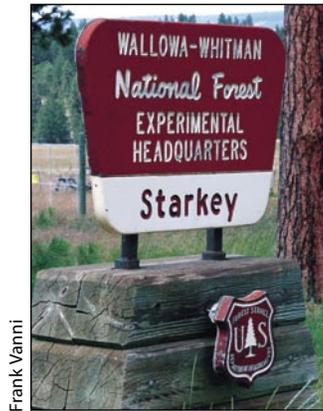


Starkey Experimental Forest and Range



The Starkey Experimental Forest and Range (Starkey) is a one-of-a-kind, world-class research facility, located in the Blue Mountains of northeastern Oregon. Starkey is the primary field location for scientific study of the effects of deer, elk, and cattle on ecosystems. Most of the 28,000-acre forest and range is enclosed by a game-proof fence.



Frank Vanni

The research project on ungulates (hoofed mammals) is conducted jointly by the USDA Forest Service Pacific Northwest (PNW) Research Station and the Oregon Department of Fish and Wildlife. Other research at Starkey includes studies on forest man-

agement, wildlife, plants, and recreation. Starkey research explores facets of disturbance ecology and the management of disturbance regimes to restore and enhance ecosystem health.

Experimental areas represent important ecosystem types and provide opportunities for short- and long-term field studies and demonstrations. One of ten experimental areas associated with PNW Research Station, Starkey and all its activities are administered cooperatively by PNW Research Station and La Grande Ranger District, part of the Wallowa-Whitman National Forest.

Environment

The entrance into Starkey is at about 4,140 feet in elevation, and the highest elevation is Bally Mountain at 4,927 feet. Broad, rolling

Cover photograph: Frank Vanni

Introduction

uplands are separated by moderately steep canyon drainages. Most of Starkey lies within the Grande Ronde River watershed; several thousand acres in the southwest corner are in the John Day River watershed.

Average yearly precipitation is 20 inches. Most precipitation comes as fall rain, winter snow, and spring rain. Very little rain falls during summer, and snowmelt is generally complete by May 1. The growing season lasts about 120 days, but no months are considered frost free. The average high and low temperatures for January are 38 and 24 °F, respectively; the average high and low temperatures for July are 87 and 53 °F, respectively.

Disturbances by fire, people, and grazing have always been part of the Starkey ecosystem, but European-American settlers changed the historical disturbance patterns. Heavy livestock grazing occurred in the 1880s and 1890s, and logging began in the 1890s. Logs were transported by river or stream in early years. From the late 1920s and into the 1950s, narrow-gauge railroads were built along most stream valleys in the Starkey area for hauling logs to mills. After 1955, logs were hauled down the new Highway 244 on log trucks. Ponderosa pine was the preferred species, and Douglas-fir and grand fir were often left as the principal seed sources.



USDA Forest Service

Starkey research led to changed hunting regulations for bull elk.

Forest Types

Forests cover about 70 percent of Starkey, intermingled with natural grassland openings. Open stands of ponderosa pine, or pine mixed with Douglas-fir, are the most common forest types and cover nearly half the Starkey acreage. The pine stands grade slowly into grasslands on south slopes.

Other forest types consist of Douglas-fir, grand fir, and

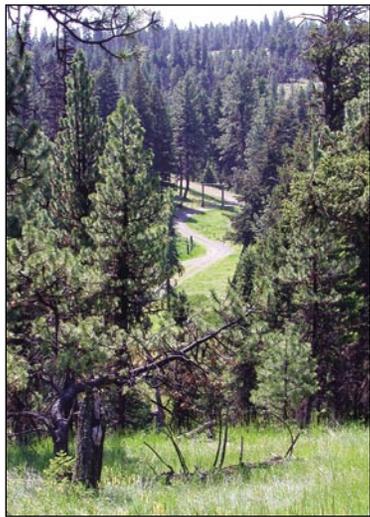


Starkey is the only Forest Service area in the United States that is both an experimental forest and an experimental range.

western larch, found on north slopes, some flats, and lower slopes in canyons. Some Engelmann spruce and Pacific yew grow in canyons, and dense stands of lodgepole pine occur on old burns and in cold air drainages.

Wildfire was always part of Starkey ecosystems. Fire intensities and frequencies varied, with a wide range of ecological effects. Fire interacted with other disturbances such as insect outbreaks, elk and deer grazing, and eventually timber harvest and livestock grazing. In the early 1970s a pine beetle

outbreak killed a number of ponderosa pines. Spruce budworm populations exploded in the early 1980s after several drought years and killed many trees in some parts of Starkey. Healthy young trees, already 4 to 12 feet tall, are growing among the snags and fallen dead trees.



