and the other, a three-month-old, was named Fig. She still needed constant care, feeding through a syringe, and did not like to be left for more than two hours at a time. The whole schedule revolved around her feeding and the fact that she had to be clinging to me for the majority of the day. Newton had his own enclosure and Fig stayed in a small cage because she was too young to be left outside. It was like caring for a baby. Every day I would cycle two miles to the river and cross to the other side via canoe. It was then a twenty-minute hike through the forest to get to the release site. I took supplies and water to Robin every other day, but then the river flooded and became too dangerous to cross. I was left to care for the animals for three weeks by myself. It seemed like a very daunting task, but turned out to be one of the most rewarding things I have ever done.

Fig and Amy Craigen.

And so I am back, two years later, assisting Robin with another release, camping in the rainforest, eating out of a can, bathing in a river, and sweating what feels like my entire bodily fluids out of my pores. But I love it. Two days ago we came across a troop of four monkeys and managed to identify them as Fig and Newton and two wild males. Robin had successfully released Fig and Newton in 2003, but unfortunately I was not able to make it out. Seeing them now in the wild was like a dream come true. I think I felt every conceivable emotion in the one hour we stood and watched them. The last time I had seen Fig she was still only six months old, and now she was free, in the wild, in the place she was meant to be, interacting with two wild males. I know a few tears were shed that day—how could there not be? How could I not get emotional? Why do we as humans continue to destroy this world? Why do we only consider ourselves? Respect can be found everywhere in nature, the lion respects the antelope, the juvenile male respects the silverback, but as the dominant mammal that walks this earth we are different. Not because we are bipedal, not because we have the ability for language, not because we are intelligent, but because we do not respect nature. We are wise, yet every day we act unwisely. This world is not ours. We do not own it, nobody or no thing owns it. We simply live here. I cannot begin to understand the forces that drive us to act in this way, but the day I saw Fig and Newton will remain one of the best days of my life, an hour of my existence that really made sense.

So I find myself wanting to stay, in this world that is so far from my other life, yet feels more like home than any place I have ever been. In 2002 over the period of eight weeks, I never once heard wild howling. But in 2004 it is a different story. Every day I have heard howling and every day it brings a lump to my throat, because that is what Robin has done. She has successfully re-established black howler monkeys back into the forest where they once lived and where they were once eradicated by man. To know that I have assisted in that is almost too much for me to comprehend. So as I stand here, looking to the trees, I can't help but smile to myself. This is where I feel at peace; this to me is worth everything.

Amy Craigen is from Newcastle-upon-Tyne, England. When she was eighteen and fresh out of high school she took a year off before heading to university, going to Belize for six months. She volunteered there on a variety of projects and worked with Robin Brockett and the rehabilitation of black howler monkeys. Two years later she returned to work again with Brockett and the Wildlife Care Center of Belize. Says Craigen, "Both experiences have given me a whole new perspective on life, and I still cannot believe I was a part of something so amazing. I came to Alaska in August 2004 on the international exchange program and I have never looked back. It will be very hard to leave." Craigen notes that Fig is still thriving in the wild and recently had a baby, one of their first released monkeys to do so.

A Soiled Epiphany

Ben Meyer

How I discovered my environmental ethic, and how you can discover yours.

In the quest for principles that help us guide our lives, environmental ethics is useful in the pursuit of deciding what should be a person's relationship to the world around them. In this essay I will attempt to describe my views on what "ought" to be my relationship to my environment (regardless of what it is at my present state), describe how I came to my own conclusions in regard to this question, and to suggest some ways that a greater connection between people and the world around them can be established in the frontier of modern human consciousness.

As a mental exercise, I like challenging myself to envision the origins of everyday objects. It is a thought process that occupies the otherwise empty space of my imagination while I am out running, pretending to study, pretending to listen in lecture, etc. Whether these objects be Nintendos, lasagnas, recliners, or toenails clippers, the search for origins leads me to every corner of the world and peeks in to every walk of life, from the oil sultans of Saudi Arabia to the factory workers of Taiwan to the copper mines of Chile. In these journeys through my imagination I find that all of these dissimilar entities are bound together by tenuous and anonymous connections. My favorite example of this phenomenon is a baseball-sized globe of the world that sits on my desk. There is a sticker on the bottom side of the stand that says, "Printed in Germany. Made in China." I can see both Germany and China on this globe, and I have never ceased to be amazed at the magnitude of the five inches of distance from Germany to China to Alaska, where it sits today. Usually these international interdependencies are not so explicitly advertised.

Yet even when I can trace the origin of some household object back to a specific country, it seems as if from there the trail disappears. Sure, my globe was printed in Germany and made in China, but what of the ink that was used to print the map? Each different color is a precise mixture of minerals and dyes from who knows where. Perhaps the electricity that powered the factory came from fissioned uranium from a mine in Africa owned by an international corporation based in Canada. The ship that brought the printed maps to be plastered on the globes was perhaps constructed in Hong Kong by Filipino immigrants, and was designed in Japan. At every destination the trail towards an origin branches into a thousand new paths. It seems as if there is no single place or entity to which I can trace the birth of my globe. At least this is what I believed for a long time.

Each time I pondered my globe I held in my mind the idea that there must be some universal medium from which it was made. Atoms, sure, but that didn't really reveal anything new. It didn't just pop out of the air, and it didn't fall from the sky, so of course it was from the earth. Yet even this seemed a little abstract. It was from this planet, of course, but beyond that it was hard to specify. I knew there must be some more tangible location as to where it had come from. As it turned out, the answer was right beneath my feet.

For most people, the words *soil* and *dirt* conjure up images of gardening, agriculture, lawns, and little else. The belief that soil is interesting only for agricultural purposes was an ignorance that I too shared until one bleary-eyed April morning when a guest speaker from the Wasilla Soil and Water Conservation Association came to visit my high school ecology class.

The speaker was keenly aware of the inattentive nature of teenagers in the morning and seemed to be experienced in remedying this problem. Besides his well-meaning though feeble attempts at humor and the fact that he had free sandwich coupons for whoever participated in class, he used a teaching technique that is all too often overlooked in much of today's public education—he dared to us to question why we should even care at all about his spiel.

"...The difference between soil and dirt is that you don't soil your pants, you dirty them! Ho ho!" The class offered no hint that they were alive. "Anyways," he continued, "the point I want to make is that *soil* is just too great to be treated like dirt," he jested to an audience of blank stares. "But really, why should we care about soil at all?"

He let us ponder this for a moment or two. A few students shifted in their chairs.

"I have in my hand," he said, " a coupon for a free Subway sandwich for anyone who can name something, anything, an object, a product, that did not originally come from soil."

Many ideas were named, however, it was repeatedly revealed that every suggested item, barring seafood, did indeed have their origins in a substance so lowly and commonplace as the ground beneath our feet. One suggestion was the computer—an impeccably engineered morass of plastic and metals, seemingly too precise and complex to have anything to do with something as humble as soil. However, upon further discussion it was reasoned that that the plastics had been refined from crude petroleum (which is found deep below the soil), and all the internal circuitry had been processed from a wide variety of minerals (also found below and within the soil). To acquire these materials in an ecologically sound and economically reasonable manner would require a working knowledge of soil dynamics. What about glass? It was originally fired from sand, which is a type of soil. How about a car tire? Again, a tire had to have been spun either from rubber (found inside rubber *trees*, of course growing in soil) or from synthetic materials, from petroleum. The more we thought about it, the more it seemed that we could devise nothing that was not in some way originally taken from the earth. There was nothing too remote that we couldn't trace it back to its origins in the soil. It was then clear that cars and computers and candy originated not from factories or stores, but from mines and croplands.

Looking around me then, I envisioned in my mind my t-shirt unraveling its cotton fibers back out into diminutive cotton fluffs growing on short green stalks on an Alabama

plantation, the plant with its roots sunk firmly into the soft southern soil. I imagined the wood of my pencil not too long ago lodged somewhere within the heart of a towering pine somewhere in Manitoba, its massive weight supported by roots deep in the soil. I envisioned the apple in my backpack as hanging from an overloaded branch in an orchard in Washington state last fall. Soil was suddenly omnipresent, indispensable, a permanently ingrained characteristic of anything I touched and all that I saw. It was the ether from which the globe on my desk had emerged.

After class was dismissed, I snuck out the back door and skipped third period to go for a walk on the trails behind school. I needed some time to think.

—photo by David Nance, courtesy USDA Agriculture Research Service.

As it happened, soil was something that I already had cultured a great appreciation for. When I was younger I spent a great deal of time in the soil. On the ground was where everything was happening—aphids gnawed at blades of grass, a prismatic collage of bugs coated the undersides of decomposing birch leaves, and parades of ants assembled grand civilizations. Each grain of gravel had its own unique swirl of elements, and every fallen branch could be a pirate's sword or a rafter supporting the roof of a moss-chinked fort—but best of all the many diversions that the ground offered was dirt. Dirt was a veritable manna that could be prepared into pies, engineered into muddy quagmires for barefoot toe-squishing, and rubbed into one's hair and all over one's face—I loved it, and still do. As I grew older and learned about gardening, I realized that it was the ideal occupation. It allowed me to do something productive and fulfilling even while playing in the dirt. I remember warm, mosquito-hazed afternoons I spent with my mother and father down on my knees in the soft soil of my garden, helping to groom chickweed out from between rows of carrots, onions, zucchini, peas, and an assortment of other vegetables.

Throughout my life I have maintained that friendly relationship with the mud that clings to my shoes and the bugs that sneak through the cracks around the window frame. In the summer I feel as if I am not really at home if I don't have dirt permanently lodged under my fingernails. The extended process of starting the seedlings indoors in early April, to carefully planting them in June (not too early for fear of frost, not too late for the short growing season), to pulling endless heaps of weeds, to finally harvesting and washing the crop, is a labor that many people I know are wholly unfamiliar with and grateful for it. I, however, find satisfaction knowing that I can be mostly self-sufficient in providing for at least one very small part of my needs. It is a step in the direction I want to take.

I see my garden as a microcosm of the world. My garden is finite, it provides me with things I need to live, and its health and vitality are wholly dependent upon how I choose to manage it. Because of my own experiences with gardening, I am intimately familiar with the relationship between how I treat it and how well it will produce for me. If I fill every available inch of space of the garden with nutrient-leaching crops, I know that after a number of years the soil will be depleted of nutrients and will no longer yield a viable harvest. To solve this dilemma, I could choose to simply enrich the soil with fertilizer. However, fertilizer is expensive. Some fertilizer is good, but it alone cannot restore the original vitality of the soil. Or, I could choose to simply move on, to plow up new, healthy soil somewhere else. Yet I know that this would only be a temporary solution. If this process was repeated ad infinitum, it would take a while but eventually I would deplete all the soil on my property. Thus, I know that ultimately, it will be simpler, cheaper, and less work to manage the garden at a level of production that is not over-exploitative and is self-sustaining. This epiphany is one that bears a great deal of responsibility, for managing a garden this way requires the extra work of making compost, as well as seeking out ways to lessen one's impact when dealing with weeds and pests.

This is the garden of my imagination and of my dreams rather than the one in my backyard at the moment. I don't know if it is a realistic way to feed to world or not, only that it is one way of maintaining regional sustainability. It is but a small patch of earth that has taught me more about where food comes from than actually providing for the majority of my diet. It is this simple connection between place and sustenance that I value as much or even more than the currants, potatoes, or crab apples that I take from it.

