

agroborealis

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breeding
barley

barley
crackers

managing
reindeer

muskoxen

forests &
our future

fire
research

green
mapping

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

University of Alaska Fairbanks

GREEN MAP
ICONS DEVELOPED
FOR USE WITH
THE GREEN MAP
SYSTEM. TOP TO
BOTTOM, THE
ICONS REPRESENT:
WIND ENERGY
SITE, WETLANDS,
AND PARKLANDS/
RECREATION AREA.



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—PHOTO COURTESY MIKE DENEGA,
WWW.ULONICE.ORG



Two barley grains.

—PHOTO BY NRCS PLANT DATABASE

About the cover:

Barley growing in fields at the Fairbanks Experiment Farm. See story on page 29.

—PHOTO BY BOB VAN VELDHUIZEN



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UAF UNIVERSITY OF ALASKA
FAIRBANKS



DEAN CAROL E. LEWIS

letter from
the dean and the
associate director:

This issue provides insight into actions we're taking at SNRAS/AFES to help Alaskans sustain their northern resources and strengthen

the critical connection between natural and human environments. For our faculty, identifying a problem is a call to action.

In a special topics course called Fairbanks Sustainability Inventory, Susan Todd, associate professor of regional and land use planning, involved students in creating a Green Map of the Fairbanks community that illuminates the connections between natural and human environments and can be used for planning.

While forest sciences coursework prepares undergraduates for forestry careers or graduate study, our forest research produces knowledge of boreal forests that we communicate to those who depend on, use, and manage our forests. As our climate changes it is vital to understand the linkages between climate, fire, and vegetation. Another pressing need is to assist communities and agencies in their fire mitigation efforts by providing as much science-based information as possible. Scott Rupp, associate professor of forestry, is working on these problems, and on a cooperative program to provide the best possible information to public agencies and individuals.

Cooperative relationships and partnerships are critical to problem solving. Livestock and small grains have historically underpinned Alaska agriculture, and today our animal research has turned toward appropriate livestock for Alaska. To better understand these livestock and help producers manage them, we're working with cooperators in the Institute of Arctic Biology to study muskoxen husbandry, genetics, and reproduction; our partners in the Kawerak Reindeer Herders Association are working with us to find more effective ways to protect their livestock from loss to caribou herds and to improve animal productivity.

Wooding barley is the latest in a long line of barleys developed for circumpolar areas by the USDA Agricultural Research Service and SNRAS/AFES researchers. Because barley can be more than just animal feed, AFES agronomist Bob Van Veldhuizen asked the UAF Cooperative Extension Service Food Product Development Program to help determine if daughter strains of Thual barley had similar characteristics to their parent when used in a food product. Using thual and its daughters, Kristy Long, professor and specialist with the CES program, developed barley crackers for consumer testing.

These stories illustrate very well how SNRAS/AFES researchers use their extensive abilities to create basic knowledge about northern natural resources and bring this knowledge to Alaska's people. Their dedication to both science and problem solving are crucial for achieving natural resources management for sustainable use.

Sincerely,

Carol E. Lewis
Dean and Director

G. Allen Mitchell
Associate Director



ASSOCIATE DIRECTOR G. ALLEN MITCHELL

Green Map Fairbanks

Deirdre Helfferich

4

“Don’t just STUDY problems—help SOLVE them!” read the publicity fliers for a fall special topics course called Fairbanks Sustainability Inventory. How can students actively solve the problems of Alaska’s second-largest city? Susan Todd, associate professor of regional and land use planning with the School of Natural Resources and Agricultural Sciences, decided to introduce them to one approach.

Before a problem can be solved, it must be identified. So too must possible assets and solutions. Enter the Green Mapping System, an international project that originated with the Green Apple Map, a map of New York city created in 1992 by Wendy Brawer and Modern World Design. Brawer developed, from this original mapping project, a systematic, collaborative approach to mapmaking that would be useful to both residents and visitors in communities around the world.

In 1995 the original concept expanded to a full-scale mapping system and went international in 1997, becoming, as the Green Map website describes it, “a global organization surrounded by a constellation of locally-led Green Map projects.” Participants in the project mentored each other and collaboratively developed icons, methodology, and tools. Modern World Design took the Green Mapping System to nonprofit status in 2000; Brawer continues to direct this organization. In 2006, it was recording up to about sixty new projects each year. As of this writing, the Green Map System includes approximately 372 projects, with 273 maps published. There are maps in almost fifty countries, and seventy-five online maps.

System organizers describe it this way:

The Green Map System (GMS) is a locally adaptable, globally shared framework for environmental mapmaking. It invites design teams of all ages and backgrounds to illuminate the connections between natural and human environments by mapping their local urban or rural community. Using GMS’s shared visual language—a collaboratively designed set of icons representing the different kinds of green sites and cultural resources—Mapmakers are independently producing unique, regionally flavored images that fulfill local needs, yet are globally connected.

The resulting Green Maps identify, promote and link eco[logical] and cultural resources. Merging the ancient art of map making with new media tools, each of these maps creates a fresh perspective that helps residents discover and get involved in their community’s



environment, and helps guide tourists (even virtual ones) to special places and successful green initiatives they can replicate back home.

Specifically, a Green Map is a sustainability inventory in map form of the environmental and social assets and liabilities of a community. Environmental assets might include community gardens, bike trails, wildlife viewing areas, renewable energy power generators (such as a business using solar panels on its roof), or public transportation networks. Environmental liabilities might include Superfund cleanup sites or other contaminated areas, a strip mine, or a polluting power generator such as a coal plant. Social assets might include libraries, museums, concert or drama associations, neighborhood or community associations, parks, hospitals, and universities. Social liabilities might include run-down neighborhoods or poorly maintained roads, or an area recognized as a danger zone (such as a high-crime area).

The process of creating a Green Map starts with a local group registering the project with the Green Map System. The designated contact to the GMS is known as the official Green Mapmaker for the project. The group is expected to provide copies of the finished map, and pay an annual fee (anywhere from \$30 to \$100, depending on the size and nature of the group) and a royalty, one to three percent, “based on grants and donations received to fund your project, plus funds raised from map sales, advertising etc.” These funds are put back into the GMS. Integral to the mapping are the icons used; the global icons are available in a font for ease in designing a map. The group is sent a CD with resources and tools (available for both PC and Mac users), including the icon font. Once the map is created, that team is the owner of the map.

Professor Todd initiated the Fairbanks Green Map project (#350) in June 2006. On the website for the Fairbanks

committee working on this map (Todd's students in fall 2006) is a description of the aims of their mapmaking effort:

Our Fairbanks Green Map will depict locations of sustainable interest, nonprofit organizations, government programs, social and public health resources, private businesses, volunteer groups, and natural areas. Each mapped site must foster one or more of the following: public health, outdoor recreation, social equity, environmental quality, sustainable economic growth, resource conservation, energy conservation, community engagement, and/or education.

Mapmakers create criteria for selecting sites to be included on their local map; this may vary from place to place, but the GMS provides some guidelines and examples of criteria that are helpful. The students chose to use broad, inclusive criteria, following their general mission.

"To date, we have 80 assets and 480 liability sites in the database," said Susan Todd. Most of the sites that the students have identified are contamination sites, such as leaking fuel tanks, but they have also started recording social services and sustainability assets, such as thrift stores, renewable energy supply retailers, health care services, parks, and co-ops. Among the categories included are Green Businesses, Information Sources, Infrastructure, Mobility & Recreation, Nature, Polluted Sites, and Renewable Energy.

Criteria for maps can be very different in detail and focus from map to map, however. For example, here are ECOMAP Copenhagen's criteria for three of their site types, presented on the GMS website as "a particularly good job of setting criteria":

Green oases: 1. The fundamental element of the oasis must be plant systems consisting of multiple species. 2. The conditions for the air, water, energy, soil and fauna must continuously be improved, and pollution must be reduced. 3. The local care-takers must maintain the oasis in a sustainable manner, using a minimum of energy. The oasis should generate more energy than it consumes. The oasis must be ecologically cultivated by applying, for example, a compost system instead of using pesticides and artificial fertilizers.

Transportation & tours: The transportation must be pollution-free. The purpose of the company must be to practice and demonstrate ecology and sustainability, either regarding the themes of the tour or the production of the vehicles.

Economic counselling: The institutions must conduct the counselling from an ecological and sustainable point of view.

The Fairbanks group didn't want to go into this level of detail, however. As Todd explained, "We were very loose on criteria, trying to avoid being put in the role of 'Green

Police.'" The intent of the special topics course is to create a focal point for discussion of sustainability issues and to enhance students' knowledge of the local environment and environmental issues in general. The course improves students' skills in teamwork, real-world research, data gathering, interviewing, documentation, communication, computerized map-making, and use of databases.

At the end of the semester, students gave presentations of the sites they had contributed to the Fairbanks Green Map database. Rich Ackerman concentrated on parks and trail systems, cultural and historical assets such as tours and museums, and social assets such as the Big Brothers Big Sisters program office. Rosie Trodden focused her selections on local farms and farmers' markets, renewable energy equipment suppliers, and museums. Emily Souza selected landfill transfer stations as examples of Infrastructure conducive to recycling, water fill stations, a couple of small farms, and a local library. Eli Sonafrank, who works for the Associated Students of the University of Alaska Recycling Program, selected the Fairbanks North Star Borough landfill, several scrap and metal recyclers, more landfill transfer stations, and his own employer.

Grant Wright, who single-handedly contributed better than 400 sites, focused exclusively on toxic sites, using the Department of Environmental Conservation's database of leaking underground fuel storage tanks. He also included the three Superfund sites in the area and other toxic hotspots at old mines and other areas. One example was the Superfund site at Alaska Battery Enterprises, where the soil had been found to contain up to 14,200 ppm of lead. (For comparison, the Environmental Protection Agency's legally acceptable level of lead, a highly toxic heavy metal, for residential soil is around 400 micrograms per cubic meter of soil. Thus, the lead level in Alaska Battery's soil is several orders of magnitude greater than this safety threshold.)

The map that results from the project will be web-based, and will provide a sustainability inventory of Fairbanks that can be used as an educational and planning tool by teachers, policy makers, and community organizations as well as tourists. Updates to the online map will be ongoing; Todd plans to offer the course again and to encourage members of the community to participate.

Further reading:

Green Map System, www.greenmap.com




Green Map Atlas, www.greenatlas.com

Fairbanks Green Map, www.fairbanksgreenmap.org. The draft website can be viewed at http://greenmap.gina.alaska.edu/maptest/start_w_more_points.html.





The goal of the Fairbanks Green Map group is to have a website similar to that of London (<http://greenmap.awardspace.co.uk/index.php>) and Villeurbanne, France (<http://www.ccja-heb.com/frapna/web/front/?%20sn=a4m7q67e5eynzphmthzp>).

Sample key to selected Green Map categories and icons





NATURE: FAUNA

ICON NAME	DESCRIPTION	
Bird and wildlife watching	Animals in the wild, using their instincts to thrive. Because sites may be delicate nesting areas or habitats, Green Mops should stress that people to approach with care and understanding. Officially recognized sites, as well as locally known sites, could be accompanied by rules for viewing and details on the species one might see.	
Wildlife info/ rehab centre	Places to see animals collected and cared for by humans.	
Duck pond	Places where ducks, geese, and other friendly waterfowl gather. In cities, these are often a good place to watch and feed the birds. In the wild, just enjoy their water ballet.	






INFORMATION SOURCES

Community centre	This is a place where clubs, meetings, and social gatherings involving the whole community are held. May be a formalized community center, or one established through common use.	
Social /political resources	Services and offices that help individuals (such as a food bank that helps prevent waste of food), or that develop environmentally sound policies and practices: alternative and governmental agencies, grass roots organizations, trade organizations and political parties, nonprofit social services, or environmental justice and native rights organizations.	
Alternative health resources	Alternative medicine sources (herbal, homoeopathic, eastern, etc.); spas, apothecaries, clinics, health clubs, nutrition and yoga are possible examples	
Protest point	Places where people consistently gather or post messages that respond to official political actions and decisions. May not all be related directly to environment — can be social, historic, or cultural protesting point. In New York, for example, there's a protest point right in front of the United Nations headquarters.	



NATURE: FLORA


Parklands/ recreation area	Green spaces that offer places to relax and play. May include sports fields, running paths, canoe rental, or children's play equipment, along with vegetation and a pond, creek, or other water feature. Some parkland may be publicly owned and free, some may may be private and charge admission.	
Special tree	Trees that have historical importance, or are especially beautiful, large, old, or rare. May be old growth, virgin trees (never cut by humans), ancient, sacred or medicinal trees or native plants. Could be indoors.	
Community garden	Often on public or formerly abandoned land, community gardens allow people to plant and grow their own vegetables and flowers in small plots. People also grow relationships and a close connection to the land/city. Sometimes fenced and locked (gardeners have keys). Sometimes threatened by development. Text should include contact numbers.	
Gathering/ fishing area	Collect wild food here, including mushrooms, seaweed, berries, fruits, and greens. Farms that permit gleoning, and services that pick up party leftovers for food banks. Fishing piers and ponds where the fish is safe to eat (otherwise, indicate restrictions on your Map). Information sources for these areas. Calgary warns us: mapping gleaning areas may result in over-harvesting.	

INFRASTRUCTURE






Waste water treatment plant	Generally, municipal systems for treating waste water and sewage, some with public information centers or tours, which can be noted, with statistics, in the text.	
Recycling	Drop-off sites for materials that can be reprocessed or refilled. Businesses that buy, work with, or sell products made from recycled materials. City program information contacts. Can include good examples of places where recycled materials are in use.	
Land-fills	Municipal solid waste dumps where garbage and soil are layered together, sometimes in a properly lined landfill (dump) with a methane gas capturing system. When filled, decommissioned landfills are capped and sometimes landscaped.	
Solid waste transfer station	Where refuse is transferred from one kind of transportation to another, for more efficient movement to land fill, recycling processor, or other resource/waste facility. Some transfer stations offer places to exchange useful items, separate recyclables, or dispose of household toxins.	
Energy grid generating facility	Generally these are conventional, fossil-fueled, hydro-electric, or nuclear facilities that provide electricity to the public. May include utility company or conservation offices. Alternative eco-generation facilities could be mapped. Where does your power come from? How can you use it more wisely?	

RENEWABLE ENERGY





Wind energy site	On this site wind turbines and windmills harness energy that is generated by the wind. Can be a small system that operates a simple pump or a large electricity generating facility. Can indicate wind power information resources.	
Bio-remediation Site	Bio-remediation sites are places where a natural method of recovery, such as plants, animals, reconstructed wetlands, and moving water are used to clean up contaminated or polluted waterways. A growing number of techniques are being used in cities to use natural systems to purify tainted areas.	

Re-use Site	Reuse sites are second-hand shops, flea markets, repair shops, materials exchange. Decide whether all secondhand shops should be included, or only those run by a charity. You can select the top ten, or choose another criterion for inclusion. Significant reused buildings and other examples of reuse can be included.	
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

MOBILITY & RECREATION

Bicycle site	Good place to buy, borrow, or rent bicycles, work bikes, and other kinds of human-powered vehicles. Organizations and places to find out about bike safety or advocacy. This icon can be used to indicate other kinds of bike-friendly services and sites.	
Pedestrian zone	Streets and public areas that prohibit motor vehicles, other auto-free areas, and bridges with safe pedestrian lanes. Access by vehicles may be allowed part time. Use icon in a line	
Boat launch site(sail/hp)	For human-powered boats, like canoes, rowboats, or kayaks, or wind-powered ones like sailboats. Your Map can mention if a permit is needed, or if there are any other restrictions.	
Local transport stop	Subway, bus or trolley stop, etc. Bus stops may be too numerous to map, except in proximity to remote green sites.	
Alternative vehicle/fuel station	Where you can fill your car with compressed natural gas, propane, bio-fuel or hydrogen, or buy bottled fuels, or exchange batteries or fuel cells, and other renewable and ecologically preferred power sources. This icon can be used at a site where you can buy or research alternative fuel vehicles, or learn about the true environmental costs of producing various fuels.	




