OREGON'S AGRICULTURAL PROGRESS

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OREGON STATE UNIVERSITY, CORVALLIS

No prize for second

G. Burton Wood
Director
Oregon Agricultural Experiment Station

Success story.

One of the greatest of the century is the contribution of agricultural experiment stations toward improving the food supply and getting more food from the same resources.

Evidence?

Today the American consumer buys the finest quality, easiest to prepare and most attractively packaged food in the world for the lowest percentage of take-home pay. During the last 20 years, the agriculture industry has steadily reduced this percentage until it reached a low of about 15.7 percent last year. Since then, because of inflation and higher food prices, the percentage has climbed to a little more than 16 percent, which means, in many cases, that our food costs only half as much of take-home pay as it does in other developed countries.

It took work to reach this low percentage. At our experiment station it has meant that the bulk of research has been directed to improving both the quality and quantity of food consumed in Oregon and elsewhere.

An independent review team, looking at our program a few years ago, suggested that the average Oregon consumer invests about three dollars annually in agriculture research. For that he receives at least a $200 benefit in keeping down his food bill.

Part of our work has been to improve the supply of wheat, a vital part of the food picture. Yamhill, a variety we introduced in the 1970's, is planted on 102,000 acres in western Oregon (acreage has tripled in the last three years) and 6,000 in western Washington. Results with Hyslop, another of our recent varieties, are even more impressive. About 9,000 Oregon acres were planted in 1972 and this year, 612,000 acres. Hyslop, now the leading wheat variety grown in our state, accounts for 49.5 percent of our total wheat acreage.

This has all happened within three years. It is conservatively estimated that these two wheat varieties have increased yields from the same basic resources from 10 to 50 percent—and in this period have added about $12 million in new wealth to farmers and to Oregon.

This contribution is simply an example of innovative research. We depend upon a statewide research and advisory council and other farmer-industry groups to help keep our research relative to the needs of our people. We also conduct periodic statewide surveys to ascertain what our clientele think we ought to be doing.

Actually, we are never satisfied with what we are doing, for our scientists realize that there is no second prize for research. It is the policy of all of us in the Agricultural Experiment Station to do everything we can, within the limits of available funds, to keep our research creative and forward-looking.

Given the continued support of the people of the state, I am sure that we can continue to contribute materially to making an abundant supply of food available to consumers at reasonable prices.

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Cover

Dwarf wheat smut spores, deadly foes to Oregon's wheat export industry, form intriguing shapes under the photographer's microscopic lens. Several OSU scientists are waging war against new agricultural diseases and the reports of their battles begin on page three.

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Troubleshooters

Like a fifth column, the forces of nature keep attacking our new food crops, challenging scientists anew in their efforts to produce more. Three new battles just started.

WHEAT: China says 'no'

Finding a quick way to identify some tiny, black spores may increase sales of Northwest wheat to the Peoples' Republic of China.

USDA botanist Edward Trione has started the search.

The spores are from the TCK fungus, commonly known as dwarf smut, a serious wheat disease. The dwarf smut fungus invades the young wheat plants and produces black spores inside the wheat seeds. When the infected seeds are broken during harvest, the black spores are released.

The small spores, like fine dust, are blown easily by the wind. Grain-handling equipment contaminated with these spores can pass the spores along to subsequent clean wheat shipments.

"The disease occurs in a small area of the U.S. wheat-growing region, primarily in Eastern Oregon and Washington, Southern Idaho, and Northern Utah," said Trione. "It affects only winter-grown wheat."

Two other smut diseases are more widespread in the U.S. and the rest of the world. They are common wheat smut and grass smut.

Last year, after the U.S. agreed to sell China 135 million bushels of wheat for about $285 million, the Chinese found the black spores of the TCK fungus in early shipments. The infected wheat does not affect humans but does reduce quality and quantity of wheat yield. The Chinese acknowledge they have common wheat smut and grass smut but believe they do not have the TCK fungus in their country. Because they do not want the dwarf smut fungus to be admitted, they set up a zero tolerance against the black spores.

If they find a few TCK spores in a wheat shipment, the entire ship load is rejected. Last fall, more than half of all shipments of wheat from Pacific Northwest ports to China were rejected because they contained dwarf smut spores. Today, all U.S. wheat to China is sent from the East Coast and Gulf Coast ports because states east of the Rockies do not have the dwarf smut disease. The Northwest, which was supposed to provide 25 percent of the wheat shipments to China, now sends none.

The Chinese prefer western white wheat, the kind grown in the Pacific Northwest because of its baking and milling qualities.

(Continued on page 16)

Troubleshooters

Cereals: An unwanted first in an oat field

One stranger in Oregon is not welcome.