Later on that day back at school, I saw someone crumple up and toss a totally blank piece of paper into the trash. At lunch, I observed my peers throwing away massive quantities of food that they had chosen not to eat. In the parking lot I witnessed the usual ceremony of tires spinning beneath loud and powerful engines of enormous vehicles. These were not work vehicles, they were status symbols. These were all annoyances that I observed on a daily basis, but somehow today after my realizations about soil they seemed especially irksome. Did they realize the consequences of their actions? Did they know that paper was made of trees, and that wasting paper would ultimately lead to more trees being cut that might have otherwise been left alone? Did they realize the enormous amount of wasted energy and effort that a half-eaten and thrown away roast beef sandwich represented? Did they consider that irresponsible use of fuel might lead to otherwise unnecessary development of petroleum resources? Did they realize that these resources they so wantonly and irresponsibly consumed are finite, that one day their supply may be extinguished? Perhaps one sheet of paper, one half-sandwich, and one ounce of gas are insignificant in the grand scheme of things, and perhaps I am being judgmental. Yet waste and overconsumption can

be seen as an undesirable thing from many aspects besides an environmental one. Someone, somewhere is paying for that blank sheet of paper and would probably be upset to see it being crumpled up and tossed. Some poor mother probably made that sandwich for their unappreciative son.

More important, I also began analyzing my own habits of consumption. How could I, owning a veritable mountain of outdoor paraphernalia such as skis, bikes, winter clothing, etc., I who also subsist largely on a diet of food grown in faraway places that may or may not have been produced in a responsible manner, who also creates the demand for more trees to be harvested to produce more paper upon which to write, how could I claim to be a more responsible consumer than they? Am I a hopeless hypocrite? Perhaps, but recognition of my needs puts me a step towards better managing them. Owning things is not intrinsically bad, but I contend that wasting them is.

I sincerely believe that most us do realize these ramifications, even if only on the vaguest level. However, they are not perceived as immediately pressing issues. Even if we do claim to place value on not overexploiting forests or prairies or petroleum reserves, there are so many degrees of separation between origin and purchase of goods that this recognition is often at best quite dim, thus the weight of our values usually does not tip the scales enough to actually influence our actions. The resources that we consume are shipped in from faraway places, thus how responsibly we use them will have little immediate effect on our own lives. Moreover, these habits can be perpetuated without repercussion, because it is likely that throughout our own lifetimes the corporations that provided for our demands will do their best to create the illusion of an infinite supply. Hopefully, it will not be until a much later generation that people have to worry about how their food will be grown with useless soils, what they will use to build their homes, or what they will use to power their vehicles when gas is unreasonably expensive. This is not Malthusian scaremongering, it is purely biology. My faith in human ingenuity is great and I know that challenges to meet increasing demands for resources can be overcome, but resources are finite nonetheless.

Thus, in regard to the question so often probed in environmental ethics, that of whether humans have any obligation toward nature, my response is that the very essence of this inquiry is fundamentally flawed. The question implies that humans are somehow a separate entity removed from nature, or perhaps divorced is a more appropriate term, or perhaps simply drifted away is better yet. The fact that this question has to be asked at all has much to say about how far we have diverged from what should be knowledge intrinsic to any human who lives and breathes—that we, just as any other animal, are inextricably dependent upon the integrity of world around us. The world that we live in today is more globalized and our footprints can reach to every corner of the earth, but it is the same world that we have always depended on. It should then follow that consumption of resources without first exploring future consequences is also detrimental to the survival of our own species. Today in Western culture, there is so wide a gap between producer and consumer that many of us no longer recognize this connection between objects and origins, the way that waste and irresponsible management of resources will ultimately incur higher expenses and more work in the long run.

I see this issue of overconsumption as a result of three principal causes: one is that the distance from producer to consumer in wealthy parts of the world has grown to such an extent that overconsumption is no longer recognized as ultimately damaging to the survival of our species. Two, that the concepts of *intergenerational equity* as well as *international equity* are given short shrift in public policy and personal philosophy. Today, a person's, corporation's, or nation's survival is generally valued more than the survival of our species as a whole. The idea that future generations (intergenerational), as well people whom we have never met on the other side of the globe (international), should all have access to adequate resources has far to go before being accepted as axiomatic. Our society is not built to accommodate such ideas. The third cause is that due to the incredibly adaptive and resourceful nature of our species, the factors that would otherwise limit our population size and distribution have been drastically curtailed. To quote James L. Gould on this issue:

> ...Once our species was a minor member of the biological cast on our planet. Two technical breakthroughs—domestication first of plants and then of animals—erased the major limiting factors that controlled our population size and distribution. The ability to manage crops and herds, and to store grain, allowed the development of cities and wealth and a self-perpetuating series of cultural and agricultural advances. [...] Our population size is continuing to increase exponentially, and the effort to feed and otherwise support these billions of individuals is leading inexorably to the rapid extinction of other species, and the destruction of forest, croplands, water supplies, and even the air we breathe. Further scientific advances can ameliorate these problems and slow the destruction of the biosphere, but ultimately only a dramatic decrease in the rate of human population growth offers any long-term hope for survival. *Whether that end comes from a demoralizing and debilitating series of wars, diseases, and famines, or from conscious and informed decisions will be the choice of the twenty-first century.* [Emphasis added].‡

My own interpretation of Neolithic agriculture's contribution to the rise of modern civilization varies from the traditional perspective that Gould elaborates. At least the concept of agriculture is simple enough that I imagine it was a widespread practice for many millennia before just ten thousand years ago, and the revolution that brought about the growth

—photo by Sarah Masco

of cities and civilizations was brought about more by specific changes in the way food was distributed, rather than how it was produced. But this is a subject for a different essay.

The informed decisions that Gould speaks of will be able to be made only when people are just that—well informed about their world. I contend that an effective angle from which this issue can be addressed is through our public education system. There are a multitude of ways in which our educational system could be tailored in order to accommodate this. Not simply by piling additional curriculum upon already overburdened teachers, but rather incorporating certain ideas into requirements already in place. A relevant, useful education cannot be wholly removed from the world that it studies, not taught only as abstract concepts and formulas. I offer as one small step toward this ideal that students should be better exposed to the places and processes that sustain them. Specifically, they should know where their food comes from, and what better way to discover this than having students grow it for themselves? A number of public and private schools already maintain gardens or greenhouses for which the students are partially responsible, and a small portion of their curriculum involves science, history, and other subjects that directly relate to their garden projects. The addition of a garden or greenhouse would be inexpensive compared to a new computer lab or gymnasium. It would be a valuable and affordable addition to any school.

Clearly, a successful curriculum will be designed to integrate many areas of study into individual projects, just as they are in real-world situations. Certain aspects of any issue can be understood from the compartmentalized studies of physics, biology, economics, aesthetics, etc., but in reality all of these things are happening at once. Students should be made aware of this reality.

An example of a project that incorporates many areas of expertise is where a student, or team of students, is asked to design their own factory, for example a paper factory. Using simplified information about the factory's geography, engineering requirements, economics, legal restrictions, and public relations, the students would be asked to design and plan a plausible and profitable factory. Following this, the students could do a lab exercise in which they make their own paper, and perhaps even write part of their final draft upon it. This is one of many possible examples of an integrated curriculum. Rather than attempting to blindly indoctrinate students that they have an "obligation" to the integrity of the natural world, schools could facilitate an education in which students may discover for themselves that they are in fact dependent upon it.

Any successful solution to today's dilemmas of resource management will have to occur on the same scale as the agricultural or industrial revolutions that produced them, and will be equally as complex and all-encompassing. The human species has been able to control its destiny thus far to a greater degree than anyone a few centuries ago could have ever imagined. The task before those who value the survival of our species today is to share our epiphany with those who have yet to discover their backyards. As Aldo Leopold wrote, our task is "to build roads of receptivity into the still unlovely human mind," up the narrow and overgrown path toward seeing how a healthy person can survive, ultimately, only on a healthy planet.

Ben Meyer, a biology major, believes he's found at UAF the exciting academic environment he was seeking in a college. He has been an exchange student in Argentina, a surveyor's assistant in Ketchikan, a veterinarian's aide in the Aleutian Islands, a lichen collector with the Institute of Arctic Biology, and a top-ten finisher in the Susitna 100 cross-country ski race. He is a fanatical skiier, biker, runner, reader, and gardener.

‡ The extended quote in the text of this article is taken from:

Gould, James L., and Keeton, William. *Biological Science.* New York, N.Y. WW Norton & Co Inc. 1996.

Ripple Effect

Christopher Held

The turtle had most likely been drawn from the muddy brown waters to bask in the sunshine and heat of the summer afternoon. While the depths had always proven a safe haven and suitable habitat, the banks of the pond, which rose up sharply and leveled off several feet above the water, provided a opportune area to simply sit in the sun and do whatever it is that turtles do on a hot summer day. This was a snapping turtle of the genus *Chelydra* and its size and appearance reflected more than a few years spent scrapping out an existence in this New Jersey woodland pond. Small though it was, the pool of water and the stream that slowly fed it were a magnet for a wide variety of life from birds and ducks, deer, and raccoons. Many were drawn to the old turtle's haunt including, on this particular day, two young boys. Regular visitors to the pond, the boys were drawn to the area by a sense of adventure and the desire to discover the secrets of the "woods." They spent their free time climbing trees, fishing the pond, and relishing their suburban wilderness. The turtle had probably observed the two many times from the safety of the algae-covered pool, but on this day, as the animal dozed in the sun and the boys stalked along the banks, the three would meet on common ground.

As I consider my personal environmental ethic I am reminded of this episode from my youth. In many ways the story of the snapping turtle represents the beginning of a personal process, an internal struggle to define for myself what my place in the natural world is. The evolution of thinking that has lead to the development of my personal environmental ethic traces its origin to early encounters with wildlife such as the turtle. What, if any, were my responsibilities to the wild animals and trees or plants I encountered on my wanderings? Prior to this I recall an "experimental" view of nature in which my desire to experience, for example, the chopping down of a tree, would overwhelm any notion of whether it was right or wrong to do so.

My early interest in hunting also reflected this experimental view. While my father and brother had no interest in the hunt, I pursued a program of self-education with focus and determination, honing my aim with thoughts of trophies and outwitting my "quarry," a mentality largely borrowed from the pages of magazines such as Field and Stream. My desire to contact the natural world that existed in the woods and fields of my hometown was innate. Hunting, I figured, would grant me entrance into the mysterious and intriguing world of the woods. This "hunting experiment" did prove a means to this end. Sitting still for hours cloaked in camouflage and strategically positioned near a well-worn game trail, I felt imbedded in the environment in a way I had not experienced during my carefree romps. I was afforded a more intimate view of the woodland community, and ultimately my planning and patience put me in position to take a shot at an unsuspecting deer. Taking aim, heart pounding in my ears and nerves charged with "buck fever," I knew that I had become a part of a drama I had previously only read about. I left the woods with no sense of conquest and without a "trophy" for the wall, but with more questions and internal dialogue regarding the dynamic that lead me into the woods with lethal intent. Ultimately, the question I posed to myself was, "What was the true reason for my trips to the woods?" I knew that the desire to collect a trophy was no longer a valid reason and that the only rationale I could conceive for taking an animal was hunger. Not the deluded hunger for recognition pervasive in the trophy-hunting mentality, but actual real physical hunger. Personal accountability and self-reflection began to affect my thinking and would prove to be critical components in the formulation of my personal environmental ethic.