View from near Cow Camp.

Plant and Animal Species

G **Grasslands and meadows cover about 30 percent** of the Starkey acreage. Meadows occur on bottomlands along seasonal and year-round streams and cover only about 2 percent of the Starkey acreage. Plants grow from late spring to early summer, with little or no growth during the dry season. Fall rains often initiate some greening-up and regrowth.

In grassland openings, the most abundant species are bluebunch wheatgrass and Sandberg bluegrass. On larger scab grasslands, the most common species are bunchgrasses such as Idaho fescue, bluebunch wheatgrass, onespoke danthonia, and Sandberg bluegrass. Less common grasses include prairie Junegrass, bottlebrush squirreltail, and needlegrasses.

Flowers are most common in spring when abundant moisture is available. Just a few of the grassland spring flowers are buttercup, camas, wild onion, and Mariposa lily; grassland summer flowers include western yarrow, low gumweed, and rush pussytoes. Forest and riparian flowers include lupine species, larkspur, mountain bluebell, shooting star, and many others. The most common brush species on Starkey are snowberry, wild rose, willow species, ninebark, huckleberry, and buckbrush ceanothus.

Cheatgrass is the most common invasive plant species in Starkey. Other invasive plants are sulfur cinquefoil, knapweeds, bull thistle, Canada thistle, and Scotch thistle.

Rocky Mountain elk and mule deer were abundant in the Starkey area in the mid-1800s but scarce by the late 1800s, probably owing to hunting and livestock grazing. Populations rebounded in the 20th century after hunting and grazing were regulated.

Other large mammals include cougar, black bear, coyote, and bobcat. These predators are able to go either over or under the game-control fence and are part of the Starkey ecosystem, just as they would be outside Starkey. Small mammal species at Starkey include the Columbian ground squirrel, yellow pine chipmunk, red squirrel, flying squirrel, northern pocket gopher, deer mouse, three vole species, vagrant shrew, snowshoe hare, mountain cottontail, porcupine, little brown bat, and long-eared bat.

The diverse ecosystems provide habitat for dozens of bird species, from northern goshawk in dense forests to western meadowlark in the grasslands. Besides the goshawk, raptors include the sharp-shinned hawk, Cooper's hawk, red-tailed hawk, bald eagle, and occasionally the golden eagle. Other birds include the common nighthawk, pileated woodpecker, northern flicker, Steller's jay, Vaux's swift, mountain chickadee, red-breasted nuthatch, ruby-crowned and golden-crowned kinglet, chipping sparrow, and many more.



Buttercups are a sign of spring on the range.



Indian paintbrush.



Mariposa lily.



Evelyn L. Bull

Great gray owls nest and hunt on Starkey.

into alternative approaches to grazing management, seasonal flock reduction options, invasive plants, thermal cover, and competition among sheep, cattle, and elk.

In 1939, Gerald D. Pickford reported that the Starkey Cattle and Horse Allotment was a suitable research area and the first field crew was assigned to Starkey in the same year. Starkey Experimental Forest was established on July 11, 1940. Several years later the name was changed to Starkey Experimental Forest and Range.

Starkey scientists pioneered several research directions in the 1940s. They developed new range survey methods and started using aerial photographs in range surveys. The first grazing exclosures were installed in 1941 to assess ecological change over time. In 1945 two large grass nurseries were established at Starkey to produce seed from range grass species. Research on grazing management tested a system of rotational deferred grazing and ways to improve cattle distribution by developing off-stream water sources, salting, and range riding. During the late 1950s, scientists expanded their studies of grazing forage and started their first studies of seasonal weight gain in heifers and steers that grazed open range at Starkey.

As research expanded, facilities were built. In the late 1940s, a permanent office was established in La Grande, and the Starkey headquarters got its first permanent buildings. A new laboratory was built in



Frank Vanni

Starkey scientists share their findings with people through field trips and workshops.

La Grande in 1969. Year-round electricity came to Starkey headquarters in 1970.

The first wildlife research looked at the effects of grazing management and cattle numbers on the distribution and abundance of deer and elk. Scientists began the first Starkey research on nongame wildlife with a study of pileated woodpecker biology and habitat needs in the 1970s. This research eventually influenced regional policies on snag and down wood retention. The Meadow Creek riparian habitat studies began in 1975 in response to concerns about grazing in streamside areas. Hydrology, water chemistry, aquatic biology, fisheries, and livestock nutrition were all included in the new research.