In fact, an Experiment Station nematologist and Extension Service specialists are trying to make sure its days are numbered because the invader is the oat cyst nematode, a destructive cereal grain pest never reported before in the United States.

Like other nematodes, the oat cyst nematode, a threat to production of major small grains in Oregon, is a microscopic thread or roundworm about 1/25-inch long which lives and feeds on plant roots. Also known as the cereal cyst nematode, it infested a 25-acre Washington County oat field, infecting the oats and volunteer wheat and rye grass.

How the nematode got into the oat field remains a mystery. Stunted plants appeared in patches ranging from several square yards to about two acres in the field. Stunted plants were sent to the OSU Plant Clinic and after a brief investigation by Station nematologist Harold J. Jensen and Norman Goetze, Paul Koepsell and John Leffel of the Extension Service, the pest was identified as the oat cyst nematode.

The oat cyst nematode (*Heterodera avenae*) is found in more than 15 countries and affects oats, wheat, barley, and rye. In India, it has been reported on corn. In addition, about 20 other plants of the grass family are susceptible to attack by the nematode.

"Apparently the oat cyst nematode requires several years to reach numbers sufficient to cause visible symptoms in infected plants," Jensen said. "High infestations can cause serious damage. In Australia, for example, infestations have reduced yields by an average of 56 per cent for oats, 36 per cent for wheat, and 20 per cent or less for barley."

Symptoms of plant infection, in addition to stunting, are purple discoloration of first leaves, late flowering, depressed yields, and an overwhelming invasion of weeds.

Infection usually causes excessive root branching. Supporting the short, thickened roots and attached nematodes drains the plant of vital nutrients needed for other growth and reproduction.

The oat cyst nematode apparently completes only one generation a year with larval invasion of the plant probably occurring in the spring. Once established in plant tissue, the nematode may complete its life cycle in 9 to 14 weeks.

The male remains wormlike. The female becomes white, lemon-shaped, and is visible on the root surface. After the female dies, the body hardens, turns brown, and becomes a protective cyst for eggs and larvae. Each cyst usually contains 200 to 250 eggs but some have as many as 600. Eggs within the cysts may remain viable for several years.

Once introduced, the nematode can spread by cultivation, irrigation, floods, soil erosion, or any other action that disturbs soil. Like other nematodes, the oat cyst nematode attacks plants by depriving them of water and food.

Working with USDA and State Department of Agriculture representatives, the OSU researchers have been collecting samples for further study to learn if any incidences of oat cyst nematode infestations have occurred outside the Washington County oat field.

The OSU researchers are installing a series of wheat, barley, oats, rye cereal, and triticale plots in infected part of the field to try to define the host range and to discover what strains of the pest occur in Oregon. Control plots are being planted in other areas of the field that seem to be normal.

"In addition, we are setting up a smaller series in the greenhouses, using infested soil from the field," said Jensen. "We also will incorporate some alfalfa, clover, vetch, and normal pasture plants to see how they react to the nematode."

The plots will not be examined in detail until next spring. At that time, the plants may give some of the answers to why the invader, which may have been in the hilly oat field for years, suddenly made itself known by stunting the growth of some oat plants this spring.

Three gray winter oat plants on left show stunting from oat cyst nematode. Plants on the right have average mid-June appearance.

Troubleshooters

Filberts: Yesterday's disease strikes again

A long-sleeping menace to the filbert industry has awakened.

Eastern Filbert Blight, a fungus disease, was recently discovered in orchards of two Washington counties. Later, blighted trees were discovered across the Columbia River in one orchard near St. Helens in Columbia County, Oregon.

The all but forgotten disease can kill orchards and seems likely to spread if not identified and contained. It once devastated filbert orchards in the Eastern United States, but a quarantine imposed in 1923 kept the disease from spreading west of the Rocky Mountains. No case of the blight had been recorded in European filberts since 1937 until the recent outbreak in the Northwest.

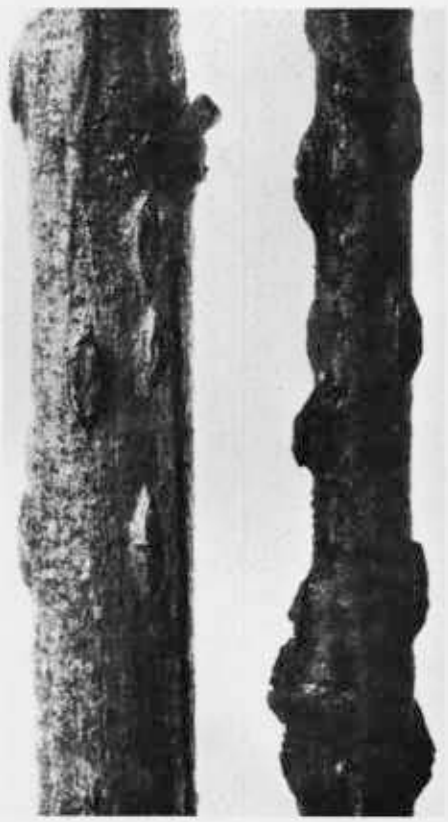
How Eastern Filbert Blight managed to reappear in Oregon and Washington now is unknown. However, a cooperative study between Oregon State University, Washington State University, the State Departments of Agriculture in both Oregon and Washington and the Oregon Filbert Commission is now underway to identify how the disease functions and check its spread. Because so little is known about the fungus, the task is a difficult one.