Eastern snapping turtle, Chelydra serpentina.
—PHOTO © 2002 TRAVIS J. RYAN

The idea of personal accountability as a self-monitoring mechanism for backcountry conduct was formally introduced to me during a month-long mountaineering trip in the North Cascade Mountains. The National Outdoor Leadership School had developed a program based on the principles or ethics espoused by its founder, Paul Petzoldt. Petzoldt, an avid climber and backcountry explorer throughout his life, created a curriculum based upon rules of conduct collectively known as minimum impact camping. According to Petzoldt, the wilderness traveler should make every effort to "leave no trace," thereby preserving the natural condition of the backcountry. These ideas struck a chord in my psyche. Here was an ethical standard that reflected personal accountability not only to the animals but also to the land itself. The environment: rocks, trees, streams, animals including people, were factored together in an ethical approach that strove to reduce the negative impacts of human visitation in the backcountry. Spending a month in the mountains without such common conveniences as toilet paper and bar soap would strike some as extremist (as well as questionable hygiene). Far from extreme, the National Outdoor Leadership School was an experience that affirmed

many thoughts I had been having since my early years in the woods of New Jersey. Personal accountability and respect for the environment were essential if I was to come to terms with my relationship with the "natural world." While I had always been aware of my "love" of the outdoors and of nature, I was unaware of *how to love* these places I visited. I wanted my actions and decisions to reflect the reverence I felt for wild places, and learning how to travel lightly in the mountains bolstered my sense that my relationship with the land was improving. It seemed logical to apply these standards when visiting lands set aside as preserves of one kind or another, but what of all the other environments I interacted with? The dramatic stage of the North Cascade Mountains seemed like the Sistine Chapel compared to the degraded and compromised backyards and woodlots where I earned my living. What, I wondered, was my obligation to these fragmented environments where human impact was the dominant theme?

Working for many years as a professional arborist (tree climber), provided an ongoing forum for exploring a key aspect of my environmental ethic. I was, in a very real sense, acting as a liaison between landowners and their trees. Many of the people I dealt with were seeking advice on how to deal with their trees and their land as a whole. They generally knew very little about what they had come to own, and yet somehow by owning it, they felt a need to manipulate the land, possibly to gain a sense of involvement and control. Conversations that began with "how much to cut these trees?" often evolved into dialogue concerning land stewardship and ethics. These would, on occasion, deteriorate into arguments that could not be resolved and the job would be abandoned with the simple explanation that "this is not the kind of work we do." Quite often, however, the conversations would open up new avenues for the landowners to consider when contemplating their investment. A very common example of this is the now-outdated practice of topping trees for safety. Prior to scientific study, many people considered tall trees near their homes to be "unsafe" and would pay a "tree topper" to remove up to half of the main trunk, reducing the size of the tree and making it "safe." We now know that this thinking is for the most part flawed; instead of creating a safer situation topping actually introduces decay into the trunk, which reduces the tree's health and stability. Despite this information being available for years, many people still request topping as a way of managing their trees. My years of involvement in this field provided a dynamic and at times challenging setting that played a major part in reinforcing the idea of accountability while proving that the ethical standards I tried to uphold in the backcountry were, in a fundamental way, the same as those I applied to my job as an arborist.

The ripple effect that began years ago on the small pond in New Jersey continues to reverberate outwards in expanding circles. My encounter with the turtle is connected to many experiences, including my participation in this class, that have contributed to the evolution of my personal environmental ethic. What then is my personal environmental ethic?

Chris Held mountaineering in the backcountry.
—PHOTO BY ROB SACKERSON

More than anything else it is a work in progress. It is founded on a belief that personal accountability is one of the most powerful guides I know of for resolving conflicts or questions regarding my interaction with nature and the environment. Critical to my process of ethical thought has been a fairly diverse educational background that has served to broaden my thinking and provide many real-life examples of the human-land relationship. I have seen many examples of humans living separate from nature and a few of people striving to live as members of what Aldo Leopold describes as the "biotic community." Admittedly, my most recent thinking of environmental ethics can be traced directly to the words of Leopold. The power and accuracy of lines such as, "Examine each question in terms of what is ethically and aesthetically right, as well as what is economically expedient," is difficult to overlook. If ethics and the assigning of moral value are indeed connected to our own evolution as a species, then in my thinking we are best off heading in the direction so eloquently described in Leopold's "Land Ethic."

The ripple began years ago, when my friend and I made a decision that would result in the old snapping turtle's demise. The turtle's death was a result of fear and ignorance and a sense that in removing it from the pond, we were somehow creating a better, safer place. As we stood on the bank and watched the old creature slip slowly towards the bottom of the pond, I felt an almost overwhelming sense that we had been wrong.

Chris Held is a senior in Geography, Environmental Studies. Born and raised in New Jersey, he lives in Fairbanks with his dogs and training partners, Jim and Maggie.

Resources:

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National Outdoor Leadership School website: www.nols.edu. Information on Paul Kiesow Petzoldt, the school's founder, can be found here.

Exotic Plants in Alaska's Parks

story and photos by Chris McKee

Above: Exotic dandelion (Taraxacum officinale officinale)*, growing at the Trail Creek trailhead, mile 29 Nabesna Road, Wrangell-St. Elias National Park and Preserve in 2004. Below: Native Alaska dandelion* (Taraxacum ceratophorum) *in the same park.*

SNRAS alumnus Chris McKee received his master of science degree in natural resource management in 2004 at UAF. McKee's thesis was "Distribution and Ecology of Exotic Plants in Wrangell-St. Elias National Park and Preserve, Alaska." He conducted surveys on Alaska Park Service lands throughout the state, identifying about fifty non-native species. His thesis advisor was professor Patricia Holloway.

The summer of 2004 marked the fifth year of surveys for exotic (non-native) plants on National Park Service (NPS) lands in Alaska. These surveys provide baseline data on exotics in the parks, and help in formulating a long-term monitoring and control plan for exotic plants in Alaska's NPS units. These species are a concern to resource managers because they threaten the genetic integrity of native flora through hybridization, can monopolize limited resources for resident plant species, and can change the structure and function of ecosystems through alterations of geochemical and geophysical processes. Invasive exotic plants cause billions of dollars' worth of economic loss in the lower forty-eight states every year. By 1996, exotic plant species had infested an estimated seven million acres of NPS lands nationally, with 4,600 acres of new infestations occurring daily.

Alaska parks are the only parks in the nation that are still relatively unaffected by exotic plant invasions. Infestations can have profound implications for other aspects of the ecosystems they invade. Some exotic plant species are capable of altering processes such as nutrient cycling and fire frequency and intensity. These effects can be at the small scale (local infestations of a given exotic species altering the nutrient content of the soil, as with sweetclover and nitrogen), and at the large scale (such as cheat grass and its alteration of fire patterns).

Alaska NPS lands have been relatively free from the establishment of many of the more pernicious exotic plants species found in the lower 48 states. Several factors have contributed to this apparent immunity. The most important is climate. Circumboreal flora are adapted to a range of climatic conditions that many exotic plants cannot tolerate. In addition, park lands in Alaska have remained relatively free of man-made disturbances such as livestock grazing, wildfire suppression, and altered hydrological regimes that encourage the introduction of exotic species, and they still have all of the major floral and faunal ecosystem components. Despite these protective factors, the threat of exotic plant invasion is increasing due to global climate change and increases in disturbance related construction. Fortunately, the NPS has an opportunity to get a head start on exotic plant control in Alaska before it becomes a severe problem, but research and active management must begin now.

The summer of 2004 marked the first year that extensive surveys for exotic plants were conducted using highly accurate Trimble Geo XT GPS units. These units can achieve sub-meter accuracy and can be downloaded with data dictionaries to map infested areas with spatial detail sufficient for year-to-year monitoring of spread. Within the framework of a nationwide database for exotic plants on NPS lands, a data dictionary was customized for Alaska with multiple fields used to describe the composition, size, and severity of exotic plant infestations in a given area (Table 1). A digital photo of each site and species was made in addition to a qualitative description of the area. When exotic species were found in low numbers, they were removed by hand after recording location and other data.

The surveys were opportunistic in nature, being carried out in areas of human use within park lands, including park hiking and ATV trails, roadsides, developed areas such as hotels and other tourist related infrastructure, and administrative and employee housing facilities. More remote areas such as backcountry use cabins and primitive airstrips were also visited in some parks. ArcGIS software was used to generate shapefiles that included all records from the GPS unit, from which a map of surveyed areas was generated. Seven parks were surveyed in 2004: Denali National Park and Preserve (DENA), Glacier Bay National Park and Preserve (GLBA), Kenai Fjords National Park (KEFJ) Klondike Gold Rush National Historical Park (KLGO), Sitka National

Table 1. Selective fields used in GPS data dictionary and GIS analysis for surveys of exotic plant species within Alaska national parks, summer 2004.

Field Abbreviation	Field Description
Location ID	Location ID
Dstrbncs	Disturbance Type (trampling or mowing)
LctnDscrpt	Location Description (park = inside park boundary)
Taxon	Dominant exotic species
Phenology	Phenology of dominant exotic species (no flower or full flower)
CvrClssPer	Cover class percentage of dominant exotic species (1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100)
CntrlEffrt	Control effort (low, medium, high)
Action	Inventory or Treatment
Undetermined	Stem count of dominant exotic species
Remarks	Remarks
AssocPark	Associated park (four letter park code)
Recorder	Recorder Initials
Taxon2, Taxon3…	Additional 8 fields for 8 other exotic taxa for each unique site
Treatment	Treatment (only PULL/DIG-MANUAL this year)

Maltese cross (Lychnis chalcedonica)*, a new exotic species for Alaska, growing in Gustavus.*

Table 2. Exotic species list for Alaska national parks, 2004.

Species	Park Unit						
	DENA	GLBA	KEFJ	KLGO	STHP	WEAR	WRST
Achillea millefolium	*			*			*
Allium schoenoprasum							*
Brassica rapa	*						
Bromus inermis	*						*
Capsella bursa-pastoris	*			*			*
Cerastium fontanum		*					
Chenopodium album	*			*			*
Crepis tectorum	*			*			*
Descurania sophia	*						*
Digitalis purpurea					*		
Elymus repens							*
Erysimum cheiranthoides				*			
Eschsholzia californica							*
Euphrasia nemorosa				*			
Galeopsis tetrahit				*			
Lappula squarrosa	*						*
Lepidium densiflorum	*						*
Leucanthemum vulgare	*	*	*	*	*		*
Linaria vulgaris	*		*	*			*
Lolium perenne		*					*
Lupinus polyphyllus	*	*					
Matricaria discoidea	*	*	*	*	*		*
Melilotus alba	*						*
Melilotus officinalis	*						*
Phalaris arundinacea		*					
Phleum pratense	*	*					*
Plantago major	*	*	*	*	*		*
Poa pratensis				*			
Polygonum aviculare	*			*			*
Polygonum convolvulus	*						
Polygonum cuspidatum					*		
Ranunculus acris				*			
Ranunculus repens					*		
Rumex acetosella				*			
Rumex crispus				*			
Senecio vulgaris				*			
Silene cucubalus				*			
Silene noctiflora	*						
Sonchus arvensis	*						
Sorbus aucuparia					*		
Spergula arvensis	*						
Stellaria media	*			*			
Taraxacum officinale	*	*	*	*	*		*
Thlaspi arvense				*			*
Trifolium hybridum	*						*
Trifolium pratense	*	*					*
Trifolium repens	*	*	*	*	*		*
Triticum aestivum		*					
Vicia cracca	*						
Viola tricolor				*			

Historical Park (STHP), Western Arctic National Parklands (WEAR), and Wrangell-St. Elias National Park and Preserve (WRST).