POLLUTION SOURCES

Danger zone	An area that has been tainted by humans or is dangerous by nature and therefore may be hazardous to humans, fauna, or flora. Can include active volcanoes, places where you don't want your Map's users to fall victim to crime, etc.	
Air pollution source	Anything from industrial smokestacks to truck routes, to poorly-run composting projects can be included here.	
Underground storage tank	Usually used for oil and gas leaks; for example, a gas station with leaking underground tanks can be an invisible source of pollution. Home fuel oil storage tanks can also be a problem source.	
Mining site	May not be currently in use, but the effects may still be felt. Some cities are built directly on top of mines and quarries. Indicate what is being mined: coal, salt, etc.	

GREEN BUSINESSES

Farmers market	Sell regionally and organically grown produce. Some have other farm produce, such as flowers, hand-crafted items, baked goods, wine, wool, and regional cookbooks. Farmers markets and the associated small family farms maintain a green countryside, plus the food doesn't have to travel far, so it's nice and fresh. You can experience the changing of the season as each new crop takes its turn showing up at the market. It's often very neighborly at farmers markets too.	
Organic produce/natural food	Foods grown without pesticides or synthetic fertilizers, and no chemicals or waxes are added after harvesting. If processed, it is usually prepared in a way that maximizes nutritional value. Organic produce, prepared food, dairy, and meat are becoming more popular and easier to get all the time. Some natural food places include fair trade practices in their definition of ecological foods. Some supermarkets have a few kinds of organic vegetables amidst a large selection of conventionally grown produce. Should this store get the organic food icon? You have to decide.	
Green business/service	The last five items listed with the examples above fit into this category. Balance with resources that help businesses become greener, and organizations that refer inquirers to good businesses. You can create strict criteria like Oakland, California, or use a softer approach to selecting businesses. You can leave them off and let the community discussion help to decide what to include in the next map edition.	
Fair trade/social shop	This "light green" category includes somewhat green and socially responsive products and policies, but doesn't offer many things that "go all the way". Fair trade and social workshop stores can use this icon. Look closely at the shop's products, ask questions and decide the right category with your Team. Maybe its cosmetics are promoted as natural and socially responsible, but the brightly-colored petrochemical-based products don't really have many eco-advantages. Maybe the store has a nature theme, but has too many plastic novelties mixed in with the educational stuff. Consider adding your definition with this icon.	

CULTURE & DESIGN

Cultural site	These contribute to the city's environment and sense of place in many important ways. Noninstitutional resources, monuments and places, even temporary events (monthly swap meet, annual eco-fair) may be included.	
Traditional way of life	May be indigenous, pioneer, or migrated peoples' traditions. Might not be assimilated into prevailing culture. May be resources for learning about or visiting people living in traditional, more self-sufficient ways.	
Eco design resource	A source for the best materials and supplies for sustainable building, landscape, graphic, product, fashion, and other kinds of designers. May be an organization for information, or a place to gather natural materials, a store, exchange center, or showroom. May also be a place where you can draw inspiration from natural systems.	

We all depend on our forests

commentary by Don DeHayes

Don DeHayes is dean of the Rubenstein School of Environment and Natural Resources at the University of Vermont and president of the National Association of University Forest Resources Programs, a consortium of sixty-nine universities, including the University of Alaska Fairbanks, School of Natural Sciences and Agricultural Sciences.

Reprinted from the Rutland Daily Herald, Rutland, Vermont

Thursday, June 8, 2006

I am deeply concerned that today's front page squabbles and gridlock between the so called "hikers and loggers" is overshadowing our shared interest in the health, productivity, and sustainability of our forests.

A recent bill introduced to Congress proposing 48,000 additional acres of federal wilderness in Vermont has reignited the quarrel about the best use of our public land.

While the stage for this controversy is Vermont, this type of battle is national in scope.

Such debates about the national forest certainly have their place. However, the people who are knowledgeable and care about forests are on both sides of the debate—pitted against each other on the front pages. Our forests have become just another pawn in a game of partisan politics.

What's lost in all the squabbling is that forests significantly shape all of our lives, whether we live in urban or rural communities.

Forests help define the distinctiveness of our landscape and contribute to our quality of life and our nation's competitive position in an increasingly complex global marketplace. The forest cannot be viewed as only one thing or another, as serving only one set of values. Our broadest understanding of and best science about forests show that the lives and livelihood of all of us depend on forests.

While the debates rage onward,

public and private forests are threatened by sprawling development, climate change, air pollution, invasive species, and, perhaps more important, by government disinvestment in education and research about forest ecosystems and their management.

Yet the groups that truly care about forests are battling each other. Who is the public to believe or trust for information and advice? Why would young people want to enter this tumultuous field? We all will benefit, as would our forests, by working together to inform neighbors and community leaders about the benefits and values our forests provide.

A few brief examples:

- New York City's need for clean water was met through thoughtful forest conservation in Catskill Mountain watersheds rather than building new filtration plants, saving billions of dollars and providing naturally clean water to the city.

- Forest trees and soils consume carbon dioxide and are estimated to store more carbon than is in the atmosphere, thereby slowing the rate of climate warming.

- Forests provide more than a quarter of all medicines, including the recently discovered compound Taxol from yew trees used to fight cancers, heart disease, and AIDS.

- Forests provide stormwater and erosion control at little or no cost; when fire damaged the forests of San Diego, the cost of the increased stormwater runoff was tallied at \$25 million.

Our forests support industries that employ millions of citizens and provide products that positively impact our lives. Healthy forests enhance property values and provide habitat that sustain fish and wildlife that enrich our lives.

Forests provide solutions to environ-

mental and societal challenges. Healthy forests stabilize soils, protect headwaters and aquifers, and harbor biodiversity necessary to sustain life. Forests provide beauty, purify our air, and minimize temperature extremes. Ultimately, healthy and productive forests are an important foundation for human health and prosperity.

While enrollment is growing in the University of Vermont's Rubenstein School of Environment and Natural Resources, the national trend, especially in forestry programs, is the opposite. National enrollment data compiled at Utah State University has confirmed significantly declining undergraduate enrollments in natural resources and environmental fields at many universities. At the same time, a recent report of the National Research Council has documented dwindling forest research capacity in our agencies and universities.

Instead of battling for limited self-interests, we need to join together to support the roles, values, and potential for forests to serve the greater good.

Looking to the future, the natural resources deans of the 69 universities in the National Association of University Forest Resources Programs have come together to put forward a new vision for America's forests. Importantly, these programs extend from the Deep South and Southwest to the Pacific Northwest and northern New England; our diversity is a microcosm of the range of opinion about forest policy nationally. Yet we were able to find common ground and establish a joint commitment to promoting shared values, applying the best science, and advancing stewardship to create lasting forests. Our shared statement, "Forest for a Richer Future," is being delivered to members of Congress and other leaders across the nation. Our collective vision speaks with one voice in saying: We all benefit from an investment in our forests—because we all share a future dependent upon the services forests provide.

Forests for a Richer Future

A Vision for America's Forests for the Twenty-First Century

The National Association of University Forest Resources Programs, of which SNRAS is a member, comprises sixty-nine of our nation's leading universities that are committed to advancing the health, productivity, and sustainability of forests around the world through high quality education, research, outreach, and international programs. For more information, see <http://www.naufrp.org>. The following is the organization's new vision statement.

We are inspired by forests, their resilience, beauty, and the numerous and critically important services and values they provide. Forests directly and positively influence the social, economic, and ecological conditions of the world. They sustain and enrich the wellbeing of individuals and communities. We recognize the complexity of forests and their interdependencies with human life, and the challenges this brings. While we know much about forests, we acknowledge there is so much we have yet to learn.

We, the National Association of University Forest Resources Programs, therefore envision for our nation's forests:

A renewed national commitment to understanding, enhancing, and protecting the health, productivity, and sustainability of forests—a commitment needed to ensure our forests will thrive and remain vibrant and dynamic ecosystems capable of providing the full array of benefits, services, and intrinsic values necessary to sustain and enrich quality of life. We envision forests as a constant source of learning about the relationship between humans and natural resources that simultaneously benefits both people and nature.

In partnership with agencies, nonprofits, and the private sector, we enthusiastically commit:

Our intellectual, technological, and financial resources to achieve this vision—forests that are vibrant, thriving, dynamic, and sustained well into the future.

We recognize that, like the many benefits forests provide, their role in our lives are diverse and complex and include, for example—the family forest that offers a quiet place to reminisce or an investment for the future; managed forests that provide jobs and supply numerous products; urban forest landscapes that we enjoy in our daily lives; and our treasured and majestic public lands, home to a multitude of flora and fauna. Indeed, the nation's forests enrich our lives; as such, the realization of this vision will ensure a richer future for all.

Our Commitment

Our part of this vision includes a renewed commitment to promoting shared and balanced values among all constituents, applying the best science to create lasting forests, and advancing a new stewardship ethic that ensures our forests remain as forests. We pledge to do our part to realize this vision by:

- Educating current and future generations and a diverse workforce about the interdependencies of forests with all natural processes and human influences.
- Building an ever-improving body of science-based technologies that together with local knowledge contribute to sustaining forest resources and ensuring that they are productive, diverse, and resilient in the face of constant change.
- Applying conservation and management strategies that meet the dynamic needs of society.
- Advancing a new social contract that draws people together toward the sustainable management of forests to enhance human wellbeing, provide needed and desired goods and services, and protect the intrinsic value of forests.

Our Role

The National Association of University Forest Resources Programs, as scientists and educators, serves as a link among the many diverse users and beneficiaries of forests—the scientists, professional resource managers, producers, and the public more broadly. Our education, research, and outreach programs serve as the core of society's knowledge about forests and their many roles in our lives and future. These programs are vital to stimulating fruitful discussions and viable solutions about how to sustain the many benefits that healthy and productive forests offer.

Promoting Shared and Balanced Forest Values: Diverse, productive, and resilient forests contribute richly to a vibrant and productive society. Forests cleanse the water we drink and give us quality air to breathe. They stabilize soils, provide beauty and recreation in our rural, suburban, and urban communities, and are home to hundreds of thousands of fish and wildlife species. Forests provide us with paper, lumber, furniture, and wood-based energy and mitigate climate change by sequestering carbon. Our forests contribute to the distinctiveness of our landscapes and enhance property values and business opportunities. Indeed, people depend on forests for their livelihoods and way of life.

Applying the Best Science: We pursue our vision with passion and vigilance, reflecting on the lessons we have learned on how to best manage, conserve, and protect our nation's forests. We recognize that our actions must be based on a strong foundation of objective and relevant science, and experiences sustained through excellence in forest resources research, education, and outreach. Our utmost priority is to apply knowledge derived from careful scientific exploration leading to sound decisions that benefit the forests and humanity.

Advancing a New Stewardship Ethic: We challenge others responsible for or interested in America's forests and forest-related communities and economies to join with us in building a larger shared vision for our nation's forests—a vision built upon respect, innovation, and commitment for forests to serve the greater good. In recognition of the diverse and sometimes competing values and the importance of scientific understanding, we seek to advance a new ethic—one of common ground and partnerships that respects and balances diverging values, acknowledging differences and building upon similarities. By working together to overcome disagreements, we can ensure forests for a richer future for all.

Investment: The sustained health of our forests and competitive position of our nation requires investment in education and research about the roles and values of our forests, and their potential to advance humanity. Our forests are confronted with numerous challenges—invasive species, fragmentation, parcelization, climate change, security threats, globalization of markets, and more. Dwindling research capacity in our agencies and universities further threatens the vitality and resiliency of our forests and the nation's competi-

tive position in the global community. An investment in the future of our forests is an investment in the future of our nation and the global society. We seek your support for this social, economic, and ecological imperative to keep forests diverse, vibrant, productive, and resilient. Join the national commitment to maintain, enhance, and protect the quantity and quality of our forests and the benefits and intrinsic values they offer. Join us to ensure forests for a richer future.

America's Forests—Past, Present, and Future

Today, nonurban U.S. forests cover roughly the same amount of land as they did in the 1920s—749 million acres, or about one third of the nation's land area (USDA Forest Service, 2003). In fact, since the 1980s, total forestland in the U.S. has increased slightly. These forests protect the headwaters of nearly every major river system in the U.S. and are among the nation's most productive and biologically diverse ecosystems.

Prior to 1920, conversions to agriculture and other human developments reduced U.S. forest cover by about 25 percent. Today, forest conversions are mostly driven by urban growth and are roughly offset by reforestation of previously unforested lands.

Forest transformations are not new. Most notable is that the U.S. now has only 75 percent of the forest it had in 1630. Human activities have continually transformed the ecological and economic characteristics of forests since people first appeared on Earth.

More recently, Native Americans cleared agricultural plots and burned forests, woodlands and prairies to aid in procuring food and fiber and to create openings for desired plants and animals. Later, settlers cleared larger forested areas, often more permanently, for agriculture and industry development. These past land uses have greatly influenced current forest conditions, and some have left long-lasting impacts on the landscape.

The majority of America's forestland is owned by private citizens in what we call family forests. While most of the private forestland is east of the Mississippi River, the majority of

Forestland Ownership in the U.S.



forestland in the west is public land managed by federal agencies in the U.S. Departments of Agriculture and the Interior.

While we have about the same amount of forest today as we did in the early 1900s, not all forests are safe from conversion to non-forest uses. Urban growth now impacts almost one million acres of previously nonurban forest per year. Our vision is to maintain and improve, where appropriate, the forests we have and balance forest values as we move into the twenty-first century. Only after sustaining the forest first can we discuss for whom, for what, and how forests should be managed in different places.

America's Forests Face Many Challenges

Despite past land-use conversions, America still sustains a remarkable wealth and diversity of forests. But our society's demands for the variety of products, values, uses, and services of forests are ever increasing and create many challenges including but not limited to:

- Changing land uses such as fragmentation and parcelization
- Loss of share in global wood markets
- Rising regulatory costs
- Global climate change
- Security threats
- Invasive plant and animal species
- Uncharacteristically intense wildfires and pest epidemics
- Unmanaged recreation in some public forests

Wood is currently the most significant commercial use of America's nonurban forests. As the twentieth century closed, the U.S. was the world's leading producer and consumer of wood and fiber-based forest products, accounting for 22 percent of the world's industrial wood production and 30 percent of its consumption (UN FAO, 2005). The U.S. is the world's largest importer of wood products from other nations, exporting the economic, social, and environmental consequences—both positive and negative—of our wood use. As the economies of developing countries continue to grow, world demand for wood-based products is expected to increase by up to one-third by the year 2050.

While wood is the largest contemporary commercial use of nonurban forests, it is only one of the many forest resources that people value and expect. Water, wildlife and fish habitats, recreation, biodiversity conservation, aesthetics, and climate services are other highly valued benefits of healthy forests. Demand for these values is changing the way forests are managed, especially in places where wood production is no longer the top priority.

The biggest challenges facing forest managers, policy makers, and conservationists are derived from these diverse, often competing values and the needs of expanding American and global populations. Increased public demands create

challenges and opportunities for university forest resources programs.

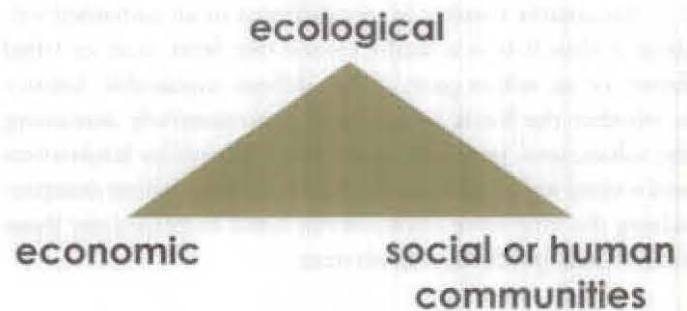
Our mission is to provide the most appropriate science and knowledge to educate and inform the forest stewards charged with sustaining forests to meet the demands of forest users and forest resource consumers while exploring better ways to use forest resources to offset the consumption of non-renewable materials for energy, shelter, or packaging.