"We know the disease spreads slowly, and that is the only thing we have on our side at the moment," said Dr. H. Ronald Cameron, plant pathologist studying the problem.

Research so far suggests the air-borne fungus spores first attack new buds or twigs. Suckers and shoots near pruning cuts seem to be especially susceptible. The bark on the twigs becomes dark and sunken, and leaves beyond the infected area may wither. First the twigs, later the branches and eventually the trunks become girdled. Spore-like pustules break out in lines along the cankered area.

New spores appear to remain in the pustules until they are released into the wind and rain. Researchers don't yet know how the disease spreads over great distances, but they suspect it may travel on leaves, twigs or infected wood transported into new areas.

Concern for possible infection of other Oregon orchards brought about stringent sterilizing procedures for all filbert nuts brought into Oregon from Washington for processing this fall. Nuts to be trucked across the Columbia River into Oregon are being fumigated at a site near Vancouver, Washington to insure that any infection which might linger on the nuts has been removed.



Filbert shoots showing new pustules, left, and older pustules, right.

Cameron said the possibility of nut contamination is unlikely because no evidence of Eastern Filbert Blight has been found in any orchards near Oregon processing plants. Yet with an $8 million industry at stake, no possibility is being left to chance.

The future of Eastern Filbert Blight in the Northwest is unknown. No definite cure is on the horizon, but an experiment underway in one Washington orchard may offer some clues to solving the problem. Test rows of filberts are being sprayed with three chemicals and Cameron hopes to determine whether one of the three sprays will be effective in halting the fungus development.

Meanwhile, orchardists and persons with backyard filbert trees which show signs of infection are asked to bring a sample to their county Extension agent for analysis. If the infection is shown to be Eastern Filbert Blight, the recommended treatment is to prune diseased portions of the wood and burn the trimmings in order to reduce the number of spores and check fungus spread.

Cameron said that by working together with filbert growers, especially those with diseased trees, researchers hope they will halt Eastern Filbert Blight before it ruins the Northwest's filbert industry. Perhaps, through their combined efforts, growers and researchers can find a method of controlling this new menace.

Deer carefully choose between 7 sagebrush varieties in a test of their preference.

Flavor counts in sagebrush

Sagebrush in Oregon comes in at least seven flavors.

It also includes some surprises, range ecologists A. H. Winward and Dennis Sheehy found when they used sheep and deer to test the tastiness of half of Oregon's 14 woody sagebrush varieties.

According to literature, a highly preferred sagebrush choice by game and domestic animals is black sagebrush. Not so, say Winward and Sheehy.

They could not get deer, trucked from Steens Mountain to the Corvallis area, to eat very much of it. Both the deer and sheep preferred Foothill Big Sagebrush, an unnamed sub-species which Winward discovered growing throughout parts of Oregon, Idaho and California. He also has found another unnamed species in Idaho and is seeking recognition of both new kinds of sagebrush.

Unless you are a hungry deer, sheep, range cow or are one of the few sagebrush experts in the world like Winward and Sheehy, each sagebrush plant looks pretty much like another. They have a sagelike odor, woody branches, bitter juice and are found from alkaline plains to moderately high mountain elevations.

Experts see them differently. They categorize sagebrush by elevation and soil type and have found 14 Oregon types. Seven of these were used in the animal preference tests, these included: Foothill Big Sagebrush, Mountain Big Sagebrush, Silver Sagebrush, Low Sagebrush, Basin Big Sagebrush, Wyoming Big Sagebrush, and Black Sagebrush. Many of the sagebrush types found in Oregon are difficult to distinguish without a simple chemical test developed by Winward.

He places a few grams of sagebrush leaves in a clear glass bottle, adds alcohol and exposes the mixture to ultraviolet light. The leaves show shades of blue or red, depending on type.

Despite the many legends surrounding sagebrush, and the thousands of acres of it in Oregon, little is known about the range plant's true role in sustaining livestock and deer in the state.

"One reason sagebrush's value is played down is because it is hard to detect utilization on sagebrush shrubs," said Winward. "For example, deer seem to reach in and browse from the side of the plant, leaving few signs they have eaten."