A total of fifty exotic plant species were found in seven different park units during the summer of 2004 (Table 2). Parks with the highest levels of human use also had the greatest number of exotic plant species. The largest numbers of exotic plant species were identified in Denali, Klondike Gold Rush, and Wrangell-St. Elias parks. Of the species identified during the summer of 2004, nineteen were new records for Alaska park units. All species found were limited to the immediate area of disturbance and no species have been found to be moving into undisturbed native plant communities. The more remote parks of Bering Land Bridge National Preserve and Cape Krusenstern National Monument had no exotic species. Visitation to these parks is limited and expensive, and is usually confined to the winter months. The most common exotic plant species found included oxe-eye daisy *(Leucanthemum vulgare)*, pineapple weed *(Matricaria discoidea)*, common plantain *(Plantago major)*, common dandelion *(Taraxacum officinale officinale)*, and white clover *(Trifolium repens)*.

Most of the exotic species found in the Alaska national parks are not invasive to natural ecosystems, and are innocuous in terms of their ecological impacts. However, a few species should be of concern to park managers, particularly white sweetclover *(Melilotus alba)*, bird vetch *(Vicia cracca)* and Japanese knotweed *(Polygonum cuspidatum)*.

White sweetclover is a nitrogen-fixing plant capable of spreading rapidly and developing large infestations. Each plant can produce up to 350,000 seeds that can remain viable in the soil for over eighty years. Large areas of the Stikine River in southeast Alaska, as well as several areas along the Nenana and Matanuska Rivers in the interior region of the state have already been infested by this species. Dispersal of sweetclover seeds along river corridors could provide a vector for the invasion of more remote areas of Alaska's national parks.

Bird vetch is a climbing plant with coiling tendrils at the end of each leaf, and the plants can overgrow herbaceous vegetation and climb over shrubs. This species has a symbiotic relationship with *Rhizobium* bacteria that fixes atmospheric nitrogen. Each plant produces copious amounts of seed that can remain viable for many years.

Japanese knotweed is adapted to southeast Alaska and is capable of forming large monocul-

tural stands, reducing biodiversity and degrading habitat for resident wildlife. The species is also capable of clogging waterways and preventing germination of native plant seed through formation of deep, slowly decomposing organic layers.

Though Alaska parks have yet to witness large infestations of exotic plant species in intact ecosystems, they are by no means immune to invasion. Increases in disturbance related to construction and infrastructure maintenance are creating an environment conducive to the establishment and spread of these species. Ongoing global climate change may result in the northward expansion of some of the more pernicious exotic species from the Lower 48 into northern regions. Once established in large numbers, these species require large investments of time and money in order to control or eradicate their populations. Site and species-specific control efforts should be a priority of park resource management staff. The mantra of the Alaska Exotic Plant Management Team is "early detection and rapid response." Indeed, aggressive control and eradication efforts are needed sooner rather than later before infestations become financially and ecologically untenable.

Chris McKee is a biologist with the National Park Service.

White sweetclover (Melilotus alba) *growing off of a park road, Denali National Park and Preserve. This species is one of particular concern to park managers.*

Common plantain (Plantago major)*, a common exotic plant, growing in Denali National Park and Preserve.*

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Creativity and Independent Thought

Resources management seniors tackle rewarding thesis projects

Doreen Fitzgerald

The assertion that the quality of the question determines the value of the answer was one of the most interesting I encountered as an undergraduate. During their senior year, undergraduates majoring in Natural Resource Management (NRM) at UAF spend two semesters working to define a good research question, develop appropriate methods, carry out the research, and present their findings orally and in writing. They are enrolled in NRM 405 and 406, Senior Thesis in Natural Resources Management, a course required for all NRM majors, an optional one for students with minors in NRM. Their work covers a wide range of topics, reflecting the three areas in which the students concentrate their coursework: forest sciences, or resources management, or plant, animal, and soil sciences.

"The process itself is as important to students as the end product," said professor Patricia Holloway, the thesis course coordinator. "This is the first time many students work on an independent research project. They learn how to work with a committee, three professionals in their field. This is an opportunity that's seldom available to undergraduates. Although this is a lot of work for the faculty, they get to see the students develop in remarkable ways."

Musk ox. Musk oxen produce extremely long, soft, and valuable fiber known as qiviut. Jennifer Miller, a natural resources management student at SNRAS, is working on a thesis project researching qiviut quality.

To complete the course, students draw on the collective knowledge they have acquired through past coursework, internships, and work experience to formulate a natural resources management research question. During the research and thesis presentations, they demonstrate their competency in problem solving, analysis, and written and oral communication.

"The thesis program was a great opportunity to pursue a line of natural resource related research I was interested in," said 2004 graduate Michael Gibson. "I was able to come up with my own idea and find the university professors and professional staff that would help me turn my idea into a finished research project. No doubt it was a challenge. I had to draw upon what I learned in my classes as well as the skills I had gained outside the classroom." Gibson is now a recreation technician for the Bridger-Teton National Forest in Afton, Wyoming. His work is presented on page 25.

A review of qualifications listed in natural resource management job advertisements quickly reveals that effective communication is one the most important skills a student should master. Regardless of the area of specialization, the ability to write and speak clearly in one's field of expertise is essential.

"As well as determining what to do and how to do it, senior thesis students gain experience writing in the natural resources field and experience in presenting their findings," said Holloway. She noted that students often use their theses later, when applying for jobs, as an example of their written communication skills.

The project's three major components are identifying and defining a research question; attempting to answer the question by conducting an experiment, gathering survey data, analyzing existing literature; discussing or defending conclusions and supporting them with existing literature; and sharing findings with others. Creativity and independent thought are important to the value of the projects, which go far beyond the research paper concept of reporting what others have done. A thesis project is judged both on content and the student's ability to effectively communicate with peers and faculty during presentations and in writing.

"The experience adequately prepared me for the professional-level projects I'm required to complete as a U.S. Forest Service employee," said Gibson. "It was by far the most useful and rewarding class I participated in."

In the fall, students first attend an introductory workshop conducted by the course coordinator. They must formulate an acceptable thesis topic, find a thesis advisor, and assemble a thesis committee. After the first two weeks of class, the coordinator meets with students as needed to answer questions and solve any problems that have arisen. Along with conducting workshops, she also schedules presentations and facilitates functions of the advisory committee. When necessary, the coordinator may help a student find a thesis advisor.

Before any research is conducted, a draft thesis proposal and a final proposal is presented and approved. "The most amazing thing to watch is how in the beginning, many students are at a loss," Holloway said, "and their proposal presentations are often rough. But by the time they finish and make their final presentations, the students are polished and professional."

The thesis advisor is a SNRAS faculty member who is selected based on how their expertise coincides with the student's research interests. During the two semesters, the advisor is the student's major contact, providing guidance in defining the topic, designing the project, preparing drafts and final products. They work with students to ensure that the selected project is feasible given time and economic constraints.

Three faculty serve on the thesis committee: the advisor and two others who have an interest or expertise in the student's chosen topic. The committee approves the topic and grades all written and oral projects during the two semesters. When approved by the course coordinator and advisor, one committee member can be other than a SNRAS faculty member (faculty from another department, agency personnel, or a private researcher), although this member cannot chair the committee. Technicians and graduate students from SNRAS, other university departments, agencies, and public organizations may be included as additional, nongrading members, but cannot replace a faculty member. UAF graduate students and technicians may participate and often lend support on a voluntary basis. Students meet with their committee and advisor within the first three weeks of each semester so that all committee members can have input at one time into the topic area and can help with methods.

"Students who really involve themselves in their thesis projects can gain a lot from the experience," said Peter Fix, a faculty member who specializes in outdoor recreation management. "Probably more so than with conventional courses, the outcome depends on what the students expect of themselves and the work they're willing to do." Fix was Michael Gibson's thesis advisor.

"I think the most important thing a student gets from the course is the opportunity to make a specific project their own, of taking ownership of it and responsibility for it," said professor Milan Shipka (animal science). "They have to work independently and be professional; it's an introduction to what many of them will be required to do in the workplace."

Milan's thesis advisee, Jennifer L. Miller, this year developed a proposal that led to funding by the UAF Office of Sponsored Programs. Funding for the award was donated by Williams Alaska Petroleum (now Flint Hill Resources). Miller is researching differences in qiviut quality between wild and domestic muskoxen and, in domestic muskoxen, the variation in quiviut samples from shoulder, side, and rump samples. She has already collected the wool. The funding supports the collecting work and purchase of the quiviut and supplies. Samples will be analyzed by the Texas Wool and Mohair Laboratory. Miller will complete her thesis before her expected graduation next spring.

To develop a research question, students are advised to use their classroom discussions and work experience to identify a topic, then talk with other students, their academic advisor, and other faculty members about their idea. The faculty advisor helps the student refine the idea, and makes sure it is feasible to complete the project within the two-semester time frame.

The thesis project may or may not involve an experiment or laboratory research. Also, it may or may not represent original research. However, the topic should have a level of complexity that distinguishes the senior thesis from a term paper. The topic should be one that provides for independent thought and critical analysis. For example, a paper reviewing the published methods of germinating white spruce seeds is a good term paper, but it is not acceptable as a senior thesis. A paper based upon an experiment comparing several methods of germinating white spruce seeds at different temperatures could be a good thesis.

A comprehensive review of the literature on a particular topic is appropriate if it contains an analysis or critical review of the literature. For instance, an outline of the literature relating to land use practices in the Tanana Valley would not be sufficient for a senior thesis. However, a critical comparison of land use practices on public and private lands could be appropriate, as long as the topic can be formulated as a hypothesis or question.

All of the students prepare an annotated bibliography with a minimum of fifteen references, eight being primary sources. At least two of the sources are historical, and at least two written within the past three years. Each citation is followed by a short paragraph, outline, or notes describing how the article will be important to the student's research.

After the middle of the second semester, the student presents the thesis to the faculty and other students, giving a 25-minute formal presentation that includes a short summary of your objectives, methods, results, and conclusions. Presentation must include visual aids and are followed by a short question and answer period. The presentation is a formal university seminar, with an audience that may consist of all faculty, the student's peers, guest lecturers and scientists, agency personnel, and other members of the university community.

Holloway said the idea of a thesis project for NRM majors was first presented to the faculty by Tom Gallagher who at the time was a professor of regional and land use planning at UAF. The program began in 1993.

Selected Abstracts

Electrical Stimulation of Reindeer Carcasses during field slaughter and the Effect on Meat Tenderness

by George Aguiar. Submitted May 2005 in partial fulfillment of the requirements of the B.S. degree in natural resources management (plant, animal, soil science option).