America's Forests Meet Social, Economic, and Ecological Needs

Traditional forest management in the U.S., often called sustained-yield forestry, has sought to maintain the forest values, uses, products, and services historically desired by society and landowners—traditionally wood and fiber products, clean water, recreational opportunities, and wildlife and fish habitats.

Today, people are demanding more than these traditional forest resources. Thus forest managers, policymakers, and interested parties are increasingly seeking policies, plans, and practices to sustain forest conditions that will provide a more diverse suite of forest benefits across all ownerships and landscapes.

Sustainable forestry is the new terminology for this broadened concept of sustained yield and it is an evolutionary expansion of traditional sustained-yield forestry. It addresses desired outcomes for three essential, interacting systems:



The integration of these three systems translates generically to "meeting the needs of today's people without compromising the ability of future generations to meet their needs" (United Nations conference on Environment and Development, 1992). The interacting systems also translate more specifically to forests as "The suite of policies, plans, and practices that seek to protect, produce, and perpetuate forest ecosystems for the values, uses, products, and services desired by communities and landowners for this and future generations" (National Commission on Science for Sustainable Forestry, 2005).

Over the past ten to fifteen years, interest in forests, fish, and wildlife has broadened to embrace all of life's complex organisms and processes, a concept known as biological diversity. Sustainable forestry seeks to perpetuate those aspects of biological diversity that are essential to and compatible

with the primary purposes for different forest types and ownerships.

But there is still work to be done on sustainable forestry beyond simply embracing a broader notion of biological diversity. It is crucial that an understanding of the cultural and economic aspects of forests also be incorporated in the concept and practice of sustainability. Cultural and economic diversity and vitality are no less valued and vital to future forests than biological diversity.

One of the challenges in implementing sustainable forestry across all ownerships and regions of the country is that there is no single definition or approach to sustainable forestry that can or should work in all places regardless of forest type, ownership, or designated purpose. Sustainable forestry varies by forest type, by location, by ownership, and by time. Given the vast range and dynamics of forest and social diversity in the U.S., there never will be one single specific definition of sustainable forestry that fits everywhere and for all time.

Only the general principles and aspirations of sustainability are universally valid—integrating ecological, economic, and social aspirations to meet the needs of people now and in the future. The specifics of sustainable forestry must also be tailored to every different place and adjusted over time to respond to new knowledge, new markets, new technologies, and changing social aspirations. Therefore, the development and refinement of regional and local approaches to sustainable forestry will be essential to realize the full utilization and conservation of forest benefits.

Sustainable forestry is very different in an unroaded wilderness than it is in a family owned tree farm, state or tribal forest, or an urban park. What defines sustainable forestry is whether the forest in question is progressively sustaining the values, uses, products, and services desired by landowners and society today and for a better tomorrow without compromising the long-term ability of the forest to perpetuate those values, uses, products, and services.

America's Forests Have Different Purposes

Forest management in America now focuses on different purposes to meet a variety of needs. Each purpose delivers a distinct suite of forest benefits.

Reserve Forests

One traditional purpose is to protect forests for certain natural and cultural values they possess. Forest reserves are relatively large contiguous areas designated for protection from

development. In the U.S., “mega reserves” include national parks and wilderness preservation areas that are administered by federal agencies as well as various state agencies and non-governmental organizations such as The Nature Conservancy and the National Audubon Society.

Historically, conservation of forest biodiversity and ecological values has focused on places that are managed or preserved as forest reserves primarily for “naturalness” or specific elements of native flora and fauna. “Mini reserves” are highly protected places within working forest landscapes such as streamside zones. Reserves typically provide habitats for species that do not tolerate human activities or impacts well. Yet all forests regardless of purpose are distinctly diverse and offer a suite of ecological values that are important to sustain. Hence, forest managers, scientists, and policy-makers now recognize that naturalness or biodiversity cannot be maintained only through forest reserves. Biodiversity is an important component of all forests and each kind of forest and forest purpose offers its unique contribution to sustaining life today for a better tomorrow.

Wood Production Forests

Another purpose for forests is maximum growth of trees for wood and fiber products. While efficient production of wood and fiber is the primary purpose of these forests, they must also protect water quality. They can also provide substantial recreation, climate services, and natural forest benefits, particularly favoring birds, mammals, insects, plants, and reptiles that are resilient to human activities and depend upon young and vigorously growing habitats.

Multiple-Resource Forests

The most diverse forests are managed for multiple benefits. Multiple-resource forests differ from reserve or wood production forests in that no single purpose dominates their function or role in sustainability. Their most distinct feature is that they sustain a wider array of values, uses, products, and services than forests dedicated to either wood production or reserves, including the widest spectrum of biological diversity and the broadest variety of recreation opportunities.

Urban and Community Forests

Urban and community forests are not commonly thought of as forests, yet they still provide many aesthetic, economic, and environmental benefits. They can range from large forested urban parks to tree-lined streets or residential landscaping. About 80 percent of the American public lives near or in

*Promoting shared values,
applying science, and
advancing stewardship
to create lasting forests.*



NAUFRP

National Association of University Forest Resources Programs

Creating Knowledge—Developing Leaders



The boreal forest in winter: snow-covered trees along the Dalton Highway.

—PHOTO BY JIM AKARAN, YUKON PLATS NATIONAL WILDLIFE REFUGE, COURTESY THE US FISH & WILDLIFE SERVICE ALASKA IMAGE LIBRARY

urban forests and thus, most of their encounters with forests occur here. The most important urban forest values are aesthetics, energy conservation, watershed protection, clean air, reduced noise pollution, and enhanced property values.

New Approaches and New Pathways for America's Forests

The past forty to fifty years have been tumultuous for America's forests and its citizens. Common purpose over forests has given way to cultural conflict over values and uses. These conflicts have damaged communities, weakened relationships, compromised trust, caused company closings, and left managers of many public forests caught in a cross-fire of competing opinions about the role of forests and their future.

It is critical to move beyond the gridlock mentality that "the forest" must be only one thing or another or serve only one set of values. This approach fails to recognize the complexity and uniqueness of individual forests and that at appropriate geographic scales and over time a mosaic of forests can be many things for many people.

We can move to a new pathway for forests, away from the unproductive and unsustainable path of conflict and control,

gridlock, and rancor. We must build a new paradigm that moves toward:

- **Promoting Shared Values**—Common commitment to meet broad goals and shared needs through respect for different values
- **Applying Science**—Agencies as facilitators of efficient production and collaborative conservation
- **Advancing Stewardship to Create Lasting Forests**—Conservation-minded practices based on broader purposes and in consideration of global forces of change by people who live on and with the land

It is imperative that all parties interested in America's forests pull together with a common vision for sustaining our forests today for a better tomorrow. Working toward this common vision requires a financial investment in education and research about the role, value, and services forests can provide for the greater good. An investment in America's forests is an investment in our future.

Fire, climate, and vegetation

Doreen Fitzgerald

Alaska's climate is changing, and the change has raised many questions about how wildland fire is linked to climate, how it influences land cover, and the associated feedbacks in the terrestrial ecosystem.

"Understanding the linkages between fire, climate, and vegetation is critical for accurate forecasts of the effects of global change and it's also necessary for developing sound public policy related to wildland fire," said Scott Rupp, associate professor in the Forest Sciences Department.

Rupp's research focuses on spatial modeling of fire and vegetation succession in boreal forest landscapes to improve understanding of the effects of both climate change and wildland fire. "There is an increasing need," he said, "to assess future fire regimes, fire frequency and severity, so that we have a basis for projecting changes in landscape dynamics and can consequently make recommendations for policy development."

The fire seasons of 2004 and 2005, during which 11.2 million acres burned, represent the largest (2004) and third largest (2005) annual areas burned since record keeping began in 1950. Both occurred during prolonged drought conditions. Given current climate projections, similar fire seasons will likely become more common. In the past three fire seasons (2004-2006) more than twenty Alaska communities have been threatened. For these years, the cost of fire suppression actions, which limited losses to approximately 100 structures, exceeded \$190 million.

State and federal officials have responded to these recent events with renewed interest in reducing fire risk to communities adjacent to forested wildlands.

"In this regime of changing climate, and an increasing wildland-urban interface, we need to understand the short- and long-term effectiveness and consequences of these management actions," Rupp said. "And it's important for us to apply this understanding as quickly as possible so that the best informed mitigation strategies and policies can be developed and implemented."

Strong linkages between climate, fire, and vegetation imply that fire's sensitivity to global change could be more important than the direct effects of climatic warming on terrestrial ecosystems. Several lines of research point to fire-driven changes in vegetation composition and the possible effects on regional climate feedbacks. One possible result of increased area burned is an associated increase in deciduous vegetation cover, which could produce one of the few negative feedbacks to additional climate warming due to changes in regional energy budgets.

During the past five years, Rupp's research laboratory has developed a strong program to begin to meet the challenges outlined above.

"Specifically, we've developed strong collaborative ties within the fire management community," he said. These collaborators include the Alaska Department of Natural Resources Division of Forestry, the US Bureau of Land Management, the Alaska Fire Service, the US Fish and Wildlife Service, the National Park Service, and US Geological Survey's Alaska Science Center. To date these collaborations have yielded \$1.2 million in fire science research support from the USDA/USDI Joint Fire Science Program (JFSP). During his proposed sabbatical leave starting in

the fall of 2007, Rupp plans to strengthen collaborations between the state and federal fire management community and the School of Natural Resources and Agricultural Sciences. His specific objectives for the sabbatical are outlined here.

One goal is to work closely with agency personnel in both Fairbanks and Anchorage to provide training sessions on the use of Rupp's dynamic landscape model, Boreal ALFRESCO, and work with personnel on specific project applications within specific agencies.

Boreal ALFRESCO simulates the responses of subarctic and boreal vegetation to transient climatic changes. The model assumptions reflect the hypothesis that fire regime and climate are the primary drivers of landscape-level changes in the distribution of vegetation in the circumpolar arctic/boreal zone. It also assumes that vegetation composition and continuity serve as a major determinant of large, landscape-level fires. Boreal ALFRESCO operates on an annual time step, in a landscape composed of 1 x 1 km pixels, a scale appropriate for interfacing with mesoscale climate and carbon models. The model simulates five major subarctic/boreal ecosystem types: upland tundra, black spruce forest, white spruce forest, deciduous forest, and grassland-steppe. These ecosystem types represent a generalized classification of the complex vegetation mosaic characteristic of the circumpolar arctic and boreal zones of Alaska.

The Boreal ALFRESCO model provides an important tool for synthesizing multidisciplinary management issues, as well as an operational tool for preparing environmental assessments for fuels and fire management. Model outputs will also assist managers complying with the federally mandated Fire Regime Condition Class mapping efforts by providing the natural reference landscapes and estimates of fire frequency needed by the Vegetation Dynamics Development Tool models. In the longer term, this project will provide valuable information and methodology for the national LANDFIRE (<http://www.landfire.gov/>) project application in Alaska.

Rupp's second goal is to assess and report what major pressing research issues and research tools are needed by state and federal fire management agencies, while identifying how the university can play a leading role in those efforts. This report would also outline a strategy (see objective three) for developing the university's role. The assessment would be conducted at multiple levels, from field fire ecologists through regional management to national administration, within individual agencies.

Finally, Rupp wants to develop an initiative to establish a Wildland Fire Research Network based in the School of Natural Resources and Agricultural Sciences at the University of Alaska Fairbanks. This formalized network would be a vehicle for addressing the issues and needs identified in objective two. The network would seek to provide a management framework, technology, and information infrastructure required to enhance current wildfire assessment, management, mitigation, and remediation capabilities in Alaska, and ultimately



King County Creek fire, in Kenai National Park summer 2005.

—PHOTO BY KAREN MURPHY, ALASKA DIVISION OF NATURAL RESOURCES

throughout the North American boreal forest.

The fire research network would be organized around five major elements: (1) hazard assessment under changing climate and land-use, (2) enhanced wildfire suppression capabilities focused on the wildland-urban interface, (3) mitigation strategies for high-risk communities, (4) enhanced wildfire detection and monitoring systems, and (5) postfire remediation strategies to maintain long-term ecosystem integrity. During 2007–2008, Rupp plans to develop the collaborative ties and investigate the funding opportunities necessary for establishing the network and to fully develop the proposed research initiative.

Further Reading

For more on recent fire-related research, see the annual reports of the School of Natural Resources and Agricultural Sciences (SNRAS). They can be found on line at: <http://www.uaf.edu/snras/afes/pubs/ar/index.html>, or requested from the SNRAS publications office (contact information on page 3).

For a history of fire control and management in Alaska, see *Wildland Fire in Alaska: A History of Organized Fire Suppression and Management in the Last Frontier* by Susan K. Todd and Holly Anne Jewkes. This publication is available on line at: <http://www.uaf.edu/snras/afes/pubs/bul/B114.pdf>.

See also references relating to Dr. Rupp's research, p. 17.

Fuel breaks for fire mitigation

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Note: the following is adapted by Doreen Fitzgerald, and based in part on "Modeling outcomes of hazardous fuel reduction near Fairbanks, Alaska," *Western Forester* (December 2006), by Tom Paragi, Scott Rupp, and Joe Little.*

After the 2004 and 2005 fire seasons, reviews by fire managers and the public prompted recommendations for a more proactive approach to hazardous fuel reduction, particularly in the black spruce ecosystem type.

In the mid-1980s, the interagency wildland fire management plans adopted for Alaska, gave priority for suppression resources to fires near communities resources, whereas many fires in remote areas were monitored instead of suppressed. Consequently, near communities where fire is suppressed, forest fuels build up and these continuous fuels eventually increase the risk of catastrophic fire. It also makes maintenance of wildlife habitat and other subsistence resources increasingly difficult.

In recent years, federal agencies in Alaska have been assisting communities with thinning treatments accomplished by hand that remove ladder fuels and increase spacing of trees to reduce potential for fire spread near developments. These shaded fuel breaks often cost more than \$1,000 an acre.

To enhance wildlife habitat where prescribed fire is difficult to achieve for social reasons, since the late 1990s the state of Alaska has been experimenting with vegetative response and the cost efficacy of mechanical treatments, such as dozer shearblading with windrowing of debris, which has an estimated cost of \$150 an acre. The larger-scale picture of potential fuel reduction with shearblading is a major negative effect on the visual landscape near communities.

Now municipal and tribal governments want to understand how fuel

breaks may influence fire risk, how frequently breaks must be maintained, and how they influence habitat for wildlife, such as moose browse production. Thinning treatments raise another question: is there any use for all the resulting wood?

Identifying alternative uses for the biomass generated by local fuel treatment projects is important because potential revenues from such uses can be used to offset thinning program costs. Although markets for small-diameter wood do not currently exist in interior Alaska, economic feasibility studies indicate that, under specific assumptions about transportation, harvesting costs and per-acre yields, chip fuel may be cost effective in the cogeneration of municipal heat and power. From an economic standpoint, a full life-cycle cost and market analysis will be needed to assess the efficacy of potential co-generation projects.

Outcomes

Predicting outcomes from mechanical treatments requires an understanding of post-disturbance succession and how vegetation changes influence fire risk and habitat features. There are two key questions:

- Under what conditions can spruce be temporarily replaced by shrubs or deciduous trees?
- How long before coniferous fuel is re-established?

Rupp has been awarded a two-year grant from the USDA Cooperative State Research, Education and Extension Service for "New Crop Opportunities" to conduct a pilot study on production of biomass fuel from harvesting small-diameter trees in boreal forests.

Boreal ALFRESCO (Alaska Frame Based Ecosystem Code) is a spatially-explicit computer simulation model

developed by Rupp and others to predict how climate change may influence vegetation distribution and patterns of wildland fire in Alaska.** Rupp is using this simulation model for his new research.

Rupp's pilot project will scale the model down to the greater Fairbanks area and may incorporate terrain and wind vector in simulating how fuel breaks influence the potential for fire spread among vegetation types in the wildland-urban interface. A recent fuel type map made by the Alaska Department of Natural Resources Division of Forestry to assess fire risk will be used as the vegetation layer for modeling two items:

- biomass yield and potential for type conversion in mechanical fuel treatments, and
- how treatments may influence fire spread and habitat features.