Frank Vanni

Meadow Creek.



Frank Vanni

Disturbances such as timber harvest (shown here), fire, insect outbreaks, and grazing interact with each other in many ways.

More research topics were added in the 1980s. Studies included work on western spruce budworm population dynamics, root diseases, and damage to trees from insects and diseases. Other research focused on the life cycles of insects and their host trees, particularly on the influence and interaction of factors such as temperature, day length, budding, and flowering.

Current Research

The common themes of managing disturbance regimes and ecosystem management run through the research projects at Starkey. A coordinator juggles logistics for the many different studies.

The Starkey Project. The Starkey Project was initiated in response to debates about how best to manage habitats and populations of mule deer and elk in the Western United States. “The big fence” was built in 1987 and enclosed about 25,000 acres with an 8-foot-high fence of woven wire that contains elk and deer with minimal risk of injury. More game-proof fencing divides the project area into four study areas: the main study area (19,180 acres), Campbell Flat pasture (1,537 acres), the intensive timber management or northeast study area (3,590 acres) subdivided into two pastures, and the winter feeding and handling area (655 acres).

Small animals often are less noticed by people, but play important ecological roles. In Starkey, reptile and amphibian species include the long-toed salamander, western toad, Pacific treefrog, Columbia spotted frog, rubber boa, western skink, and two species of garter snakes.

Juvenile chinook salmon use the lower reaches of Meadow Creek, and juvenile steelhead summer in all perennial streams in this watershed. Insects that eat foliage or boles of trees include the Douglas-fir bark beetle, Douglas-fir tussock moth, larch casebearer, mountain pine beetle, and spruce budworm. Starkey also has many species of beetles, butterflies, and moths.

Meadow Creek, the largest stream in Starkey,

flows east through the experimental forest and eventually into the Grande Ronde River, beyond the Starkey boundary. Starkey has several other small perennial and intermittent streams, and springs and bogs are common along major streams. Small ponds and spring boxes have been built to provide watering spots for animals.

Most Starkey soils are derived from basalt, pumicite (abrasive volcanic dust), and alluvial materials such as silt, clay, and gravel deposited by running water. Grassland soils may be as shallow as 1 inch on open ridges but can be more than 2 feet deep on better sites. Forest soils range from 1 foot to several feet deep.

Past Research

Forest Service personnel established the first grazing research plots in northeast Oregon's Wallowa Mountains in the early 1900s. The director of PNW Research Station, Thornton T. Munger, assembled the first staff dedicated to range research in 1936 in La Grande. The range research program started by developing ways to survey and measure forage production, use, and cover. Research soon expanded

The big fence encloses about 500 elk and 250 mule deer year round, and 550 cow-calf livestock pairs during summer. This area is larger than the summer home range of most deer and elk, and animals inside the big fence are living under conditions similar to wild, free-ranging herds. The elk and deer are wild animals that have been handled in winter feeding areas and traps but are not acclimated to humans (with the exception of the tame elk herd; see below). As the elk and deer populations grow, surplus animals are removed during winter and released to forests outside Starkey.

Movements of over 150 elk, deer, and cattle are monitored annually with radio collars. LORAN-C-based telemetry was used for the project's first 10 years (1989–99) and is gradually being replaced with global positioning system-based telemetry. The automated telemetry systems record animal locations several times a day and

have given scientists the largest, most accurate set of animal locations ever collected on ungulates in the world.

All studies are summer range investigations. During winter, most elk are moved to the winter feeding and handling area. Most deer spend winter in the forest and are fed hay in times of need. The winter feeding evens out effects of winter weather on animal body condition, thus making winter a control period. Researchers check the animals individually for pregnancy, disease, and overall body condition, and change or equip telemetry collars or ear tags as needed.

The 58 elk in the tame herd include 56 cows, 1 gelded bull, and 1 branched bull. These elk are hand-raised, tractable, and acclimated to human presence for research on foraging preferences and food habits, and work that requires frequent blood samples. The tame elk are maintained separately on the feedgrounds and no hunting is allowed.



The elk handling facility has a specially designed series of chutes and pens so that scientists can safely and efficiently check animals for pregnancy, disease, and overall body condition.



The Starkey project, with game-proof fencing, automated telemetry, and controlled studies, has yielded unprecedented data sets on ungulate ecology.



The original LORAN-C based telemetry collars (on elk at left) are being gradually replaced by a global positioning system technology (elk on right), which has greater accuracy and more sampling flexibility, and requires less maintenance.



Mule deer have a strong flight response to chutes and pens, so they are trapped and handled individually.