Abstract: Field-slaughtered reindeer out on the Seward Peninsula, Alaska, must be frozen immediately in the field after dressing in order to meet State of Alaska regulations. This abrupt freezing may inhibit subsequent muscle tissue processes that influence meat quality. Low voltage electrical stimulation (E.S.) has been used in the beef industry to avoid undesirable meat characteristics due to flash freezing. Twenty-six reindeer

steers were field slaughtered during February and allowed to abruptly freeze. Thirteen animals were stimulated prior to field dressing. Front shoulder meat from E.S. carcasses was statistically more tender (54% to 46%, p<.05, n=203) than control carcasses using a paired comparison consumer evaluation test. Electrical stimulation prior to abrupt freezing in the field improves tenderness of fore shoulder reindeer meat.

The author acknowledges his senior thesis committee: professors Greg Finstad, chair, Christy Long, and Norman Harris.

Public Involvement in Situk River Land-Use Proposals, Yakutat, Alaska

by Nathaniel Endicott. Submitted November 2003 in partial fulfillment of the requirements for the B.S. degree in natural resources management (plant, animal, soil science option).

Abstract: The Hubbard Glacier is currently in position to block the entrance of Russell Fiord, just outside the small fishing community of Yakutat, Alaska. The potential destruction of trail system and river access provided the foundation for case study of public involvement in land use decision-making. The purpose of this study was to describe local Situk River users and their opinions concerning access and management options. This study consisted of a mail survey of the Yakutat community, along with personal interviews. The response rate for the survey was 30%, with 64 responses from the sample population of 212. Differences were found between the user groups of commercial fishers and sport fishers, in areas such as trail access and management quality. This data, along with trends found in content analysis, led to management suggestions such as: public participation education programs, increasing boat launch access quality, and changing public participation practices.

The author acknowledges his senior thesis committee: professors Peter Fix, chair, John Fox, and Stephen Sparrow.

Opportunities for a Small Portable Sawmill in Eastern Washington

by Cody Burgess. Submitted May 2005 in partial fulfillment of the requirements for the B.S. degree in natural resources management (forestry option).

Abstract: Technology has made portable sawmills efficient for cutting logs of various sizes and producing lumber of all dimensions. Portable sawmills can be used to custom cut lumber, taper saw for increased lumber recovery, and to minimize labor costs. A case study was done using a Log-Master Model 5 portable sawmill in eastern Washington. The sawmill is owned and operated by Burgess Logging Inc, which is attempting to expand their business. Eastern Washington forests contain highly valuable species of timber, including ponderosa pine, Douglas fir, western red cedar, and others. From June through August 2004, 6230 board feet of lumber were produced. Orders, stock material, and chunks were sawed, which created a lumber recovery overrun of 511 board feet. The results show that the Log-Master is efficient sawing logs between 8 inches and 24 inches in diameter. Log scaling and lumber grading rules and techniques were also studied in order to become more familiar with the sawmilling business.

The author acknowledges her senior thesis committee: professors Edmond C. Packee, chair, John Fox, Jr., and Scott Rupp.

Slash Decomposition Following Thinning

by Christopher Swisher. Submitted May 2005 in partial fulfillment of the requirements for the B.S. degree in natural resources management (plant, animal, soil science option).

Abstract: Boreal forest management prescriptions commonly require thinning with pruning of overstocked spruce stands. A major concern with the prescription is the remaining slash. Objectives were to determine the amount of slash remaining after two different thinning regimes and to sample the fuel load on a treated site to see if an increased fire hazard still exists 22 years later. Slash removal from treated sites is expensive and currently seen as necessary to reduce fire hazards in treated areas. Nine plots were measured for fuel loading and compared to a control plot and a treated plot with the slash removed. The thinned plots contained 5 to 27 more tons per acre of coarse woody debris than the control plot and 12 to 34 more tons per acre than the cleared plot. The thinned area still poses an increased fire hazard after 22 years. This project demonstrates the need for slash treatment.

The author acknowledges his senior thesis committee: professors Edmond C. Packee, chair, John D. Fox, T. Scott Rupp.

Possible Hybrids Between White Spruce (*picea glauca* (Moench) Voss) and Black Spruce (*Picea mariana* (Mill.) B.S.P.) in the Tanana Valley, Alaska

by Heide Lingenfelder. Presented May 2004 in partial fulfillment of the requirements for the B.S. degree in natural resources management (plant, animal, soil science option).

Abstract: Many *Picea* species in North America hybridize. Reports of hybridization between black spruce, P. mariana, and white spruce, P. glauca are rare and disputed. The isolating mechanism preventing hybridization between these species is flowing time. White spruce has been shown at lower latitudes to flower earlier than black spruce. Trees showing intermediate characteristics between these species have been observed in the Tanana Valley in Alaska. The Tanana Valley is located in the interior of Alaska, and has climate constraints that might cause flowering times to coincide. Genetic analysis using PCR (polymerase chain reaction) was performed on six trees growing throughout the Tanana Valley. PCR was performed using both mitochondrial and chloroplast DNA. Mitochondrial DNA has been shown to be maternally inherited in spruce, and chloroplast DNA has been shown to be paternally inherited. Three of six trees displayed both white and black spruce chloroplast DNA. The results of this study are inconclusive. The preliminary results of this study warrant further investigation.

The author acknowledges her senior thesis committee: professors Jenifer McBeath, chair, Edmond C. Packee, and John Alden (retired).

Avalanche knowledge, experience, and behaviors among winter backcountry users in Turnagain Pass, Alaska

Michael Gibson

Submitted May 2004 in partial fulfillment of the requirements for the B.S. degree in natural resource management (resources option). The author acknowledges his senior thesis committee: professors Peter Fix, chair, Joshua Greenberg, and David Valentine.

Editor's note: In this abridged version of Michael Gibson's thesis, several sections and illustrations are omitted, along with the related citations. Omitted text is indicated by an ellipsis or an editor's note.

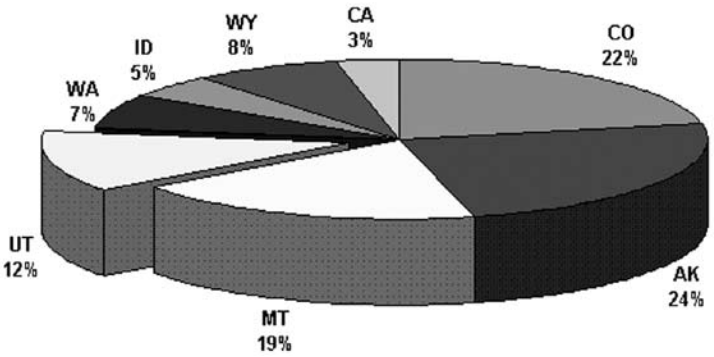
Since 1950, 693 people in the United States have died from avalanche-related incidents (Colorado Avalanche Information Center)…. Nearly half of these deaths have occurred since 1990 [and] this disquieting trend is occurring simultaneously with an observable rise in participation of winter recreation throughout the United States…. There is strong evidence to support the notion that nationwide, participation and participation intensity in winter recreational activities will continue to rise (Bowker 1999). State-level outdoor recreation participation estimates for Alaska suggest that the number of residents participating in backcountry skiing and off-road vehicle use, including snow machining, will increase by 35 percent and 29 percent respectively by the year 2020 (SCORP 1997). This is particularly important in Alaska, where in recent years a large percentage of avalanche fatalities have occurred….

As demand continues to grow, it will become progressively more difficult for land managers to provide safe winter recreational opportunities while concurrently meeting the need for increased user capacity. This is especially true on national forests lands which are "established and shall be administered for outdoor recreation" under the Multiple Use Sustained Yield Act of 1960 (Coggins et al. 1993)….

Land managers faced with meeting increased demand along with rising avalanche fatality rates could benefit from information concerning winter backcountry users. It has been suggested that the more land managers know about factors influencing a decision to perform or not to perform a given behavior, the better their ability to develop effective messages to influence these decisions (Fishbein and Manfredo 1992). Specifically, information linking avalanche knowledge, experience, and behaviors in the backcountry would be extremely useful in developing effective education campaigns that consider what messages to utilize and how to disseminate those messages.

Such information would also be useful to avalanche professionals and educators. Avalanche educators have long recognized that education has the potential to reduce the relative risks taken by winter backcountry users. Fredston et al. (1994) suggest that good avalanche training and experience are fundamental to making good decisions. To assess these risks, past research related to avalanche awareness, experience, and behaviors has relied on [after the fact] avalanche accident reports, media reports, and interviews collected and compiled by the Colorado Avalanche Information Center (Atkins 2000, McCammon 2001, 2002)….

U.S. Avalanch fatalities by state 1996-2002. (N=143)



This…study complements past research by investigating the relationships between levels of avalanche knowledge, experience, and behaviors of winter backcountry users [prior to an incident]….to: 1) obtain some generalizable information about backcountry users; 2) examine the relationships between avalanche knowledge, experience, and behavior of motorized and non-motorized users; and 3) to determine if avalanche knowledge and experience interact to affect behavior.

Methods

Sampling and Data Collection: Use of human subjects in this study was approved by the University of Alaska Fairbanks Institutional Review Board (IRB Protocol No. 03-69). My target population for this study was winter backcountry users visiting Turnagain Pass in the Glacier Ranger District of the Chugach National Forest in Alaska during winter 2004. Sampling occurred between December 31, 2003 and February 1, 2004. I stratified my population of interest into two user groups, motorized and non-motorized winter backcountry users. For sampling purposes, this was easily accomplished as the Forest Service restricts motorized use to west of the Seward Highway in Turnagain Pass. I randomly sampled backcountry users at three roadside pullouts: Turnagain-West (motorized), Sunburst, and Tincan….

[Editor's Note: the Questionnaire Design, Knowledge Measurement, and Data Analysis sections of this thesis are omitted here.]

Results

Questionnaire Response: Of the 101 individuals approached with a questionnaire, 40 motorized and 53 non-motorized users completed the questionnaire. A total of 93 people completed the questionnaire for an overall response rate of 92 percent. Only 1 non-motorized user and 7 motorized users refused to take the survey….

Knowledge Among User Groups: The mean knowledge score for the 93 backcountry users who responded to the 10 knowledge items was 5.3 out of a possible 10 (SD=2.29), indicating an intermediate level of knowledge about avalanches when all user groups were pooled. Avalanche knowledge significantly differed among user groups…. Non-motorized users had a greater mean knowledge-of-avalanche score than motorized users. That is, non-motorized users scored significantly higher on the knowledge-of-avalanche quiz than motorized users.

Table 1. Mean knowledge of avalanches for motorized and non-motorized users.

Category	n	X	SD	t	p
Motorized	40	3.83	1.62	-6.44	0.01
Non-motorized	53	6.4	2.1	-6.44	0.01

n = number in sample; X = mean knowledge score; SD = standard deviation; t = t score; p = probability of attaining a value of t as great or greater than the value that was obtained

Relationship Between Avalanche Knowledge/Experience and Behavior: Avalanche knowledge was significantly correlated with behavior…. Respondents with higher levels of avalanche knowledge were more likely to have higher mean behavior scores. Results of the regression analysis show that 36.8 percent of the variance in mean behavior scores is dependent on knowledge (R2=0.368).

Experience was also significantly correlated with behavior in this study…. Respondents with higher levels of experience generally had higher mean behavior scores. Approximately 20 percent of the variance in mean behavior scores can be attributed to experience (R2=0.195).