Field sampling has been conducted to define state-transition functions for the revised model. In summer 2005, the density of late-seral features (snags, cavity trees, and spruce rust brooms) in several stand types was estimated to understand potential loss of nesting and denning habitat for songbirds and smaller mammals.

During summer 2006, Tom Paragi, Rupp, and Joe Little worked with students on a retrospective study of post-disturbance succession in black spruce to identify ecological and treatment factors that might be useful as operational guidelines for temporary conversion to deciduous species.

"Although moose forage is an expected benefit from creating fuel breaks, we also hope to analyze how proximity to early-seral habitat may influence probability of moose-vehicle collisions near the road system, which can be a modeling scenario with respect to treatment locations," Paragi said. This winter

Rupp and Paragi are putting these components together, along with biomass yield predictions and treatment cost factors to examine where further research may be needed to provide a model useful for community landscape planning and for estimating economic feasibility of a biomass fuel industry.

For more information, contact Rupp at (907) 474-7535 or scott.rupp@uaf.edu.

**Tom Paragi is a wildlife biologist with the Alaska Department of Fish and Game in Fairbanks, where he works on habitat enhancement and restoration. Joe Little is an assistant professor of economics in the School of Management at UAF who specializes in natural resource issues. Paragi and Rupp are members of the SAF Yukon River Chapter, and Paragi was a founding co-chair of the Alaska Northern Forest Cooperative.*

Related Links

** More on ALFRESCO is on line at: <http://depts.washington.edu/nwfire/project.php?projectID=102µweb=0>

The ALFRESCO User's Guide and a Boreal ALFRESCO presentation (pdf, 3.2 MB) can be accessed at this site.

The Northwest and Alaska Fire Research Clearinghouse: <http://www.fs.fed.us/pnw/fera/firehouse>

Alaska Fire Service; Alaska Interagency Coordination Center: <http://fire.ak.blm.gov/>

Interactions Among Climate, Fire and Vegetation in the Alaskan Boreal Forest: <http://depts.washington.edu/nwfire/project.php?projectID=507>

National Biological Information Infrastructure: <http://www.nbi.gov/>

USDA Forest Service Fire and Environmental Research Applications Team: <http://www.fs.fed.us/pnw/fera/>

Fire Research and Management Exchange System (FRAMES): <http://frames.nbi.gov/portal/server.pt?open=512&objID=205&PageID=0&cached=true&mode=2>

Joint Fire Science Program: <http://jfsp.nifc.gov/index.html>

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The Muskox: a new northern farm animal?

Deirdre Helfferich

18 **M**uskoxen, large shaggy ruminants of the Arctic, are best known for their soft underwool, or qiviut. But the muskox has economic potential for a variety of products: meat, wool, horn, pelts. Muskox meat, for example, is described by the Nunavut Development Corporation as "a gourmet delicacy that offers a natural alternative to beef....Muskox is an excellent source of protein, iron and vitamin B. The well marbled meat is much leaner than pork or beef (1-2% versus 12-20%) and subsequently has fewer calories. It also has 5% more moisture than beef making it very tender and flavourful."

In Canada and Alaska, controlled hunts limit the number of wild animals that may taken, so the meat is rarely offered in restaurants and tends to be very expensive. Qiviut is highly prized, rare, and expensive. Yet domestication and commercial production of muskoxen may make the currently rare products of this northern beast better known and more accessible. According to the Robert G. White Large Animal Research Station (LARS) website,

Given the strong demand for muskox products and the limited supply of animals, there is potential for the muskox industry in Alaska. Business success will depend on calf survival (>70-80%), herd management (e.g. herd size and harvest), and the reliable supply of forages (grass hay and/or pasture) and formulated feeds. This is no different than the parameters for succeeding in other diversified animal enterprises.

Alaska is one of the few places in the world that produce commercial



Wild muskoxen in the Arctic National Wildlife Refuge.

—PHOTO COURTESY OF MARK CHASSA, WWW.ARONIC.ORG

quantities of qiviut. Canada also produces qiviut, but, unlike that from Alaska, where the animals are farmed, most of it comes from animals taken in controlled hunts overseen by the government, which produce horn, meat, pelts, and qiviut. Qiviut is among the softest, finest, and longest of animal fibers, does not shrink, and is about eight times as warm as sheep wool. The underwool, or down, can keep a muskox warm at temperatures down to -100°F.

Muskoxen are related to the goats and sheep, but are in their own tribe, Ovibovini (sheep and goats are in Capriini). Their common name is a misnomer, as they are not oxen. Although they do have facial scent glands near the eyes, they do not produce musk. Male muskoxen can be pungent (mostly from their urine, and particularly during the rut), but not as much as, say, male goats. Muskoxen are found in the Arctic in Alaska, Canada, Greenland, where they are native, and in Norway and Siberia. They are herd animals, gathering in groups of thirty or so in the winter, thinning out to smaller groups of around five to ten in the summer. They are also quite large: adults stand about 1.4 m (4.6 ft) high at the shoulder and weigh about 280 kg (~620 lbs) for adult bulls, 180 kg (~400

lbs) for adult cows in the wild, with captive animals sometimes getting as large as 400 kg (~880 lbs) or more.

"The largest bull I've seen was actually over 1,000 pounds!" said Milan Shipka, associate professor of animal science at the School of Natural Resources and Agricultural Sciences and large animal specialist for the Alaska Cooperative Extension Service. Muskoxen are known for their distinctive defensive behavior, in which they form a line or ring, adults outermost to face the danger. Unfortunately, this stand-and-face-the-music defense is no protection from human hunters armed with projectile weapons, and makes them easy targets. Hunted to extinction in most of their range, Canadian and Greenlandic muskoxen were exported in the mid-twentieth century to repopulate the species in other areas in what was a successful reintroduction to their original range. Muskoxen are now considered to be at low risk of endangerment from extinction.

An adult musk ox can produce four to seven pounds of qiviut a year. The average sheep produces about eight pounds of wool per year, but some breeds produce as much as thirty pounds annually per animal. Although muskoxen are larger than domestic sheep, they are not do-

mesticated and hence not bred for wool production. The muskox is still a wild animal; domestication, which takes many generations, was only undertaken in the latter half of the twentieth century. (Most agricultural animals have been domesticated for thousands of years; for example, sheep were among the first animals to be domesticated, about 10,000 years ago in Mesopotamia.) At LARS, however, there is a program of domestication of muskoxen that has been underway for fifty years. John Teal, Jr., an anthropologist, founded a small herd in Alaska, where they had been hunted to extinction, from animals captured in Canada. He began the domestication project in 1954 and established the muskox farm with the University of Alaska in 1964.

Teal's philosophy in domesticating the muskox was that the domesticated animals and plants of each of the world's major biogeographical zones should be selected from among the indigenous species of those areas, rather than continuing the often unsuccessful attempts of preceding millennia to transplant a few traditional domesticates to every corner of the globe.*

Starting with thirty-three animals (ten males and twenty-three females) captured from Nunivak Island in 1964 and 1965, the herd had grown to 100 by 1976. Differences in vision between the university and Teal over the herd's purpose and the conduct of the project had developed during this time, and led to a parting of ways for Teal and university researchers. Teal's original domestication project is now independent of the university, having formed a non-profit private organization in 1986, the Musk Ox Development Corporation, and relocated to the Matanuska Valley near Palmer. Qiviut from this farm and from LARS is provided to knitters



Muskox calves at the Robert G. White Large Animal Research Station.

—PHOTO BY

in the Oomingmak Musk Ox Producers' Co-Operative, and to other spinners and weavers around the state. (The word "oomingmak" is derived from an Inuit word for muskox that translates roughly as "the bearded one.") The Musk Ox Development Corporation "is dedicated to the development and domestication" of the muskox, focusing on the creation of "a gentle, non-intrusive form of agriculture to the Arctic," with the specific purpose of developing a qiviut industry for Alaska Natives. Scientific study of muskoxen continues at the Institute of Arctic Biology (IAB) and LARS, with emphasis on muskox husbandry and genetics.

Milan Shipka has been studying muskox reproduction. Animal husbandry requires a good understanding of the physiology, reproduction, behavior, and nutritional needs of the species in question, and comparatively little is known of muskoxen. (The first international muskox symposium was held in December 1984, compared to the thousands of years of study and breeding of sheep, goats, donkeys, horses, cattle, and other domestic animals.)

Shipka has been studying estrous synchronization of cow muskoxen; being able to time estrus, mating and fertilization, and hence the birth of calves is very important in maintaining healthy herds and improving their productivity. Controlling reproduction is an essential part of animal husbandry. At its most basic, this is "so you know who breeds who when," explained Shipka, but it also has many other repercussions, such as health of calves.

If calving can be timed so that the herd's young are born around the same time, then the muskox keeper can adjust management routines for the entire herd, rather than individual schedules for each animal. A good example of the advantage of this is in vaccination: muskox calves have to be at least two months old before being vaccinated, because their immune systems aren't functional enough to react to the vaccine before this age. Left to their own devices, cows in a herd will bear young over a period of about two months. This means that the muskox keeper would have to administer vaccines to individual calves over a period of two months, or wait until the youngest

* "The Muskox Domestication Project: An Overview and Evaluation," Wilkinson, Paul F. and Pamela Nunavik Teal. *Proceedings of the First International Muskox Symposium*, 1984. University of Alaska. p. 162.



calf is two months old but risk the oldest calves being unprotected for two months longer than need be. If the calves are all born within a few days of each other, then their keeper can have them all vaccinated at the same time, which is much more convenient and safer. Likewise, many other aspects of herd health and management are improved by managing reproduction.

Muskoxen go into rut in August, in large part affected by day length. Bulls in rut will roar like lions, engage in high-impact head-butting with other bulls, and gather "harems" of cows. A rutting bull muskox can be dangerous, not only to handlers and other bulls, but to the cows in its harem. If a cow is injured or

becomes sick, the bull in rut will not let people near her and will charge them if they try. Rut can last six to eight weeks, and the bulls are aggressive and hard to handle throughout. Cows have an estrous cycle of about three weeks, but are fertile for only 1-24 hours; mounting occurs during this brief period.

Shipka has discovered that by keeping the sexes apart before the start of rut and then introducing the bulls abruptly to the cows, estrus and mating will occur within a week. This results in the bulls mellowing out faster and calves being born during a one-week span rather than over four to eight weeks. In further studies, Shipka experimented with inducing estrus and fertility by using a commercial

progesterone-releasing device used for cattle, which he modified for his experiments. Removal of progesterone triggers estrus. At the beginning, progesterone levels rise, and then fall, triggering a rise in estrogen, and then release of the ova. Shipka implanted a device in a muskox cow's vagina to release progesterone over a period of a week; after the device's removal, the muskox cow's estrogen levels went up and she became fertile. The cows treated this way were then introduced as above to the bulls, and mating took place over only a one- to two-day period, further reducing the time span over which births later took place.

Shipka has also been working with George Happ, a geneticist at IAB, on



studies of the genetic potential for transmissible spongiform encephalopathy (TSE) in muskoxen. This disease, known as scrapie in goats and sheep, is more infamously known as "mad cow disease" in the strain that affects cattle. It has not yet been seen in muskoxen, but the species has not been studied nearly as intensively as have cattle, goats, and sheep, so it is uncertain whether muskoxen do not contract the disease or if it has occurred in wild populations but simply remained undetected by researchers.

Shipka, Happ, and Erik Wood, a senior thesis student, will examine the homology of muskox DNA, comparing the same region of DNA that reveals susceptibility to scrapies in goats and sheep. Some goats are more susceptible to scrapies than others, and markers in goat DNA have been identified that

correspond to resistance or susceptibility to TSE. Blood samples will be taken from muskoxen, the DNA analyzed, and compared to goat DNA. Goats are genetically very similar to muskoxen, so the same genetic region may show similarities that will be useful in predicting TSE susceptibility in muskoxen.

Reproduction management, disease management, nutrition, and calf survival are areas that need further study in muskoxen. For example, muskox calves have a high mortality rate, but researchers are still striving to understand the reasons why. Progress is being made, however: in 2001, University of Alaska Fairbanks researchers Perry Barboza (IAB) and John Blake (Biology and Wildlife Department), developed and licensed a muskox food for captive herds in Alaska. To accomplish this, Barboza and Blake conducted experiments on musk ox, caribou, and reindeer at LARS, focusing on seasonal changes in animal tissue and requirements for protein and trace minerals for reproduction and development. In more recent work, Barboza has been studying the influence of microbes in muskox digestion, and potential commercial applications for muskox digestive tract microbes and their enzymes: according to the UAF Biosciences Facilities website, "improved use of fibrous crop residues; improved use of pastures and public lands for production of meat, milk and wool in domestic ruminants; and the production of biofuels from acids and alcohols produced by fiber degradation." All ruminants rely on fermentation by microbes to help them digest their food, but muskoxen may be using theirs more efficiently or have more productive microflora than do domestic ruminants.

Such studies in nutrition, genetics, reproduction, and other areas improve the chances that muskoxen will eventually become a viable domestic animal, and that the valuable products of the Bearded One will become a regular part of Alaska's economy.

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Reindeer in Alaska: Under New Management

story and photos by Greg Finstad

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Merlin Henry did everything he could to save his reindeer herd. He went out riding his snowmachine across rough, hard-packed snow in the cold and dark, day after day, to keep what was left of his herd from mixing with the caribou. But no matter where he drove his reindeer, to the top of every hill and the bottom of every valley, into the spruce trees, and even close to the village of Koyuk, he encountered caribou wherever he went. It only took a storm and a snowmachine breakdown for him to lose his entire reindeer herd to the migrating caribou. Soon after losing his herd, he was hospitalized and underwent surgery to repair a brain aneurism. Three weeks later, against doctor's orders, he was out riding a snowmachine across his range in search of the lost herd. He caught glimpses of his reindeer mixed in with thousands of caribou, but was unable to

segregate and control the now wild and unpredictable reindeer. Merlin was devastated. The herd was his father's legacy, entrusted to him with the hope of passing it on to his own sons and daughters. Merlin Henry had been a dedicated, compassionate, hard-working herder, and now his family and the village of Koyuk were without a reindeer herd for the first time in sixty years.

But all was not lost. Merlin Henry, along with the other members of the Reindeer Herders Association, have been solving problems and overcoming obstacles facing the reindeer industry for many years. All of their efforts to improve the reindeer industry have not been without help. The Reindeer Herders Association (RHA) has been working closely in a partnership with the Reindeer Research Program at the University of Alaska Fairbanks (RRP) since 1981 to address needs of the industry.

Rural communities of Alaska have been experiencing tremendous environmental and social change over the last thirty years, and Seward Peninsula reindeer herders have been riding this wave of change with amazing adaptability and resilience. Herders have adopted modern range management animal husbandry practices, were instrumental in developing a state-of-the-art, computerized, animal identification and record-keeping system, and adopted radiotelemetry as a conventional herding tool to locate and track reindeer across large ranges.

Reindeer herding itself is relative new to the Eskimos of northwestern Alaska. For thousands of years they relied upon the relatively stable populations of marine and terrestrial mammals for their survival. Sea mammals, caribou, and muskoxen provided the mainstay of their diet (Burch, 1975). However, the influence of Euro-Americans changed

the stability of the ecosystem and the socioeconomic dynamics of western Alaska starting the mid to late 1800s.

Significant changes in the traditional hunting cycle, settlement pattern, social organization, and population distribution of all Eskimo groups in northwestern Alaska began during the period from 1850 to 1890 (Burch 1975; Ray 1975). Whaling ships ran up and down the coast of Alaska harvesting the marine mammals that were associated with the annual receding pack ice. Depending on spring weather conditions, the whaling ships were often delayed in pushing through the pack ice to reach the Chukchi Sea and Arctic Ocean. For that reason many whaling ships began to overwinter in protected areas such as Point Barrow, Point Hope, Port Clarence, and Golovin Bay (Stern et al., 1980).