The age of breeding bulls affects timing and synchrony of calving in elk.

Funding is provided by the USDA Forest Service, the Oregon Department of Fish and Wildlife, and the Rocky Mountain Elk Foundation. Research partnerships occur with Boise Cascade Corporation, The National Council for Air and Stream Improvement, Oregon State University, the University of Alaska Fairbanks, University of Idaho, University

of Montana, Purdue University, and other organizations. Researchers have a close partnership with La Grande Ranger District personnel.

The first 10 years of the Starkey Project. The project's four original studies, started in 1989 and completed during the 1990s, addressed the most prominent issues under debate. (1) Road and traffic management studies produced a set of compelling findings about deer and elk responses to open roads with varying traffic rates; these results are now used to manage road access throughout western North America. (2) Timber production studies found that changes in forests from intensive timber harvest had little or no negative effect on deer and elk survival; thermal cover studies found no positive benefits for elk condition from dense forest cover. (3) Studies on competition between wild ungulates and cattle on summer range led to a new model for allocating forage among the ungulate species. (4) Studies on the breeding efficiency of bull elk and reproductive success showed that older bulls are more efficient breeders, resulting in earlier, more synchronous calf births the next spring, which may provide calf survival benefits. These results led to changed hunting regulations for bull elk in many states and provinces across western North America.

The Starkey Project in the 21st century. Definitive results from Starkey give managers defensible options for managing off-road recreation, range allotments, and fuel treatments, in relation to ungulates. These findings are commonly used across the Western United States by state, private, and federal resource managers. The original research has been the catalyst for new studies, some of which will take another 10 years or more to complete.

Nongame wildlife research. Scientists are studying many other wildlife species in Starkey. These studies include research on the



Leslie Naylor

The existing automated tracking system makes Starkey uniquely equipped to carry out studies such as one in progress on deer and elk responses to off-road recreation.

ecology and habitat of red squirrels and flying squirrels, pileated woodpeckers, bat species, and various insect species. Research on the declining Vaux's swift population is testing whether scarcity of high-flying insects, loss of nesting trees, or other factors are the cause.

Disturbance ecology.

Disturbances such as fires, insect outbreaks, and grazing by large mammals interact with each other and have cascading effects. When the spruce budworm kills trees, other insect species are affected, and in turn populations of birds and bats that feed on insects. Overgrazing affects ground-nesting birds. Starkey research shows that even moderate grazing is an influential ecological force. People enter into the puzzle in many ways, from cutting trees to mountain biking to hunting. Interdisciplinary research is teasing out the ways that disturbances and their interactions affect energy flow, nutrient cycling, ecological succession, and biodiversity.



Evelyn L. Bull

Vaux's swift, a species of concern, nests in hollow trees on Starkey.

Education and Field Tours

Starkey staff host many field tours and educational workshops. Hundreds of people, including agency staff, professional societies, tribal foresters, Congressional staff, international visitors, and college students visit. Please contact Starkey staff well in advance to schedule a trip for organized groups.

Travel

La Grande is located about 260 miles east of Portland on Interstate 84. Use exits 259 and 261 for La Grande. The nearest airport with commercial service is at Pendleton, about 51 miles west of La Grande. Starkey is about 28 miles southwest of

La Grande on Oregon State Highway 244, roughly midway between La Grande and Ukiah. From La Grande, drive west on I-84 to exit 252. Take Highway 244 about 21 miles to the Starkey entrance.

Facilities

Overnight housing at Starkey Experimental Forest and Range is limited to people involved in onsite research or educational activities. Other forest visitors are allowed to camp in dispersed sites, although no developed campgrounds are available in Starkey itself. During summer, visitors can also camp along Highway 244 at Hilgard Junction State Park, Red Bridge State Park, and Bird Track Springs and Four Corners Campgrounds. Motels, restaurants, and stores are available in the nearby city of La Grande, or in Ukiah to the west.

Hunting and Recreation

Starkey is open to the public from May 1 to mid-December each year. Public access is through the main gate just north of Highway 244 (see map). The gate is closed but not locked, and visitors are asked to close the gate after going in or out. Vehicles are

restricted to roads posted with green dots. Some research areas have controlled access so that research activities are not disrupted.