Interaction Effect of Avalanche Knowledge and Experience on Behavior: Using univariate analysis of variance, the interaction of avalanche knowledge and experience did not significantly affect behavior in this study (F=1.76, p=0.145). Results did show however, that knowledge and experience interact to affect behavior (Figure 3). Respondents with high levels of avalanche knowledge and experience had the highest mean behavior scores. The lowest mean behavior scores were observed in users with the low levels of avalanche knowledge and experience.

Using linear regression analysis the interaction of avalanche knowledge and experience on mean behavior scores was significant in this study (F=35.34, p=0.01). Results show that 44 percent of the variance in mean behavior scores is related to the interaction of knowledge and experience (R2=0.44).

Discussion

…. My results confirm the observation that the two greatest risk groups are novices who do not recognize that a hazard exists and experienced travelers whose skill levels lead them to take greater risks (Fredston et al. 1994). In this study, high, intermediate, and low experience groups with low knowledge all had similar low mean behavior scores. This implies that experienced people with low levels of avalanche knowledge are just as likely to make unsafe decisions as low experience people with little knowledge. This identifies the high-experience, low-knowledge group as particularly dangerous. This is because less experienced group members regularly disregard their own judgments and rely on a more experienced partner without recognizing that most peoples' traveling skills far exceed their avalanche hazard evaluation skills (Fredston et al. 1994). In any case, it is not ideal to make decisions about how to travel through avalanche terrain predicated upon experience or knowledge alone.

Conclusions

My results demonstrate that avalanche knowledge has a greater influence upon behavior as experience level increases. The interaction of knowledge and experience accounts for a larger percentage of the observed variance in mean behavior scores than looking at these variables independently. Looking at the interaction effect of knowledge and experience on behavior provides much more insight than looking at experience or knowledge independently. For example, just focusing on knowledge, one may falsely conclude that knowledge is the only factor posited to positively influence behavior. This does not explain why more than once a person has attended an avalanche workshop and been caught and killed in an avalanche not long after. This is not meant to belittle the importance of education, but rather to illustrate that knowledge and experience interact at some basic level to influence the decision-making process. Knowledge and experience only partially substitute for one another. Therefore, the safest users are those with both avalanche knowledge and practical experience. Indeed, the results of this study clearly show that significantly reducing the persistence of unsafe behaviors among winter backcountry users will take a combination of both.

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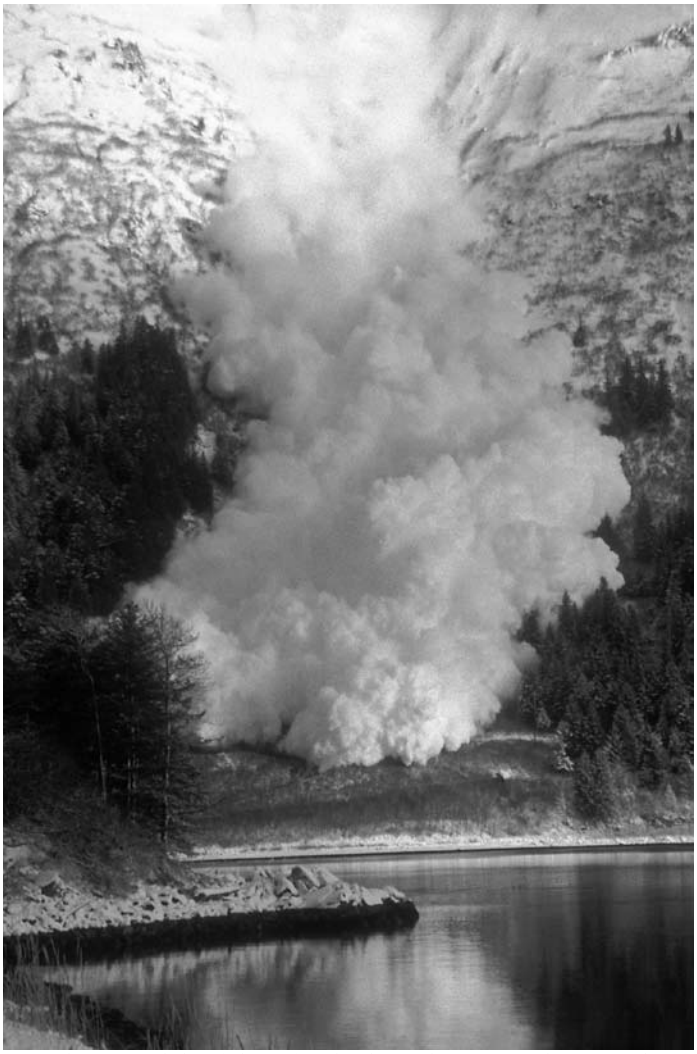


A medium-sized dry slab avalanche descending upon Thane Road in Juneau on the Snowslide Creek avalanche path.
—PHOTO © BILL GLUDE, SOUTHEAST ALASKA AVALANCHE CENTER

Avalanche Questionnaire

Michael Gibson's avalanche questionnaire used for his thesis contained the following questions. (Answers are on page 28)

1. Human-triggered avalanches are most likely to occur at which of the following slope angles?

A) 25-34 degrees B) 35-45 degrees

C) 46-55 degrees

2. Weak layers within the snowpack generally persist longer at which aspect?

A) North-facing aspect B) South-facing aspect

C) East-facing aspect D) West-facing aspect

3. Avalanches can happen on any snow-covered slope?

A) True B) False

4. Which of the following weak layers is responsible for most human triggered avalanches?

A) Facets B) Buried surface hoar

C) Depth hoar D) Ice Crust

5. Which of the following terrain variables are most important when determining whether or not it is possible for a given slope to avalanche? (CHOOSE THREE)

A) Elevation B) Aspect C) Slope angle

D) Path history E) Vegetation

F) Terrain roughness (anchoring) G) Slope Shape

6. Most natural avalanches occur when?

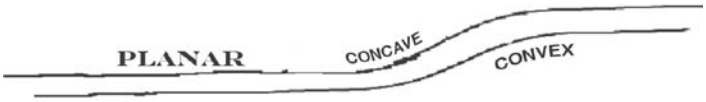
A) During or immediately after storms

B) During periods of warming

C) During periods of cooling

D) During periods of high winds

7. Which of the following slope shapes is responsible for more avalanches? (Circle one)



8. A heavy amount of new snow in a short period results in which of the following?

A) Erosion of the bonds between snow grains

B) Loose snow avalanches

C) Increased stress on the snowpack

D) Deposition of a slab over a weak layer

9. Rainfall is more likely to produce an avalanche when it encounters which of the following types of snow?

A) Wet snow B) Dry snow

C) Old melt-freeze snow

10. Shooting cracks, "whoomphing" noises, and propagating fractures are associated with which of the following types of avalanches?

A) Ice avalanches B) Loose snow avalanches

C) Cornice collapses D) Slab avalanches

11. Which of the following best describes your ability level in the winter backcountry recreational activity you participate in the most?

A) Expert B) Expert/Intermediate

C) Intermediate D) Intermediate/Novice

E) Novice

12. How long have you been winter recreating in the backcountry?

A) Less than 1 year B) 1-3 years

C) 4-6 years D) 7 years or more

13. On average, how many days do you spend winter recreating in the backcountry per year?

A) 1-7 days B) 8-14 days

C) 15-21 days D) 22 or more days

14. What types of avalanche education have you participated in? (Check all that apply)

Avalanche experience table

Types of avalanche education	Put an "x" in the appropriate squares
Watched a video/program or read literature about avalanches	
Attended an avalanche safety lecture	
Level I (field intensive) avalanche training or equivalent	
Level II (field intensive) avalanche training or equivalent	
Other (please indicate what)	

15. On average, how many times a year do you practice using an avalanche beacon?

A) Never B) Once a year C) 2-3 times a year

D) More than 3 times a year

16. Did you take an instrument to measure slope angles with you today? (If Yes, indicate the type of instrument)

A) Yes _____

B) No

17. Which of the following items did you carry on your person while traveling in the backcountry today? (Circle all that apply)

A) Avalanche beacon B) Shovel C) Probe

18. Did you make sure that each member of your party was equipped with a beacon, shovel, and probe today?

A) Yes B) No

19. Did you conduct any snow stability tests today? (If Yes, indicate which types)

A) Yes, _____

B) No

20. What is the weather forecast for today?

Temp (write in) _____

Precipitation (circle one)

rain snow none

Wind Direction (circle one)

N NE E SE S SW

W NW Variable

21. Where do you obtain information on snow and weather conditions? (Circle all that apply)

A) TV weather B) Internet C) Radio

D) Avalanche information center/hotline

E) Other (please indicate) _____

22. You would like to descend a 24° west-facing slope. Approaching the slope you hear "whoomphing" noises and observe shooting cracks. The weather is clear and cool. You observe that moderate winds from the east have transported snow onto west-facing slopes. Which of the following would you choose to do?

A) Travel the slope B) Avoid it and find another way

23. You would like to travel on a 35° south-facing slope. It is early spring and the snowpack has just begun a wet, melt-freeze cycle. The sky is clear with prevailing light winds from the southeast. You are sinking in the snow up to your calves. You notice several sets of new tracks on the slope. Which of the following would you choose to do?

A) Travel the slope B) Avoid it and find another way

24. The weather is sunny after two days of storms, and you head to "The Super Bowl" to enjoy the powder on your favorite 35° line. The shovel shear tests you conducted on a representative slope yielded easy shears. Approaching the bowl you watch a group of three people descend a 29° slope to the right of the line you intend to descend. Which of the following would you choose to do?

A) Travel the slope B) Avoid it and find another way

End

Answers to the knowledge questions:

1-(B), 2-(A), 3-(B), 4-(B), 5-(B, C, G), 6-(A), 7-(convex), 8-(C), 9-(B), 10-(D), 22-(A), 23-(B), 24-(B).

Can lettuce growers profitably use smaller containers for seedlings?

Cody Edwin Peterson

Excerpted and condensed from "Lettuce Seedling Growth in Flats with Different Cell Size and Shape," a senior thesis presented to the faculty of the School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, and the senior thesis committee (professors Meriam Karlsson, chair, Stephen Sparrow, and Mingzhu Zhang) in partial fulfillment of the requirements for the first degree of Bachelor of Science in natural resources management (the plant, animal, and soil science option) by Cody Edwin Peterson, Fairbanks, Alaska, May 3, 2004.

Introduction

A common practice in vegetable production is the use of containerized transplants. This propagation technique provides producers with many benefits such as earlier yields, improved field establishment, and use of a controlled environment to optimize growing conditions for seedling production (Dyremple and Paul, 1988; Ivanhoff et al., 1960; Nettles, 1963; Norton, 1968). To increase efficiency, producers often use transplant flats with a small cell volume. A smaller rooting volume reduces inputs such as growing media, required handling, and increases transplants per greenhouse space, which subsequently reduces cost to the grower (Weston and Zandstra, 1986). Zimet and Vavrina (1995) suggest doubling the number of muskmelon transplants in a Florida greenhouse reduces pre-plant cost by 30 to 40 percent of estimated fixed and variable cost. Dufault and Waters (1985) stated the cost of cabbage transplants produced in a 3.8 mL container is $.019 compared to $.075 for a 23.2 mL container. Cabbage seedlings in 33.7 mL container volumes cost twice as much as seedlings in 7.5 mL container volumes (Csizinszky and Schuster, 1993).