Establishing permanent shore stations enabled the whalers to start the following whaling season much earlier than before. During the winter months the whalers traded with the Natives, introduced liquor and repeating rifles, and hired the local men to hunt for them.

As the whaling industry grew, hunting of local stocks of wildlife increased to supply the whalers with meat, fur, baleen, and walrus ivory. The marine and terrestrial animal populations eventually declined due to increased hunting pressure to supply the "White" commercial market.

By the 1890s muskoxen and caribou were virtually eliminated on the Seward Peninsula (Skoog 1968), and the marine mammal population declined significantly (Foote 1965; Stern et al. 1980). By the 1890s the Seward Peninsula was devoid of any large grazing herbivores, but there remained a vast tundra rangeland that could potentially be utilized in a managed grazing system, if a domestic animal could be found that was compatible with the characteristics of the forage base.

Although it is not clear when and where reindeer (*Rangifer tarandus tarandus*) were originally domesticated, across the northern Eurasian continent many groups of people selectively bred and kept them in animal production systems. Different reindeer varieties were



Unloading building materials for a reindeer enclosure at Koyuk, Alaska in 2005. The SNRAS research project on supplemental feeding and enclosures of which this work was a part was supported with federal money as part of the New Crops appropriations and by the Bureau of Indian Affairs. These funds are helping the University of Alaska to develop new agricultural products and to improve Alaska's agricultural independence.

developed to suit local conditions and human needs. The Saami of northern Scandinavia used reindeer as a milk-producing animal, while the Samoyed and the Vogul people used reindeer primarily to draw sledges. In contrast, the Tungus people of Russia bred for extremely tame reindeer used as pack and saddle animals. The Chukchi and Koryak people of Siberia developed their breed around 1000 AD in Chukotka and northeastern Yakutia. Because they herded the animals on foot, reindeer were selected for a strong herding instinct and weak migratory behavior. Chukotkan reindeer exhibit a high degree of sire fidelity even if local areas become overgrazed. This breed was further developed in Russia through selective breeding at state farms in Chukotka, Yakutia, and on the Kamchatka Peninsula to produce carcasses noted for their very fine muscle fibers and a high ratio of muscle tissue to bone.

Reindeer were imported into Alaska from Russia starting in 1891 as a means for Alaska Natives to produce a predictable red meat supply and to provide economic development. By 1896,

approximately 1,200 reindeer had been introduced and were grazing on the Seward Peninsula. The forage base encountered by the reindeer must have provided good nutrition because the reindeer population swiftly colonized the Seward Peninsula and by 1924 had risen to 242,000 animals (Stern et al. 1980). The numbers and distribution of reindeer has varied dramatically since the 1920s; however, they have continued to be the dominant grazer and a major influence on the Seward Peninsula ecosystem during the last eighty years.

In 1944 the Bureau of Indian Affairs (BIA) took over administration of the Alaska reindeer operation and initiated a program to privatize and improve reindeer management on the Seward Peninsula (Stern et al. 1980). A plan was developed to set up nineteen reindeer grazing permit areas in large designated ranges on state and federal lands, to introduce intensive herding, and improve handling and slaughtering methods (Fig. 1, p. 21) (Stern et al. 1980).

In 1971 the reindeer producers organized into the Reindeer Herders

Association and initiated a plan to standardize and improve range management practices (Bader and Finstad 1999). Since the 1970s RHA has been particularly aggressive in its goal to modernize the Seward Peninsula reindeer industry and be on the "cutting edge" of developing new strategies, techniques, products, and technological advances (RHA 1979).

The Reindeer Herders Association and the Reindeer Research Program have collected years of animal production and health records for Seward Peninsula reindeer herds. These records, organized in a database, are used by herders to make management decisions. Initially they did not have direct access to this database because it was stored in proprietary software on unnetworked computers. Now, via the Internet, they will be able to view records and make management decisions before summer or winter handlings and query and browse herd records year round. Viewing individual animal records on line, they can select animals for culling or breeding based on production history.

The management structure of the Seward Peninsula reindeer industry is much different than found in Scandinavian countries or Russia. Individuals or families were given exclusive grazing rights on designated ranges averaging 400,000 hectares in size (Fig. 1). In this way the herder is encouraged to, and has a vested interest in, managing the reindeer and grazing resources in a sustainable manner. To develop sustainable range management plans for reindeer, the herders association requested assistance from the Alaska Soil & Water Conservation District and the United States Department of Agriculture Soil Conservation Service (SCS), now the Natural Resources Conservation Service (NRCS).

In response, the NRCS initiated a vegetation inventory and mapping of the four million hectares of permitted rangeland on the Seward Peninsula. The range survey was conducted to provide information useful for reindeer range planning and management, with special emphasis on monitoring range conditions and establishing maximum

stocking densities. Survey objectives were to: identify, map and describe "ecological sites"; describe plant community characteristics of each ecological site; and quantify plant communities in terms of species composition and annual productivity.

Seward Peninsula vegetation is classified as tundra. The diversity of soil environments and microclimatic zones create a mosaic of vegetation types ranging from high elevation alpine tundra to tidal-influenced marshlands. The landscape is not dominated by one or two vegetation communities, but by an assortment of communities made up by a multitude of graminoid, shrub, forb, and lichen species. The NRCS developed digitized maps of thirty-nine ecological sites found across the Seward Peninsula (Fig. 1). Plant species composition and cover, annual plant productivity, and biomass were described for each ecological site (Swanson et al. 1985).

Reindeer on the Seward Peninsula exhibit fast growth rates during summer and achieve a high body mass and reproductive rate compared to other circumpolar *Rangifer* populations (Finstad and Prichard 1999). Thus, because they have high demands for nutrients during times when nutritional

characteristics of the forage base are diverse and ephemeral, being in the right place at the right time is very critical for their productivity (Klein 1990, Staaland, and Saebo 1993). This means that reindeer producers must recognize the dynamic nature of forage chemistry so they can develop seasonal or rotational grazing strategies that complement the unique nutritional qualities of each designated range. The seasonal placement of reindeer in areas where concentrations of nutrients and digestibility of forage plants are high will ensure maximum growth of the individual and overall production of the grazing system.

The Reindeer Research Program developed seasonal nutritional profile models of forage plants found across the Seward Peninsula to predict and identify high-quality forage areas throughout the growing season (Fig. 2). The seasonal nutritional profile was coupled with forage biomass data to construct an online mapping program to identify the most nutritious ecological sites or larger grazing areas for reindeer (Fig. 1).

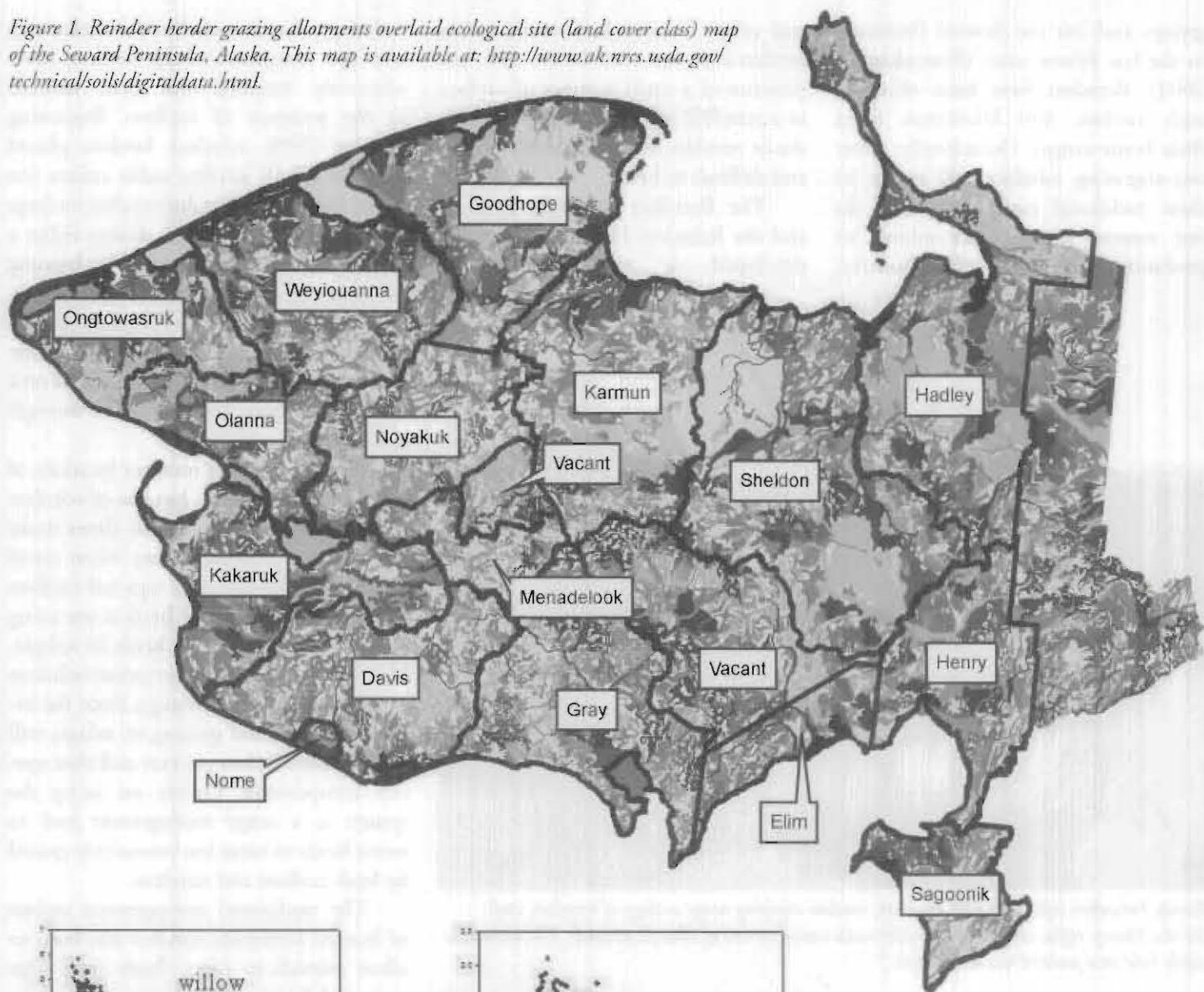
Herders can use the interactive nutritional maps to guide placement of reindeer on large diverse and dynamic ranges. By using this nutritional atlas, the producer can develop a general seasonal



Merlin Henry (center, facing away from camera), two of his nephews, and Greg Finstad (center, facing toward camera), who is using a pneumatic post pounder in 2005 to construct an enclosure for Henry's reindeer.

—PHOTO COURTESY REINDEER RESEARCH PROGRAM

Figure 1. Reindeer herder grazing allotments overlaid ecological site (land cover class) map of the Seward Peninsula, Alaska. This map is available at: <http://www.ak.nrcs.usda.gov/technical/soils/digitaldata.html>.



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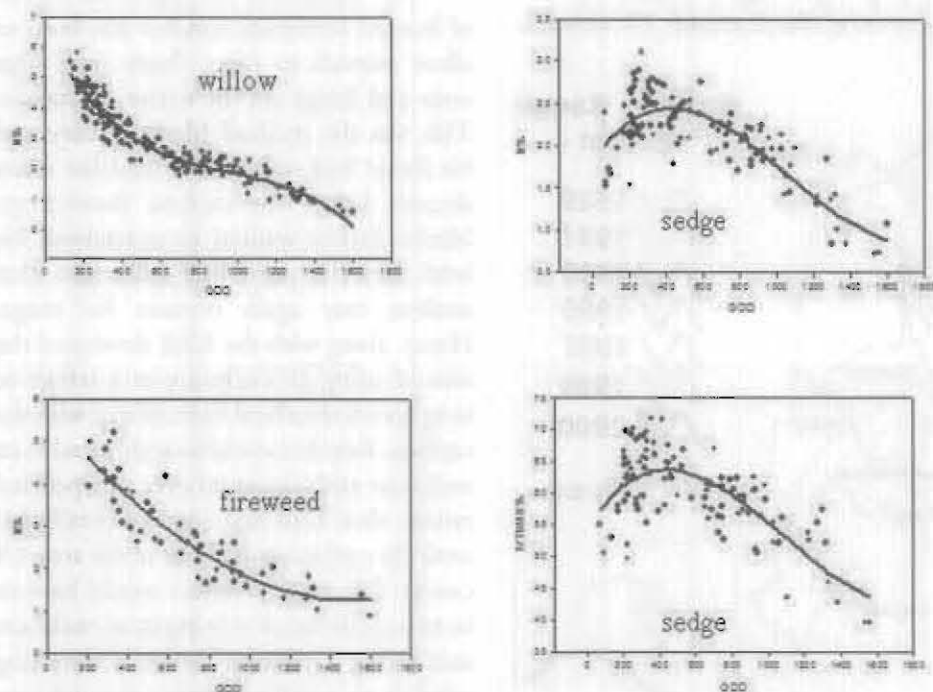


Figure 2. Examples of the relationship between Growing-Degree-Days (GDD) and some of the nutritional characteristics of reindeer forage plants found on the Seward Peninsula. These relationships were integrated with ecological site biomass data to generate seasonal nutritional maps to be used by reindeer herders to place animals in areas of high quality forage.

grazing plan using species distribution and date as the predictor of forage emergence and quality, and can refine animal placement depending upon the unique thermal characteristics of the range.

Locating and tracking reindeer on remote ranges when caribou are present has become critical to the viability of many herds because of the recent dramatic increase in the Western Arctic Caribou Herd that has severely affected Alaska's reindeer industry. This herd has increased from 75,000 animals in 1976 to approximately 463,000 animals in 1996 (Dau 2000). During this time, winter range of the Western Arctic Caribou Herd shifted west onto traditional reindeer ranges of the Seward Peninsula (Fig 3). Thousands of reindeer have commingled with migratory caribou

groups and left the Seward Peninsula in the last fifteen years (Finstad et al. 2002). Reindeer have been observed with caribou 640 kilometers from their home ranges. Occasionally, some out-migrating reindeer will return to their traditional range, but many do not return, instead succumbing to predation, harvest by caribou hunters,

and other factors. As a result, many herders have lost their herds. Also, the presence of a small number of caribou in a reindeer herd will cause otherwise docile reindeer to become easily excited and difficult to herd.

The Reindeer Research Program and the Reindeer Herders Association developed a new management

technique that uses satellite radiotelemetry and the Internet to help herders more effectively monitor and herd animals in the presence of caribou. Beginning January 1999, reindeer herders placed Telonics ST-18 satellite radio collars (on either five- or ten-day duty cycles) on large dominant female reindeer during either a June or a winter handling, or by lassoing or using a net-gun from a snowmachine. The Reindeer Research Program uses a mapping workstation to create real-time reindeer location maps that are placed on a dedicated website that is accessed through the Internet.

Herders not only monitor locations of reindeer in their herds, but also of reindeer swept up by caribou, and at times make an effort to recapture them when travel conditions improve and regional caribou numbers decline. Some herders are using the system to hold their herds in refugia. However, this is not a permanent solution or even a long-term strategy, since the intensive year-round grazing in refugia will likely deplete lichen reserves and alter species composition. Others are using the system as a range management tool to move herds to areas less intensively grazed by both caribou and reindeer.

The traditional management regime of Seward Peninsula reindeer has been to allow animals to range freely over large areas and forage on the native vegetation. This was the method Merlin Henry and his father had successfully used for many decades before the caribou showed up. Merlin Henry wanted to re-establish his herd, but the possibility still exists that caribou may again overrun his range. Henry, along with the RRP, developed the idea of using an enclosure as a refuge to keep his reindeer herd from mixing with the caribou. Reindeer could be acclimated to an enclosure and converted over to a pelleted ration, then held and supplementally fed until the caribou moved out of the area. Of course, free-range reindeer would have to be acclimated to living in an enclosure and eating a pelleted ration. Converting reindeer to a pelleted ration may take up to two weeks, with some animals never accepting the new diet.