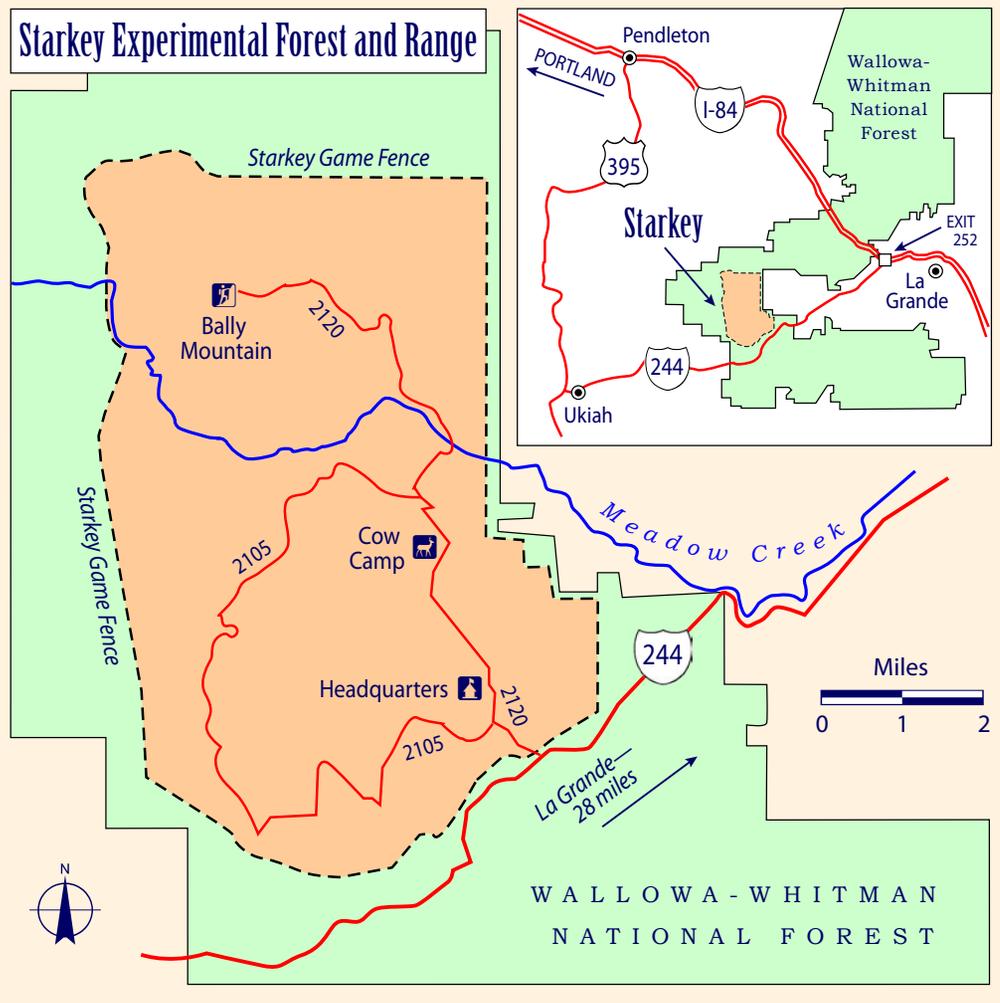
Camping, horseback riding, mountain biking, hiking, and mushrooming are a few of the activities the public can



Frank Vanni

Crews build and maintain game-proof fencing that encloses the project and separates study areas.

Starkey Experimental Forest and Range



Map by Keith Routman

enjoy. The area is not open to firewood cutting or fishing because of research projects. Upon entry into Starkey, visitors become part of the research that monitors animal response to human activities.

Public hunting is allowed and is part of the ongoing research. Controlled hunts of deer and elk are administered by the Oregon Department of Fish and Wildlife and listed in that department's annual publication, *Oregon Big Game Regulations*. Hunters help scientists

meet study goals in several ways. Hunting puts the deer and elk under the same types of pressures that exist outside Starkey; hunting helps to maintain the elk and deer numbers at desired population levels; and hunters are required to give certain body parts from animals killed to the researchers.

Starkey is closed to the public from mid-December through April. The gate is locked during these months. The winter closure minimizes disruption to the animals during winter when

the animals are concentrated near feedgrounds and trapping operations are in effect.

For Further Reading

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Skovlin, J.M. 1991. Fifty years of research progress: a historical document on the Starkey Experimental Forest and Range. Gen. Tech. Rep. PNW-GTR-266. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 58 p.

Resources on the Web

PNW Research Station. <http://www.fs.fed.us/pnw>. This site lists publications by Station scientists, including those based on research at Starkey Experimental Forest and Range.

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Starkey Experimental Forest and Range. <http://www.fs.fed.us/pnw/starkey>. This site has detailed information on Starkey research, personnel, and publications, along with a photo gallery and research updates.

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