While smaller containers may improve efficiency of transplant production, a small rooting volume can induce root restriction (NeSmith and Duval, 1998). Plants undergo many physiological and morphological changes in response to reduced root volume, which can affect transplant performance, and subsequently yield. Root and shoot growth, biomass accumulation and partitioning, photosynthesis, leaf chlorophyll content, plant water relations, nutrient uptake, respiration, flowering, and yield are all affected by root restriction and container size (NeSmith and Duval, 1998; Marr and Jirak, 1990; Weston and Zandstra, 1986). In tomato transplants, height, leaf area, flowering, and stem diameter increased with a larger rooting volume (Weston and Zandstra, 1986; Marr and Jirak, 1990; Kemble et al., 1994). Smaller container volumes reduced growth, stem length, and leaf diameter of marigold seedlings (Latimer, 1991). Similar results were observed from broccoli and cauliflower (Dufault and Waters, 1985), peppers (Weston, 1988), and cabbage (Marsh and Paul, 1988).

In many crops, transplant rooting volume affects yield. Pepper (Weston 1988), sweet corn (Waters et al., 1990), and tomato (Kemble et al., 1994; Weston and Zandstra, 1986; Marr and Jirak, 1990) yields were earlier with increased container size. Using a larger container resulted in higher yield for cabbage (Marsh and Paul, 1988) and tomatoes (Kemble et al., 1994; Weston and Zandstra, 1986).

The response to seedling root volume, especially in terms of harvestable yield, also depends on cultivar, environmental and field conditions, and location. Yields differed in response to container size for watermelon cultivars 'Charleston Gray' and 'Crimson Sweet' (Hall, 1989; Vavrina et al., 1993). Days to first harvest, central, cull, and lateral yields of 'Southern Comet' broccoli were not affected by container size in St. Paul, Minnesota (Dufault and Waters, 1985). While at the Becker Sand Plains Research Farm, Minnesota, 'Southern Comet' in 3.8 mL containers matured a week later than 30.5 mL and 23.2 mL containers (Dufault and Waters, 1985). Contradictory evidence and variable results among species and cultivars suggest a need for further experimentation to determine the response to rooting volume (NeSmith and Duval, 1998).

My objective was to determine the effect of container size and shape on the growth and development of lettuce (*Lactuca sativa* L.) seedlings. Results of this study will assist in selecting a transplant container size and shape that could potentially enhance quality of lettuce transplants. Characteristics of higher quality lettuce transplants include increased dry mass, high root to shoot ratio, reduced height, lower specific leaf area, leaf length to leaf width ratio, and hypocotyl length (Kitaya et al., 1998). These results could allow growers to produce quality transplants that will improve field performance and increase yields.

Methods

The lettuce cultivar 'Alpha' is commonly grown by commercial producers in the Matanuska Valley (Leiner, 2003) and was therefore selected for this study. The seeds were planted in plug flats filled with a commercially available peatlite medium (Premier ProMix BX, Premier Brands, Red Hill, Pennsylvania). The experiment was initiated at the planting of seeds. The lettuce was grown in a controlled greenhouse environment. The temperature during the course of the experiments was maintained at 20 ± 2°C using aspirated thermometer sensors and a Wadsworth step control system (Arvada, Colorado). The seedlings were watered throughout the study with a fertilizer solution of 100 ppm nitrogen using Peters' 15-16-17 peatlite special fertilizer (Scotts Co., Marysville,

Table 1. Effect of container cell size and shape on growth of 'Alpha' lettuce seedlings. Data recorded 35 days from seeding.

Container cell size and shape	Hypocotyl length (mm)	Leaf number	Total height (mm)	Root weight (g)	Shoot weight (g)	Total weight (g)	Root:shoot ratio
Square							
10 mL	10.8[X]	9	141.6	0.032	0.180	0.211	0.173
50 mL	7.8	11	172.0	0.110	0.584	0.694	0.198
Round							
9.5 mL	8.8	8	151.7	0.032	0.193	0.225	0.165
48 mL	8.1	11	166.0	0.084	0.472	0.556	0.182
Significant effects[Y]							
Volume							
10 mL vs. 50 mL	*	*	*	*	*	*	NS
9.5 mL vs. 48 mL	NS	*	*	*	*	*	NS
Shape							
10 mL vs. 9.5 mL	*	*	*	NS	NS	NS	NS
48 mL vs. 50 mL	NS	NS	*	*	*	*	NS

[X] Each mean is the average of 120 plants
[Y] Mean separation by Bonferroni test, significant at P £ 0.05 (*), or nonsignificant (NS), respectively

Ohio). Sixteen hours of high-pressure sodium (HPS) light was provided to all treatments with light intensity at 130–150 mmol×m-2s-1.

The effect of container size and shape on the development of lettuce seedlings was studied using four treatments. The plug trays with individual cells of square or round shape in two sizes were selected. The volumes of the square cells were 10 mL or 50 mL while the volumes for the round plug trays were 9.5 mL or 48 mL. Lettuce seedlings were grown in treatments for a period of four weeks. The experiment had three replications. Each replication was separated by one week. Treatments were randomly placed in the greenhouse.

At the end of four weeks, I collected data from lettuce in the four treatments. The outer rows of the flats were disregarded to eliminate a source of variance in my results. Height was measured from the surface of the growing medium to the top of the leaf canopy and hypocotyl length was from the media surface to the node of the lowest leaf. The roots of transplants were washed free of growing media and separated into root and shoot tissue. Dry weights were recorded following three days at 65–70° C and the ratio between root and shoot dry weights was determined. Visual evaluations of transplant quality were made before and after the growing media was washed off the roots. Data were analyzed by analysis of variance (ANOVA) using the computer software SPSS (SPSS Inc, Chicago, Illinois). Following ANOVA, means were compared using bonferroni method (SPSS Inc, Chicago, Illinois).

Results

Lettuce transplants from large container volumes, 50 mL and 48 mL, had more leaves, increased height, and larger root, shoot, and total weights compared to the smaller container volumes, 10 mL and 9.5 mL (Table 1). Hypocotyl length was significantly shorter from large square containers compared to small square containers. However hypocotyl length in large round containers was not significantly shorter than small containers. Effect of container cell shape was less evident than container cell size. Fifty mL square cells increased height, root, shoot, and total weight compared to 48 mL round cells. Ten mL square cells increased hypocotyl length and decreased height from 151.7 to 141.6 cm and leaf number by 1 compared to 9.5 mL round cells. Root to shoot ratio was not significantly affected by container cell size and shape.

Aspects of transplant quality not represented in data analysis were visually evaluated (figures 1 and 2, on page 32). Leaf area appeared to increase in the 48 mL and 50 mL cell sizes compared to 9.5 mL and 10 mL container cells. The volume of roots was larger in the large container cells compared to the smaller container cells. Hypocotyl diameter was observed to be larger in 48 mL and 50 mL cells compared to 9.5 mL and 10 mL cells. Majority of the root growth in all treatments was observed at the outer edge of the root mass next to the container wall.

Discussion

Kitaya et al. (1998) defined higher quality lettuce plug transplants as having higher dry mass, higher root to shoot ratio, decreased height, lower specific leaf area, leaf length to leaf width ratio, and hypocotyl length. The results of my study conclude 'Alpha' lettuce transplants in large containers (48 & 50 mL) were of higher quality than small containers (9.5 & 10 mL).

Although transplants grown in smaller containers were shorter compared to larger containers, this was a result of root volume restriction, which had an overall negative effect on transplant quality. Impacts of root restriction may be alleviated by cultural practices, producing a higher quality transplant. Csizinszky and Schuster (1993) indicated that increased fertilization rates reduced effects of root restriction of cabbage transplants grown in small containers. Horticultural practices applied to transplants in larger containers may also increase quality by reducing height. In addition, if seedlings were capable of being transplanted prior to five weeks, total height would possibly also be reduced.

Dry weights, height, and leaf number of lettuce transplants increased in larger containers as did previous studies of lettuce (Nicola and Cantliffe, 1996), broccoli and cauliflower (Dufault and Waters, 1985), muskmelon (Maynard et al., 1996), and cabbage (Csizinszky and Schuster, 1993; Marsh and Paul, 1988).

Container cell size and shape did not have a significant effect on root to shoot ratio (Table 1), however a trend indicated that larger containers had a higher root to shoot ratio. Previous research indicates differences in root to shoot ratio response to rooting volume. Root to shoot ratio of watermelon (Liu and Latimer, 1995) and muskmelon (Maynard et al., 1996) were not responsive to rooting volume. However root to shoot ratio of tomatoes (Peterson et al., 1991; Nishizawa and Saito, 1998) and salvia (Van Iersel, 1997) increased with increasing root volume.

Visual evaluations here suggested greater root growth at the medium-cell interface. These observations are consistent with earlier studies on tomato (Liptay and Edwards, 1994). A higher leaf area was observed from 48 mL and 50 mL cell size. Leaf area of lettuce (Nicola and Cantliffe, 1996), broccoli and cauliflower (Dufault and Waters, 1985), muskmelon (Maynard et al., 1996), salvia (Van Iersel, 1997), and cabbage (Csizinszky and Schuster, 1993; Marsh and Paul, 1988) increased with increasing rooting volume. A thicker hypocotyl was observed from 48 mL and 50 mL container cells. Larger stem size was reported for cabbage seedlings with increasing cell size (Marsh and Paul, 1988).

Effect of cell shape on transplant quality was less evident. Significant differences were obtained between round and square containers however differences did not produce a definitive trend. Significant differences were obtained between small, square and round cells for hypocotyl length, leaf number, and total height but differences were not significant for dry weight. Differences between large, square and round cells were significant for total height and dry weights but not significant for hypocotyl length and leaf number.

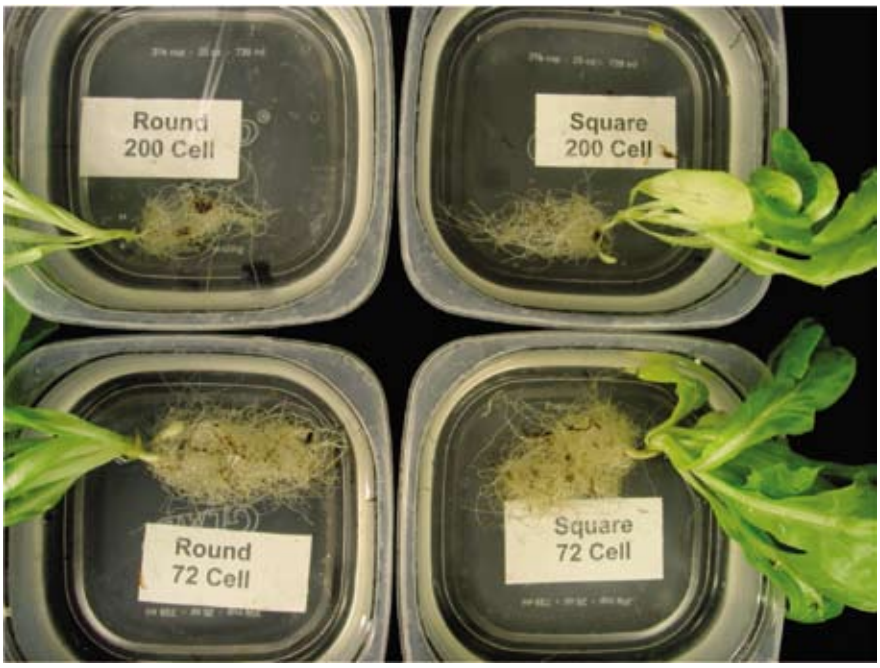
However, growers prefer square containers for lettuce transplant production. Roots in round containers tend to grow in a circular direction. Following transplanting, Roots continue growing in this direction instead of out into the soil. Growers state that this can prevent adequate anchorage and reduces field performance.