Henry and the RRP came up with a plan to train the reindeer to readily leave



Randy Fulweber, left, a SNRAS graduate student studying range ecology of reindeer, and Merlin Henry, right, attaching a satellite radio collar on one of Henry's animals. The animal is safely held in a padded reindeer "crush."

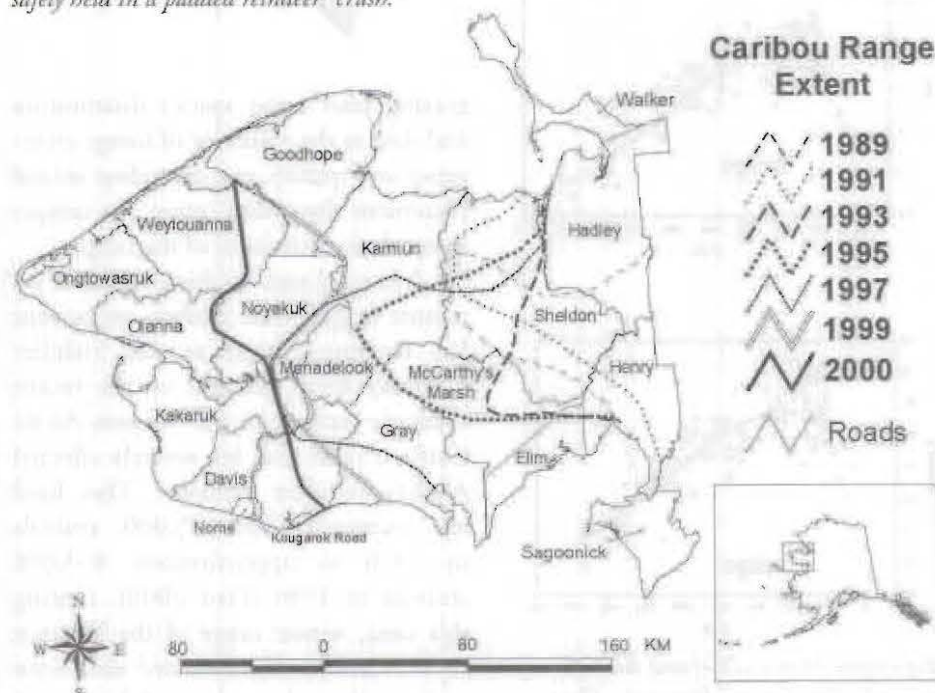


Figure 3. The westward shift of the Western Arctic Caribou Herd winter range on traditional ranges of the Seward Peninsula.

the enclosure for the day and graze in an area chosen by Henry. After the reindeer were allowed to forage they would then be returned to the enclosure at night. It was thought that if reindeer became accustomed to moving easily in and out of a pen and grazing close to home, then this strategy could be implemented if caribou suddenly moved into the area. If the caribou remained in the area, then reindeer would readily accept a supplemental ration without a difficult or prolonged conversion. After caribou moved out of the area, the reindeer could be released back unto the range and allowed to freely graze once again.

In October 2005 Henry and the RRP constructed an enclosure outside the village of Koyuk. Tom Gray, a herder from White Mountain, Alaska, donated one male and nine female calves with one adult female to use as seed stock to reestablish a reindeer herd in Koyuk. Crates were built and the animals were flown to Koyuk and released into the enclosure, their new home in January 2006. The RRP had manufactured an experimental lichen/barley starter pellet to facilitate feed conversion. Surprisingly, the animals converted to the pellet on the third day in the enclosure and consumed

it with relish. The reindeer quickly habituated to close contact with humans and were eating out of Merlin Henry's hand in a matter of weeks. The reindeer soon developed a strong fidelity to the site and would remain in the general area when released from the enclosure. The enclosure and supplemental feeding are now being used by Henry on a needs basis to keep his new herd away from migrating caribou.

Some reindeer producers wish to use enclosures and supplemental feeding during the calving season. This management option is being looked at to reduce loss of calves to predation and to increase the control of animals during a critical life event. Supplemental feeding of reindeer immediately pre- and postcalving may help the nutrition of females during a time when energy and nutrient demands are high.

The climate of the Seward Peninsula is expected to change, with increased winter temperature, wind velocity, snowfall, and occurrence of rain-on-snow events. These events will likely increase the depth and density of snow and increase the energetic costs of digging and foraging, which may negatively influence the winter condition

of reindeer with dramatic downturns in overall production. Supplemental feeding of reindeer during winter in Scandinavia has been shown to increase nutritional status and production of reindeer (Jacobsen and Skjenneberg 1979, Stalaand and Sletten 1991, Nilsson 2003) and is being considered for Seward Peninsula reindeer herds.

The leadership of the Reindeer Herders Association has been a catalyst for change for the reindeer industry because the members have a keen interest in (and a comprehensive understanding of) the local environment, policies, and a global awareness of the alternatives they have in taking action. This has been cultivated by the close working relationship they have had with researchers and agencies. This relationship led to exposure to science and technologies through travel and exchanges, participation in workshops and conferences, and an active role in developing and evaluating research and policy.

Today, the practice of reindeer herding in Alaska is continuing to change dramatically in response to the physical and socio-economic environment. Supplemental feeding and enclosures are being used to intensify management by

Henry's enclosure near the village of Koyuk. These are large, healthy yearlings. An unexpected side benefit to the combination of enclosures and supplemental feeding was increased body size in the reindeer, meaning higher productivity for his herd.



controlling animal locations and providing value-added use of their ranges. Satellite telemetry and forage quality mapping coupled to the use of the Internet allow herders to monitor range use and move their animals across the landscape to optimize the use of their ranges like they never have before.

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Breeding a new barley variety for Alaska

by Doreen Fitzgerald

Fifteen years of plant breeding work has resulted in the 2006 release of a new barley variety, Wooding, by the Alaska Agricultural & Forestry Experiment Station (AFES). The new six-rowed spring barley was developed by crossing a Finnish breeding barley (Jo1632) and Otal, a variety released by AFES in 1981. Jo1632 was developed at the Plant Breeding Institute of the Jokioinen Agricultural Research Centre (now Boreal Plant Breeding Ltd.) in Jokioinen, Finland. "It is an early maturing, high-yielding research variety," said Robert Van Veldhuizen, the AFES research assistant responsible for much of the work on Wooding barley.

The name Wooding was chosen to recognize the agronomic contributions of the late Frank J. Wooding, professor emeritus of agronomy at UAF. Much of his work with grain is reported in AFES Bulletin 111, *Performance of Agronomic Varieties in Alaska, 1978–2002*, by Van Veldhuizen and Charles W. Knight.

Work began on Wooding barley in 1990, when the new cross was made by Stephen M. Dofing, who then was the plant breeder and assistant professor of agronomy at AFES. The purpose was to improve upon the early maturity, feed quality, and grain and straw yields of Finaska, a variety under development in 1990 that was released for commercial production in 2001.

Barley, like wheat and oats, is a self-pollinating crop species. Varieties of these species can be maintained without change for many generations. To improve an existing variety, genetic variation is created by hybridizing between parental varieties that may contrast with each other in possessing different desirable attributes. From their progeny, selections are made based on what new trait is desired. This system is known as pedigree breeding. It is the most common method and can be varied in several ways.

Another method is to start with a known variety and select a single plant for a specific desired characteristic, such as height, and then plant seeds from that one plant. "In Canada, using Otal as a parent, the barley variety Albright was developed this way, through a single head selection," said Van Veldhuizen.

All plant breeding is based on selection: choosing from populations of plants those having the desired combinations of characteristics. Seeds from the selected plants are used to produce the next generation, from which a further cycle of selection may be carried out if there are still differences.

Conventional breeding is divided into three categories on the basis of ways in which a species is propagated. In



Barley ear from a 1991 crop.

—AFES FILE PHOTO

self-pollinated species such as barley, fertilization usually follows the germination of pollen on the stigmas of the same plant on which it was produced. The other categories are cross-pollination, in which fertilization usually follows the germination of pollen on the stigmas of different plants from those on which it was produced; and asexual propagation, in which the commercial crop results from planting vegetative parts or by grafting.

The creation of the original cross of two barley varieties is no small matter. The breeder starts in the fall by planting in several hundred pots the breeding barley and planting an equal number of seeds of the other parent variety. These are grown in a greenhouse. When the plants flower and are ready for fertilization, the male parts of the breeding barley are removed and used to fertilize the female parts of the second variety. Each plant has thirty flowers, each about the size of a pinhead, so this cross-fertilization procedure is performed under a dissecting microscope thirty times for each of hundreds of plants.

The fertilized plants are then grown to maturity. When the resulting seeds (about twenty) are collected from a plant they are stored in a small envelope and numbered. When these seeds are grown in numbered plots in the field, there will be about twenty plants for each of the hundreds of crosses that were originally performed (about 200,000 plants).

"This is the point where we start looking at plant characteristics (tall stalks, strong, straw, early maturity, kernel quality," said Van Veldhuizen. "Out of the thousands of plants, we may only save a few hundred for the next round of selections."

During the third year the number of selections will have been reduced to between 50 and 100. "By this time we will have 10 to 15 pounds of seed to play with, and can plant in bigger plots. Because we now have more plants, this is the point where we start looking for uniformity. If a selection does not exhibit uniformity of characteristics, it is eliminated at this time."

Progeny of the cross between (Jo1632) and Otal were grown in bulk from 1991 to 1998, at which time spikes (ears of grain) were selected on the basis of early maturity and such characteristics as spike length and kernel size. In 1999, seed from these spikes was sown and forty-four selections were made on the basis of early maturity, straw strength, and uniformity. These were grown at Fairbanks in 2000 to increase seed.

Once there are about twenty-five selections that exhibit uniform characteristics, the next step is to see how they can adapt to different environmental conditions, such as soil and growing season length. At AFES, the selections can be grown at Fairbanks, Delta Junction, and Palmer.

"Now we start to compare the plants with a known standard, well-tested variety, such as Oatal. The number of selections are reduced to by about twelve by looking at which ones do best at all three locations. It takes about eight years to get to this point, and now making selections get more difficult," Van Veldhuizen said. "There is little variation,

and because the remaining selections are mostly the same, the basis for the next selections are mostly subjective."

A farmer may prefer an upright awn, which holds water, or a nodding head. Which do you want? What is the awn length? How easily does the awn separate during threshing? By answering questions like these, the number of selections is reduced to five or six.

These remaining selections are grown in all three locations for more than one year to eliminate year-to-year variability. During this phase, unusual weather, such as a prolonged dry or wet spell, may confuse variability results, making it necessary to throw out a season's work. Due to drought in Delta, selections for Wooding barley had to be grown for five years.

At the time a final selection is made, there is now enough seed to plant many acres and the selection is grown for several years to increase the amount of available seed. Barley is planted at about eighty pounds of seed per acre.

In five years of testing at Fairbanks, Palmer, and Delta Junction, from 2001 to 2005, Wooding produced higher yields and had greater test weights than Finaska barley grown during the same period. Kernel size and shape are similar for the two varieties and they matured within one day of each other. Wooding plant height was 3.15 inches taller than Finaska, which represents a 12 percent increase in straw yield. Straw strength (lodging resistance) was comparable. Lodging is the breakage of the stalk below the ear, which causes bent plants and grain loss during harvest.

In August 2006, the registration of Wooding barley was published in *Crop Science*, the publication of the Crop Science Society of America by Van Veldhuizen, Dofing, Knight, and Mingchu Zhang, SNRAS assistant professor of agronomy.

"The Palmer Plant Materials Center, which is part of the Alaska Division of Agriculture, has the responsibility of maintaining a supply of the seed. This spring we will give them a thousand pounds of Wooding seed. They will plant



Dr. Frank J. Wooding, 1941-1994.
—PHOTO COURTESY JORIE BAUTISTA WOODING

it to create a seed stock that will then be available for distribution to Alaska farmers," said Van Veldhuizen.

Van Veldhuizen said that AFES is now at the twelve-selection stage for a hullless barley variety that is a cross between Jo1632 and Thual. Besides Wooding, barley varieties developed at AFES include Thual, Otal, Finaska, Datal, Lidal, Weal (hooded), and Trapmar (1920).

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About common barley—*Hordeum vulgare*

by Doreen Fitzgerald

Barley is a wonderful plant. Not only is it good for animal feed, brewing, bread, and soup, it is the most adaptable of all cereal grains. It can grow in diverse climates: the subarctic, the tropics, temperate zones, and such near-desert areas as North Africa. Among cereal crops, it ranked fourth worldwide in quantity produced and in area of cultivation in 2005, when it was grown in about one hundred countries. A member of the grass family, barley is more tolerant of soil salinity than wheat and can thrive in conditions that are too cold for rye. It has moderate moisture and fertility requirements, and it can grow and can grow in fine-to-medium textured soils with a pH range of 6.5 to 8.5.

Where this ancient grass first appeared and where it was first cultivated are uncertain. The first wild plants may have grown in the Ethiopian highlands or in Tibet. Barley is derived from a wild species similar to *Hordeum spontaneum*, which occurs widely in Turkey and Syria. Nine or ten thousand years ago, development of a tough rachis, which prevents the grains from scattering before harvest, was the morphological change that made domestication worthwhile. In the 1500s, wheat began to overtake barley for bread making, and today most barley is ground into livestock feed, although it is still an important human food in northern Germany, Finland, Tibet, and Ethiopia. About one quarter of the U.S. barley crop is made into malt for brewing beer and whiskey.

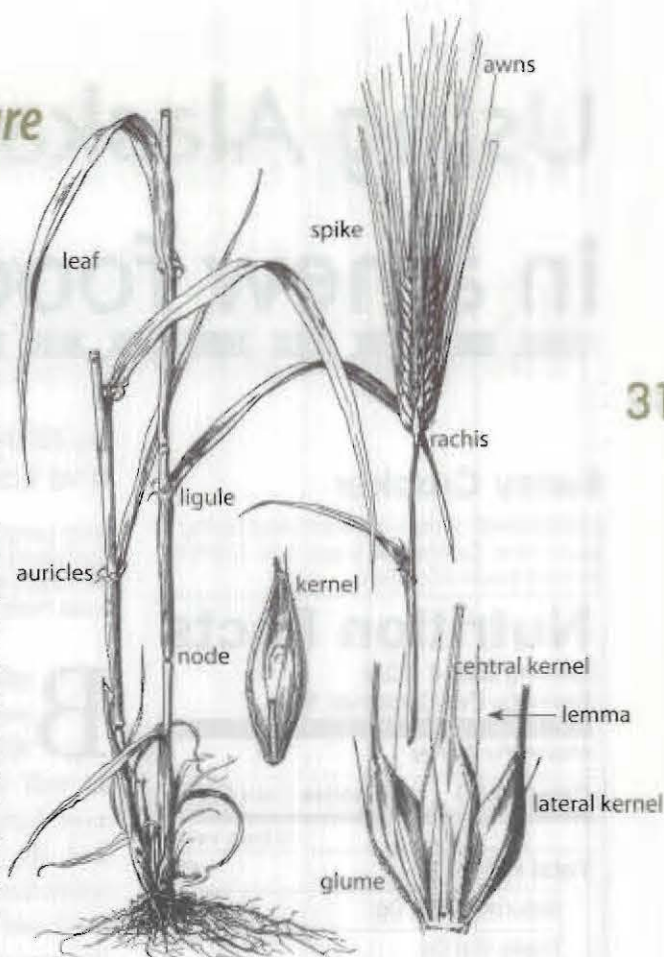
Barley varieties are either winter or spring annuals. To produce flowers and set seeds, winter annuals require exposure to cold, so they're planted in the fall. After having a rosette type of growth in fall and winter, they develop elongated stems and flower heads in early summer; they form branch stems or tillers at the base, so several stems rise from a single plant. Spring varieties, such as the barley grown in Alaska, don't require exposure to cold and develop fewer tillers than winter varieties. For

best production they're seeded as early as land can be worked in the spring. The period from flowering until barley is ready for harvest may vary from 40 days to as long as 55 days, varying with varieties and climatic conditions.

Depending on the variety and growing conditions, the stems of both winter and spring barley vary in length from one to four feet. Stems are round, hollow between nodes, and develop five to seven nodes below the head. A clasping leaf develops at each node. Leaves vary in shape and size with variety, growing conditions, and their position on the plant.

The spike, which contains the flowers and later the mature seeds, consists of spikelets attached to the central stem or rachis. In dense-headed varieties, stem intervals between spikelets are two millimeters or less; in open-headed (or lax) kinds, four or five millimeters may separate the spikelets. Three spikelets develop at each node on the rachis. Barley varieties are classed as two-row or six-row. In two-row varieties, only the central spikelet develops a fertile flower and seed. In six-row varieties all three of the spikelets at each node develop a seed. Each spikelet has two glumes rising from near the base that terminate in an awn. Glumes may be hairy weakly haired or hairless, and are removed by threshing. The lemmas in barley are usually awned. Awn length varies from very short to as much as twelve inches. Awn edges may be rough or barbed (bearded) or nearly smooth. Awnless varieties are also known.

The barley kernel consists of the internal seed (caryopsis), the lemma and palea. In most barley varieties the lemma and palea adhere to the caryopsis and are a part of the grain following threshing. In naked or hullless varieties, the caryopsis is



free of the lemma and palea and threshes out free as in wheat. This type is usually grown for human food.

Cooking Barley

Whole hulled barley (brown, unpearled) is about twice as nutritious as pearled barley, which is the easiest to find. Scotch barley (pot barley) is less refined than pearl barley. To cook: add one cup of pearled barley to three cups of boiling water and simmer, covered for 45 to 55 minutes. For whole barley (a hullless variety), add one cup of barley to four cups of boiling water and simmer covered for 60 to 100 minutes.

For **Scottish barley pudding**, add one generous cup of Scotch or whole barley to water in a heavy saucepan and bring slowly to a boil, then simmer for 90 minutes, stirring occasionally. Add 1/3 cup currants, 1/3 cup raisins, a pinch of salt and simmer another 15 minutes. Serve with castor sugar (superfine or baker's sugar) and single (light) cream.

Recipe source: http://www.glasgowguide.co.uk/scottish_recipes_Barley_Pudding.htm

Using Alaska's hulless barley in a new food product

32

Barley Cracker

INGREDIENTS: Water, Alaska hulless barley, Egg whites, Canola oil, Sugar, Salt. Contains trace amount of gluten.

Nutrition Facts

Serving Size 8 (32g)
Servings Per Container 16

Amount Per Serving

Calories 60 Calories from Fat 30

% Daily Value*

Total Fat 3.5g 5%

Saturated Fat 0g 0%

Trans Fat 0g

Cholesterol 0mg 0%

Sodium 45mg 2%

Total Carbohydrate 6g 2%

Dietary Fiber 1g 4%

Sugars 1g

Protein 1g

Vitamin A 0% • Vitamin C 0%

Calcium 0% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories	2,000	2,500
Total Fat	Less Than	65g	80g	
Saturated Fat	Less Than	20g	25g	
Cholesterol	Less Than	300mg	300 mg	
Sodium	Less Than	2,400mg	2,400mg	
Total Carbohydrate		300g	375g	
Dietary Fiber		25g	30g	

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Calories per cracker: 7.5

Above: nutrition facts label for barley crackers. In 2006, a barley cracker nutrition label was developed using the Genesis R & D, SQL product formulation and labeling software from ESHA Research. The software provides a nutrition analysis based on the ingredients of the food product. A serving size of eight crackers (32 g) was based on equivalent serving sizes for other commercial cracker products. Each cracker (5cm wide, 8cm long and 2-3 mm thick) contains 7.5 calories.

by Kristy Long
and Kamoluck Trateng

Kristy Long is a foods specialist and Kamoluck Trateng is a research technician with the UAF Cooperative Extension Service Food Product Development program.

Barley is an important grain crop worldwide and particularly in Alaska because varieties exist that do well in a harsh climate. Although most barley is today grown for animal feed, the benefits of barley for human health have recently been affirmed by the Food and Drug Administration, which announced in May 2006 that foods containing barley could carry the claim that they reduce the risk of coronary heart disease. According to the FDA rule, whole grain barley as well as dry milled barley products such as pearled barley kernels, flakes, grits, and flour, which provide at least 0.75 grams of soluble fiber per serving, may bear the health claim on product labels (Cianci, S. 2006). The new rule is supported by scientific evidence that indicates including barley in a healthy diet can help reduce the risk of coronary heart disease by lowering LDL and total cholesterol levels.

One of Alaska's cereal grain crops is the hulless Thual barley, a cross between the Finnish cultivar Otrá, and an unnamed Irish hulless line (Van Veldhuizen, R. and Knight, C. 2004). The early maturing Thual is a mid-tall, moderately stiff-strawed, rough-awned, six-row, naked-kerneled spring barley released in 1981 by the USDA plant breeding program at the AFES Palmer Research and Extension Center (Van Veldhuizen, R. and Knight, C. 2004). Van Veldhuizen, a research assistant with the UAF School of Natural Resources and Agricultural Sciences, has continued experimenting with

daughter lines of the hulless Thual barley to select for shorter-stemmed, stiffer-strawed, hulless lines that remain upright as the crop matures. Alaska's wet and windy August weather can result in crop losses of up to 75 percent if the mature barley lies on the ground and becomes soaked in the field (Duffy, R. 2006 and Van Veldhuizen, R. 2006). Twelve distinct daughter lines have been identified that meet Alaska's growing requirements and would result in increased harvest yields.

Hulless grains in Alaska have been primarily marketed as an animal feed and as a whole grain in local health food stores (Van Veldhuizen, R. and Knight, C. 2004) but attributes such as Thual barley flour's mild nutty flavor and health benefits increase its potential for human food consumption in other food products.

Developing a barley cracker

Van Veldhuizen and Knight wanted to know if the twelve daughter lines of hulless barley taste the same as the Thual variety, and posed this question to the researchers at the food product test kitchen. To provide a useful answer, a food product utilizing barley flour had to meet the following criteria: it had to accentuate the taste of the barley flour; minimize competing flavors from other added ingredients; be an acceptable product for sensory test participants; and maintain a standard of quality for the duration of the product preparation and testing.



Standard recipes for baked products, such as breads, muffins, quick breads, cookies, bars, and crackers were evaluated against the criteria. Experimentation with several different products indicated that crackers would match more of the criteria than other products.

The original cracker recipe was modified extensively, one ingredient and proportion of ingredients at a time, until the barley cracker recipe used in sensory testing was developed. The final recipe was pilot-tested to determine if it would be an acceptable product for sensory test participants. This informal testing indicated that individuals found the barley crackers acceptable; in fact, a majority of those tasting the crackers returned and asked for additional samples. The new barley cracker recipe became the food product consumer sensory panelists would taste to determine if crackers made from the twelve daughter-line barley flours tasted the same as the crackers made from Thual variety flour.

Consumer sensory evaluation of barley crackers

The basis of sensory evaluation experimental design is the question researchers want answered (CreaScience, 2002). Since the question here was one of similarity or difference in taste, the evaluation method used was a test for similarity utilizing consumers as the panelists. Similarity testing in sensory analysis determines whether two samples are sufficiently similar to be used interchangeably (Meilgaard, M., Civille, G.V. and Carr, B.T. 1999), in this case, the barley crackers from the recipe we developed.

Sensory evaluation consultants with CreaScience of Montreal, Canada, determined that 204 consumers would be an appropriate size for a panel for evaluating the crackers and answering the sensory question. Consumers would be asked to evaluate twelve pairs of barley crackers, each pair consisting of one cracker using flour from the Thual variety and one from flour from one of the twelve daughter lines. Consumers



George Aguiar pouring barley cracker batter onto baking sheets.

—PHOTO BY KRISTY LONG



Kamolluck Trateng scoring the crackers. The crackers are baked about 8 minutes, and then scored and baked another 16 to 20 minutes. Eva Wickland is at right, near the oven.

—PHOTO BY KRISTY LONG

were asked to rate the similarity in taste of the samples by scoring the pair on an eight point scale (0-7), with "No Similarity" at the 0 point end and "Complete Similarity" at the 7 point end.

Evaluation of the quantity of crackers needed for the consumer test resulted in dividing the testing into two sessions of 102 consumers. Although this added variability to the data, this option was statistically preferable to expanding the preparation and baking of the crackers

over an extended period, or reducing the number of daughters tested by each consumer to six (CreaScience, 2005).

All crackers were baked in the Cooperative Extension Service Food Product Development kitchen and the consumer test was carried out at the Wood Center ballroom on the University of Alaska Fairbanks campus. Consumers consisted of the sample of people who were in the Wood Center at UAF on the testing days and responded to an invitation to participate, and consumers

who responded to an extensive publicity campaign that reached the university campus and the Fairbanks community.

Sensory evaluation results

Dr. Ron Barry, Department of Mathematics and Statistics, University of Alaska Fairbanks, analyzed data from the sensory tests. Results indicated that there was no significant difference between the ratings of the pairs of crackers. These results mean, when evaluating taste alone, the daughter lines and the Thual variety are sufficiently similar to be used interchangeably.

Color measurement of flour, batter, and cracker crumbs

The color of the flour, batter, and cracker crumbs was measured for the Thual variety and the twelve daughter lines using an Agtron M-Series (version 204) Process Analyzer (special applications abridged spectrophotometer) for analyzing the hullless barley flour, batter, and cracker crumbs. Cracker crumbs were tested rather than the whole cracker because an attachment that would accommodate the whole cracker was not yet available. When the Agtron attachment is received, the whole crackers will be evaluated for color.

The results indicated that the Thual variety flour, batter, and cracker crumbs were darker in color than each form of the twelve daughter lines. These results have been supported by informal observations by consumer panelists and individuals sampling the Thual variety and daughter line crackers side by side.

Grain color was not analyzed because color may become lighter during storage. Grain lines harvested and stored for the same length of time will be measured for color against flour, batter, and crackers prepared from those lines.

Future hulless barley foods research

We are evaluating the following plans to continue foods research with the



Kristy Long, in apron, assisting consumer panelists at the Wood Center ballroom while they test crackers for similar taste.

—PHOTO BY KAMILLUCK TRATENG



Panelist place setting at the cracker testing.

—PHOTO BY KAMILLUCK TRATENG

Thual variety and three of the daughter lines of hullless barley:

- identify a commercial Alaska producer for the barley cracker,
- develop two new products using hullless barley flour that incorporates other Alaska-grown, -gathered, or -produced products,
- identify individual sensory characteristics of barley crackers with a trained sensory panel,

- continue physical measurements such as color and moisture content of hullless barley grain, flour, batter, and crackers.

Consumer demand for flavorful and enjoyable food products that also improve the choices they have for healthy and nutritious diets is a strong trend in the food industry. Alaska has the opportunity to meet this demand with food products that respond to this trend and also create an expanded

market for grains like Alaska-grown hulless barley.

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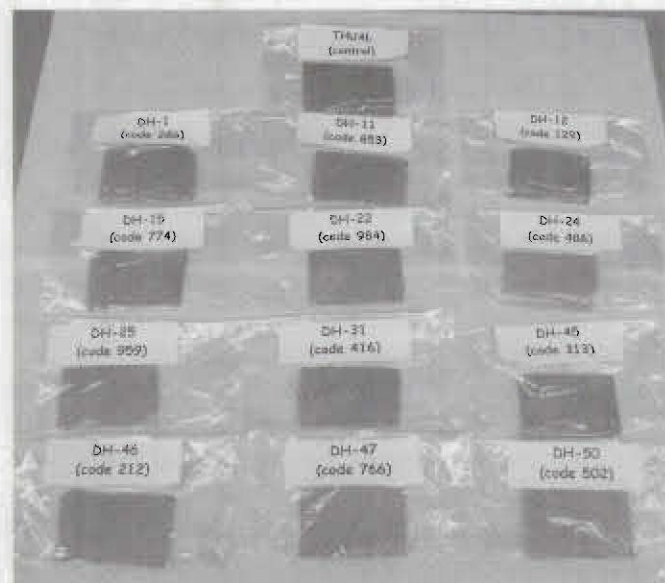
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Samples of crackers made with the thirteen different test flours, from Thual barley and the twelve daughter lines.

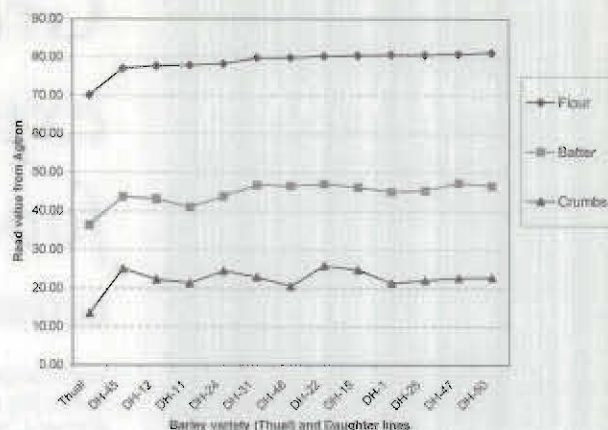
—PHOTO BY KAMILLUCK TRAINING

Agtron, M-series

(Red mode)

variety	Flour	Batter	Crumbs
Thual	70.10	36.40	13.50
DH-45	77.10	43.70	25.10
DH-12	77.70	43.10	22.30
DH-11	77.90	40.90	21.40
DH-24	78.30	43.80	24.50
DH-31	79.80	46.70	22.90
DH-46	79.90	46.40	20.50
DH-22	80.30	46.90	25.80
DH-15	80.40	46.10	24.80
DH-1	80.60	44.90	21.30
DH-25	80.60	45.20	22.00
DH-47	80.80	47.20	22.60
DH-50	81.10	46.50	22.70

Comparison in color of flour, batter and crumbs



* The value of the lightest color in red mode read by Agtron M-series is 120.30

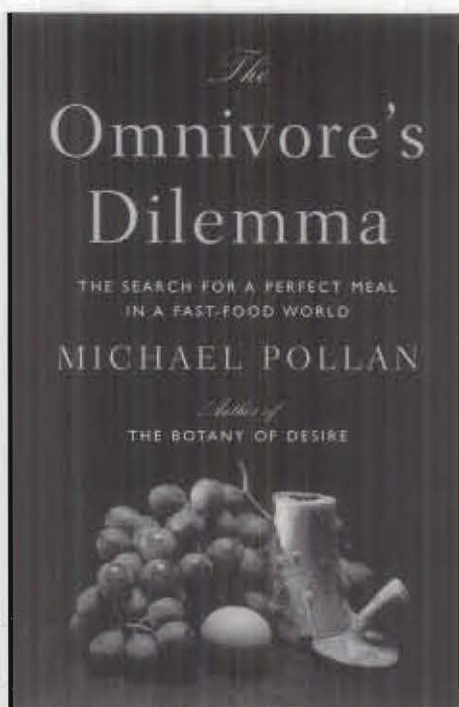
** Red mode displays the analysis result for the CW 640nm, FWHM 20nm color band. (source: Agtron Owners Manual ver. 204)

The Agtron spectrophotometer was used to measure the color and lightness of the barley flour, batter, and crumbs. A higher value corresponds to a lighter color (see also back cover). The similarity of appearance in food browning, the physical character, flavor, and cooking performance of the flours was all part of determining the interchangeability of the daughter lines with the parent barley, Thual.

Barley flour - Moisture content

Moisture content (% Moisture)

Flour variety	1st	2nd	average
Thual	9.27	9.16	9.22
DH-1	8.77	8.93	8.85
DH-11	9.07	9.10	9.09
DH-12	9.33	9.30	9.32
DH-15	9.33	9.29	9.31
DH-22	9.06	9.09	9.08
DH-24	9.26	9.10	9.18
DH-25	9.23	9.33	9.28
DH-31	9.37	9.33	9.35
DH-45	9.03	9.20	9.12
DH-46	9.33	9.37	9.35
DH-47	9.17	9.30	9.24
DH-50	9.27	9.24	9.26



Graduate seminar explores American food trips

by Doreen Fitzgerald

Seminar text: *The Omnivore's Dilemma, a Natural History of Four Meals*, by Michael Pollan. Pollan is a contributing writer to *The New York Times Magazine*, former executive editor at Harper's, and author of three other books: *The Botany of Desire: A Plant's-Eye View of the World*; *Second Nature*; and *A Place of My Own*. His numerous journalistic awards include the Reuters-I.U.C.N. Global Award in Environmental Journalism, and his articles have been anthologized in *Best American Science Writing*, *Best American Essays*, and the *Norton Book of Nature Writing*. He directs the Knight Program in Science and Environmental Journalism at the University of California, Berkeley.