The results of this experiment indicate container cell volume of 48 mL and 50 mL would enhance field establishment of lettuce transplants compared to 9.5 mL and 10 mL containers. Due to poor contact with field soil, smaller root systems are more subject to dessication when transplanted (Dufault and Waters, 1985) compared to transplants with larger root systems, which generally suffer less from transplant shock (Weston and Zandstra, 1986). Stress to transplants caused by root restriction (NeSmith and Duval, 1998) can reduce seedling vigor, which can decrease establishment in field. Lettuce seedlings subjected to less root restriction during transplant production could potentially increase field establishment, uniformity, and higher and earlier yields. Larger container cell volumes increased hypocotyl thickness and decreased hypocotyl height, which could provide more structural support during transplanting. However compatibility of container cell size with transplanting methods is essential.

Although transplants from larger containers were of higher quality, studies evaluating transplant growth, field performance, compatibility, and cost are needed to fully analyze container size and shape on lettuce production pertinent to Alaska. Additional transplant studies to include a wider ranger of container size, shapes, and depths would be beneficial to evaluate how transplant quality is effected by root restriction and container type. Increasing data collected on transplants to quantify visual evaluations and other aspects of transplant quality would provide a more complete evaluation of container type in respect to transplant quality. Data collection throughout the course of the study could provide continuous relationships of transplant growth and quality. With this information a clearer understanding could be established to determine when root restriction occurred in each container, and the impacts on transplant growth and quality.

Although container size and shape affected transplant growth, field studies are essential to evaluate post-transplanting performance of seedlings. Past research has indicated post-transplanting performance and subsequent yields vary in response to rooting volume. Post transplant performance of vegetable seedlings are dependent upon location (Dufault and Waters, 1985; Maynard et al., 1996), cultivar (Hall, 1989; Graham et al., 2000; Dufault and Waters, 1985; Vavrina, 1995; Liu and Latimer, 1995; Maynard et al., 1996), field conditions (Nicola and Cantliffe, 1996), and environmental conditions (Nicola and Cantliffe, 1996; Graham et al., 2000; Marsh and Paul, 1988). In addition, container type during

Figure 1. Container cell size and shape on root volume and hypocotyl thickness X



transplant growth may alter lettuce head size and shape, which would ultimately affect consumer acceptance.

In some cases, larger containers are reported to provide benefits such as increased total and early yields. This benefit may be especially critical to lettuce production in Alaska due to a short production season. Dufault and Waters (1985) stressed the importance of an early market and the high demand and price achieved for early produce. However, larger containers must be compatible with current production methods for growers to profit from potential benefits. Further comparisons of yield potential and cost of establishment need to be considered in selecting transplant container cell size and shape (Maynard et al., 1996; Dufault and Waters; 1985; Hall, 1989; NeSmith and Duval, 1998).

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Figure 2. Container cell size and shape on leaf area x 200 Cell = small containers, 72 cell = large containers

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Above: Lettuce seedlings ready for transplant in AFES variety trials in the Matanuska Valley. Below: Close-up of lettuce seedlings in greenhouse flats.
— PHOTOS BY ROSEANNE LEINER

Revitalizing U.S. Support for Developing Nations' Agriculture

With roots in European reconstruction after World War Two, the federal agency USAID was formally created by executive order in 1961 when President John F. Kennedy signed into law the Foreign Assistance Act. In 1975, the enactment of Title Twelve of that act, "Famine Prevention and Freedom from Hunger," created the advisory Board for International Food and Agricultural Development (BIFAD). The legislation aimed to promote activities by land-grant universities and other institutions that can increase world food production through the application of agricultural sciences.

In 2002, after an eight-year period of inactivity, the board was essentially reconstituted when seven new members were appointed by President Bush, including SNRAS dean Carol Lewis. The main role of BIFAD is to advise the USAID Administrator for International Development on agricultural development priorities and issues and to monitor activities undertaken under Title XII. The board maintains close ties with the university community, and at least four of its seven members are mandated to come from this sector. Members are people who have established credibility with the U.S. departments of agriculture, commerce, and state. Although they usually serve for three years, the 2002 appointees, all being new, were extended through 2006.

"Within the U.S. foreign policy framework, the primary mission of the USAID is to implement effective development programs that improve the lives for people in cooperating countries," said Lewis in a recent interview. "Agriculture dominates the economies of most developing countries, affecting rural income and influencing such areas as child survival, the environment, and natural resources. During the 1990s, USAID focus on agriculture declined and funding for agricultural activities, including training, dropped significantly." The number of USAID-funded students in agriculture and rural development declined from 310 in 1990 to 82 in 2000.

"It was the opinion of the newly constituted BIFAD that this should change, and that we should revisit the way in which educational programs are delivered and research results transferred," Lewis said.

The recent focus of BIFAD has been to renew graduate student long-term training to generate more advanced degree holders in agriculture and agribusiness, and to reinvigorate a capacity-building program that will strengthen ability of developing countries' own institutions to train students and carry out research. Revitalizing U.S. participation in global advanced education for agriculture faces several challenges, including the high cost of U.S. graduate education and its relevance to agricultural realities in developing countries.

A new approach and review process had begun in Africa, in the partner nations of Uganda, Mali, and Mozambique. "In Africa one in three people are undernourished and AIDS has decimated universities and agencies engaged in agriculture," Lewis said. "Short-term training in the U.S., training in the home country, and partnerships with key African universities will now be emphasized, which differs substantially from the previous focus on training African students at U.S. PhD programs in agriculture. Use of biotechnology to target critical crops will be emphasized, with demonstrations and research in-country, and there will be an emphasis on the biofortification of traditional foods to improve nutrition."

A 2003 BIFAD report* notes: "Without access to appropriate human resources and advanced training in global issues—issues such as trade, biotechnology, agriculture, education, infectious diseases, information technology, energy, and environment—developing countries will remain on the development periphery, and the various 'divides,' whether economic, digital, technical or health, will be exacerbated."

Serving with Lewis on the BIFAD are board chair M. Peter McPherson, Michigan State University president, and members Anthony Laos, President and CEO, Stauffer Seeds; William DeLauder, president emeritus of Delaware State University; Stewart Iverson, Jr., farmer and Iowa State Senate Majority Leader; Sharon Quisenberry, dean, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, Blacksburg; and Mike Deegan, president and CEO of ACDI/VOCA, Washington, D.C.

USAID is an independent federal agency that receives overall foreign policy guidance from the Secretary of State. Its dual purposes are furthering U.S. foreign policy interests in expanding democracy and free markets while fostering improvements in the areas of economic growth, agriculture, trade, health, democracy, conflict prevention, and humanitarian assistance. With field offices throughout the world, it works in partnership with private voluntary organizations, indigenous organizations, universities, American businesses, international agencies, other governments, and other U.S. government agencies. USAID has working relationships with more than 3,500 American companies and over 300 U.S.-based private voluntary organizations.

The BIFAD federal officer at the U.S. Agency for International Development is John B. Swanson. The board receives technical, administrative, and financial support through the Office of Agriculture and Food Security in the person of the Title XII federal officer and other office staff. BIFAD normally meets at least three times a year, and meetings are open to the public.

*"Renewing USAID Investment In Global Long-Term Training and Capacity Building in Agriculture and Rural Development," BIFAD report, Washington, D.C., June 2003.

— Doreen Fitzgerald

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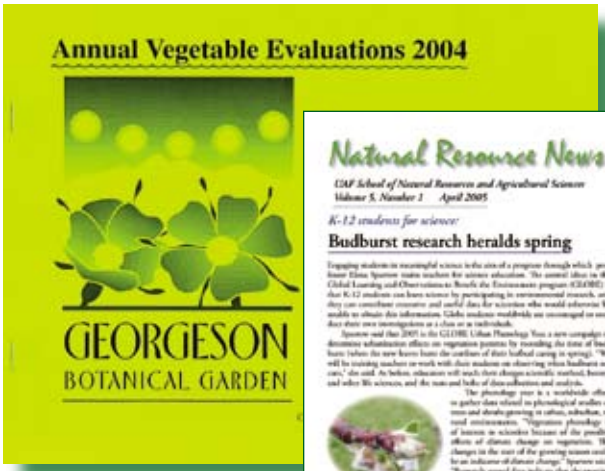

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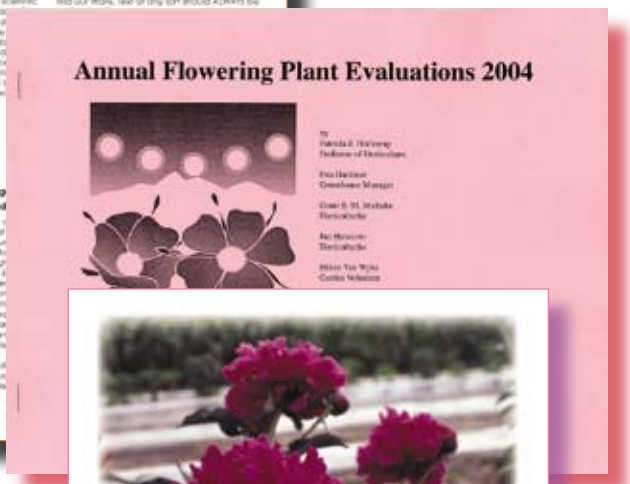
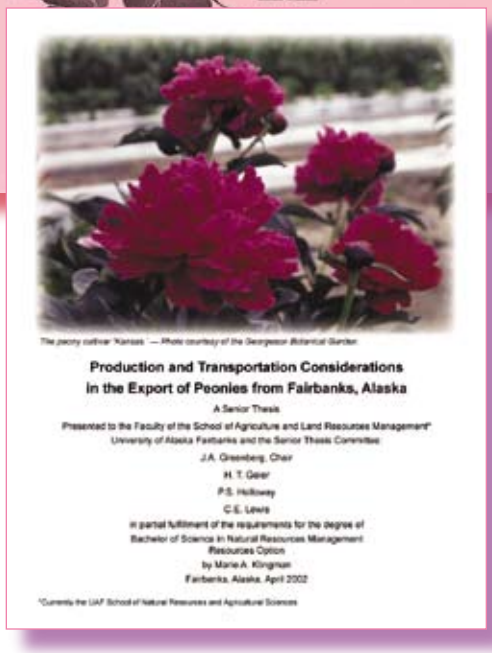


Circular 128: Annual Flowering Plant Evaluations 2004



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Alaska Exotic Plant Management Team after an effort to eradicate ox-eye daisy (Leucanthemum vulgare) *from the Kennecott Historical Mine area in Wrangell-St. Elias National Park and Preserve. From left to right: Jeff Heys, Donna Weagel, John Watson, Katja Mocnik. See story on exotic plants in Alaska on page 18.*
—photo by Jeff Heys, Exotic Plant Management Team Liaison, National Park Service