"A cornfield will never again look the same to me," is one reader's response to journalist Michael Pollan's *The Omnivore's Dilemma, a Natural History of Four Meals*. Pollan examines the American food trip using the framework of four meals and the story of their ingredients, from soil to dinner plate. His introduction, *Our National Eating Disorder*, is followed by three sections: *Industrial Corn*, *Pastoral Grass*, and *Personal: the Forest*. Whether a reader accepts his culinary road map, Pollan's detailed reporting offers some serious food for thought about how we nourish ourselves.

Graduate students in NRM 692, a one-credit course, spent the fall 2006 semester responding to Pollan's book and to the questions it raises about the social, ethical, and environmental effects of his four meals. Eleven students and several faculty participated in the course, which was led by Susan Todd, associate professor of resource planning in the SNRAS natural resources management department, and Milan Shipka, associate professor of animal science and head of the SNRAS department of plant, animal, and soil sciences.

When you can eat just about anything nature has to offer, deciding what you should eat will inevitably stir anxiety.

—Michael Pollan

In a *New York Times* book review published last spring, writer David Kamp said, "Wealth, abundance and the lack of a steadying, centuries-old food culture have conspired to make us Americans dysfunctional eaters, obsessed with getting thin while becoming ever more fat, lurching from one specious bit of dietary wisdom (margarine is better for you than butter) to another (carbs kill)."

Pollan diagnoses this national eating disorder in his introduction. Writing from the perspective of an environmental journalist, he points out that the way we eat "represents our most profound engagement with the natural world" and that all food originates with plants, animals, and fungi. The meals he examines find their way to the plate in disparate ways: a McDonald's meal of processed food (corn based) eaten in the car; an organic supermarket meal produced by large-scale organic agricultural organizations; a chicken dinner produced at a self-sustaining, "alternative" farm; and a hunter-gather feast for which the food is mostly hunted or foraged by Pollan himself.

...We eat
by the grace
of nature,
not industry,
and what we're
eating is never
any more or less
than the body
of the world.

—Michael Pollan

The first section of Pollan's book delves into the American corn crop and how related government policy and agribusiness together shape many American dietary choices. Pollan shows how the policy of keeping corn cheap and plentiful through government subsidies provides a cheap raw material that benefits agribusiness (including the processed food industry) at our expense.

Corn subsidies in United States totaled \$41.9 billion from 1995-2004. According to the Environmental Working Group's Farm Subsidy Database, the top 10 percent of recipients got 69 percent of the total distributed during this period, while 80 percent of the recipients received 14 percent of the total. The organization concludes: "It's not as if the subsidies [for all crops] are 'saving the family farm.' Of the 2,128,982 farms enumerated by the most recent Census of Agriculture for 2002, only 33 percent received government payments. Two-thirds of the nation's farmers get no subsidy payments whatsoever. For the most part they don't qualify because they grow the 'wrong' things. If you want to see what the wrong things are, stroll through the produce aisle or meat department of your local supermarket. The farmers who produce most of America's food do so without a check from taxpayers."

*True or false? Of the
45,000 items for sale in
the average American
supermarket, one in four
contains corn.*

Besides being used to fatten beef cattle, milled and refined corn can be transformed into items as varied as ethanol for the gas tank, a binder for a fast food chicken, hydrogenated oil in margarine, and high-fructose corn syrup (HFCS). Cheaper and sweeter than refined sugar, HFCS has since 1980 been introduced into such foods as soda, baked goods, soup, condiments, and other processed foods. Today, 16 billion pounds of HFCS are consumed each year in the United States.

The most criticism the book received in the seminar was for section one, "Industrial Corn," which presents many negative aspects of food production in the United States. "Although I think the book is a good one overall, I found this part biased," said professor Steve Sparrow. "The author went to great lengths to report negative details that support his critique without mentioning any of the positive aspects of modern, large-scale agriculture."

Pollan describes his second meal as "my organic industrial meal" with ingredients produced on the industrial-scale organic farm, possibly processed, often transported thousands of miles, and sold in supermarkets. "Is the industrial organic food chain finally a contradiction in terms?" he asks, after examining both the quality of the food and how it's produced and transported. "Today it takes between seven and ten calories of fossil fuel energy to deliver one calorie of food

energy to an American plate," he notes. "...growing the food is the least of it: only a fifth of the total energy used to feed us is consumed on the farm; the rest is spent processing the food and moving it around...there's little reason to think my Cascadian Farm TV dinner or Earthbound Farm spring mix salad is any more sustainable than a conventional TV dinner or salad would have been."

"This book consists of a lot of opinions and emotions, as well as facts," said graduate student Brian Jackson. "In the first two sections, Pollan presents large-scale agriculture as inhumane, destructive, and unsustainable. He's not totally wrong, but he's not totally right either. This is certainly a book that should be read with caution, unless you're satisfied with taking opinions and half-truths as gospel."

Pollan's thought-provoking book doesn't analyze U.S. food production from the perspective of food security, which is defined by the U.S. Department of Agriculture (USDA) as "access by all people at all times to enough food for an active, healthy life." The USDA reports that in 2005, 89 percent of U.S. households were food secure throughout the entire year. The remaining 11 percent were food insecure sometime during the year. The prevalence of low or very low food security (hunger) remained unchanged at 3.9 percent of households, representing about 35 million people. In these households, eating patterns of one or more people were disrupted and food intake was reduced because the money and other resources for food were lacking. Pollan doesn't discuss the question of whether we could adequately feed ourselves with a system that is more local and diversified, or whether we could produce enough to help ease global hunger.

In contrast to large-scale agriculture, Pollan finds Joel Salatin on the 100-acre Polyface Farm in Virginia's Shenandoah Valley. A third-generation alternative farmer, Salatin sells his goods only to local customers, rotates animals and crops, and produces food without pesticides or artificial fertilizers. His Polyface Farm has a mission statement: "To develop agricultural prototypes that are environmentally, economically, and emotionally enhancing and facilitate their duplication throughout the world." Salatin's family farm services more than 400 customers, farmers' markets, metropolitan buying clubs, and 30 restaurants with beef, pastured poultry, eggs, pork, forage-based rabbits, pastured turkey, and forestry products through what they call "relationship marketing." He is the author of several books, his most recent being *Holy Cows and Hog Heaven*, in which he maintains that people are increasingly aware that their cheap food is flavorless, unsafe, and produced under nightmarish conditions; and that many of them are willing to pay more for the good quality food grown by his sort of farm. He aims for a model of small-scale farming that is "humane, healthy, diverse, and profitable." The ingredients for Pollan's chicken dinner from this farm have very different soil-to-plate routes than the processed chicken nuggets his son consumed during the fast-food meal Pollan bought for his family.

An even greater difference is recognized by Pollan after his up-close and personal hunter-gather experience. While he doesn't suggest that we give up agriculture and return to hunting and gathering, he uses this meal to illustrate the difference in how people relate to what they eat and to the natural world that produces their food.

It's clear, that given Earth's current and projected population, that neither the fast-food or the subsistence model are sustainable. People are already hungry; worldwide about 789 million people suffer from chronic hunger, according to the World Resources Institute, and malnutrition accounts for one in fifteen deaths. Although Pollan doesn't prescribe how we should feed ourselves in the future, he does present a concluding challenge: "...imagine for a moment if we once again knew, strictly as a matter of course, these few unremarkable things: What it is we're eating. Where it came from. How it found its way to our table. And what, in a true accounting, it really cost."

The students and faculty ended the semester with a movie "The Future of Food," an award-winning documentary film that reviews important questions related to genetically modified foods, food production, and the need for more public debate. During the film and discussion, a potluck dinner was served that featured food that was grown, caught, hunted, and foraged in Alaska. The menu included smoked salmon, baked salmon, halibut, reindeer brats, moose, potatoes, barley bread, raspberry-rhubarb jam, Eskimo ice cream, ice cream donated by Northern Lights Dairy, and carrot cake.

Omnivore's Dilemma: a student response to chapters 14 and 15

Chapter 14, The Meal, Grass Fed and Chapter 15, The Forager

by Katie Villano, UAF graduate student

"Transformation" appeared to be the theme bringing the meal together at the end of the pastoral food chain. The section is concluded with a meal made entirely from locally grown products, all derived from the grass in some way. The transformations not only included the immediate soil-plant-animal-human transformations involved in the chicken derived meal, but the transformations in the organic movement as a whole. Section II "Pastoral-Grass" began detailing the big organic industry, how it evolved from the countercultural organic movement, and how it transformed to fit a capitalist-industrial system.

The section progresses with Pollan's experiences at Polyface Farm, and documents another sort of transformation: Salatin's reaction to the big organic wave is to produce food in a local, pastoral model that mimics the natural world.

On a smaller scale, just within chapter 14, transformations abound. The acts of converting grass into chicken, turning compost into corn, cooking meat, preparing the meal, even our own eating, are transformative acts. Pollan points out that even our diets have transformed (higher Omega-6 to Omega-3 ratio [p. 268]), while our bodies have not quite caught up to agricultural diet (p. 267). Pollan quotes an anthropologist saying, "The work of civilization is the process of transforming the raw into the cooked—nature into culture" (p. 264). But I would go even further to say the whole food chain is a process of transformation. Each consumer converts the consumed into products that can be further consumed by others. The work of the living is the process of transforming light into life.

I really believe that we are disconnected from the complex transformative processes that the act of eating entails. Pollan does an excellent job of reminding us of eating's layers of complexity: biological, political, social, and economic. However, I feel that he falls short by not including the cultural complexities of eating. He touches on subsistence cultures a bit in chapter 15, but I feel like he is neglecting a large part of the story. I appreciated Pollan touching on the spiritual complexities of food a little during his pastoral meal. Knowing the story of the Polyface foods, the act of eating became more spiritual for Pollan. The "debts" that he had felt "more keenly than ever" (p. 270), were debts to the earth, grass, animals, farmer, and his dinner hosts. The biological act of eating clearly transcended the eater. "In the same way that the raw becomes cooked, eating becomes dining" (p. 272). I can't help but think of bread and wine being transformed from staple foods into spiritual gifts.

The most interesting point in chapter 15 was the notion of fear and foraging. Pollan didn't know if he could actually shoot an animal. Likewise, he had a fear of eating wild plants instilled in him by his mother. This is a poignant illustration of how far civilization has moved from the food chain. How can we love and appreciate what comes from the earth when we are afraid of it? The first time I ever milked a goat, I was afraid. The first time I ever stumbled across cloudberry as a kid and ate it without knowing what it was, I was sure I was going to die. What is the solution to this disconnect from our food? Education? If I had grown up knowing all the edible berries of Alaska, not just cranberry, blueberry, and raspberry, would I have still been afraid? I am interested in how Pollan will address this topic of fear and foraging through the rest of this book.

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Further Reading

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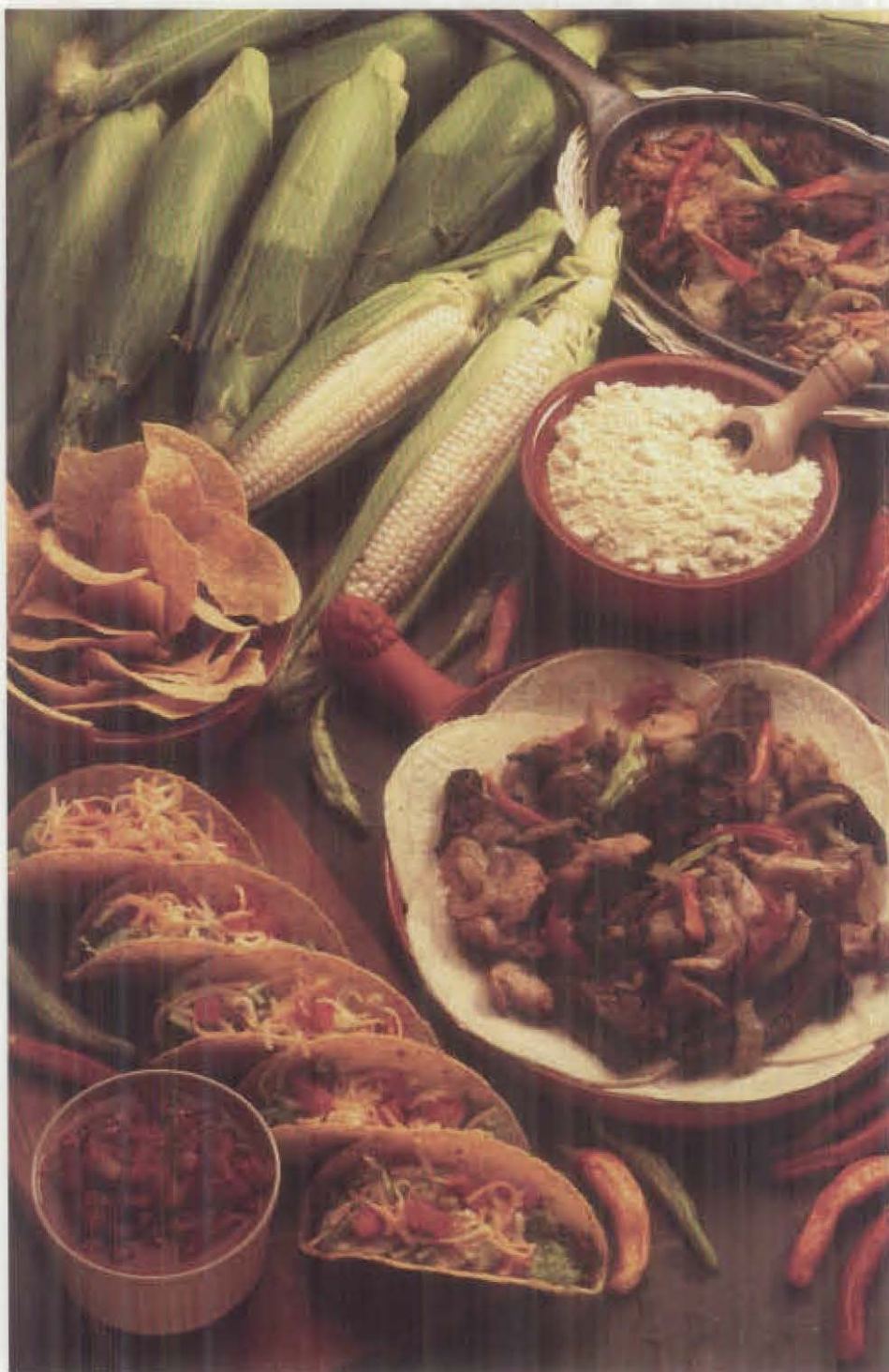
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Aside from being used in foods made from corn flour or directly as sweet corn, processed corn-derived products such as high-fructose corn syrup, hydrogenated oil, ethanol, and even corn-based plastics have been developed and used in everything from foods to food containers.

—PHOTO BY SCOTT BAUER, USDA AGRICULTURAL RESEARCH SERVICE

More information about these books and Salatin's Polyface Farm can be found on the farm website at www.polyfacefarms.com/

USDA Economic Research Service (ERS). Online briefing rooms on many topics. Each offers an in-depth discussion synthesizing ERS research and the economic issues that frame the analysis. www.ers.usda.gov/Briefing/

The USDA National Agricultural Statistics Service annually publishes Agricultural Statistics. www.nass.usda.gov/index.asp



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Color comparisons between two types of barley. From left to right: grain, flour, cracker batter, and the finished barley cracker. See story on page 32, related stories on pages 29 and 31.

—PHOTOS BY KAMOLLUK THATENG