Research at the USDA Hopland Field Station in California shows that some sagebrush is highly nutritious—if it is not more than 49 percent of the diet of ruminants. If the percentage is exceeded, volatile oils from the sagebrush interfere with organisms in the ruminant stomach.

"But the potential as a supplement to the diet of deer is there," said Winward, "and sagebrush improvement may be important to livestock, too."

He is also working with sagebrush varieties from several countries, including 13 from Russia. A variety from Iran shows promise as feed for deer and antelope.

Once nutritious varieties that appeal to animals are selected, seedlings can be used. The Oregon Game Commission successfully seeded two locations, in Klamath County and Lake County.

"Basin Sagebrush was selected because the seed was easily available," said Winward. "But it does not grow at very high elevations and we found it not desirable in either selectivity by animals or in essential oil content."

Setting up the taste for deer and sheep was not easy. The range ecologists dug up 476 plants at Silver Lake, Squaw Butte and Baker, retaining much of the soil around the roots, and trucked them to the Corvallis area.

Sheehy counted each leaf and branch of new growth on each of the plants in the feeding trials. The deer were exposed to the feeding area, for varying periods, where the potted sagebrush varieties were randomly mixed. After each feeding period, Sheehy recounted the leaves and branches.

Four deer were used in each of the two trials. The same number of sheep, also from Eastern Oregon, were used in three similar trials. The sheep, a Columbia Rambouillet cross, were allowed access to a minimal amount of grass pasture along with the different sagebrush and the deer were fed a maintenance level of alfalfa hay along with the sagebrush varieties.

Although both sheep and deer liked best the unnamed Foothill Big Sagebrush, their tastes varied on other varieties. Their last choice, however, did agree—it was Black Sagebrush. Winward and Sheehy believe that most Black Sagebrush consumed in the field in Oregon can be attributed to antelope and rabbits.

Why did the animals pick one sagebrush plant over another? "We're not sure at this point. Apparently animals use smell more than sight to select varieties they prefer," said Winward.

"Essential oils give the smell to the plant. We have found that the amount and kind of oil vary with each sagebrush variety. All varieties of sagebrush have their own smell and, probably, their own taste."

Still unknown is which sagebrush plant cattle prefer. It is a study which sagebrush experts Winward and Sheehy would like to investigate, too.

When the waiting is monumental - - -

Visitors who have sometimes chafed about queuing and waiting to tour underground attractions at the Oregon Caves National Monument may see some light ahead.

A study completed by agricultural economists R. N. Shulstad and H. H. Stoevener of Oregon State University for the National Park Service not only confirmed the long waits but also came up with some answers to waiting—to park their vehicles and to tour the cave.

"Our study showed the need to provide potential visitors with more information about what the Monument has to offer, how far it is to drive and an estimate of how long visitors must wait," said Stoevener.

The Monument is a 480-acre tract in the Siskiyou National Forest. To reach it, visitors leave Highway 199 at Cave Junction and travel 20 miles on Highway 46. They find a chateau-chalet area, gift shop, curio shop, coffee shop, dining room, hiking trails—and during the busy season of summer, a wait.

Physical features of the cave limit groups to 16 and a guide. Although groups are dispatched every six minutes for a 72-minute tour, waves of summer visitors overwhelm the facilities. Two parking lots fill early, and motorists must park on Highway 46.

The OSU study explored various alternatives, including a type of mass transit, and concluded that priority should be given to providing more information.

The Agricultural Experiment Station economists point out that a full information system, manned by National Park Service personnel, would provide information about travel time to the cave, waiting time for the tour, time required for and length of tour and strenuous nature of the tour. Regulations concerning minimum age for the tour, use of canes, sticks or tripods in the cave, and availability of picnicking and camping facilities and the restriction of trailer travel along the roadway to the Monument also would be explained before the traveler decided whether to make the trip.

The study does not recommend where a complete information center should be located but does recommend:

1. That the National Park Service train all tour guides to assure uniform presentations.
2. That all trailer travel to the Monument be banned along the mountainous stretch of Highway 16 and trailer parking be provided.
3. That more signs be put up along Highway 46 indicating the distance to the Monument.
4. That all Oregon Caves National Monument brochures include the normal distribution of waiting times.

Interviews and most of the material for the study came from work during the 1973 summer tourist season. Earlier studies by the National Park Service showed that more than 50 percent of Monument visitors were from California. A check of visitors' origins was not made during the 1973 season.

Ticked

Control cattle graze normally on the Squaw Butte range while experimental calves live on a tick-proof platform in background.

Holstein heaven?

Amid the junipers, rocks, and sagebrush of Squaw Butte the sight was startling: 10 Holstein calves happily eating away in their shaded summer home—five feet in the air.

Their home was a tick-proof platform, one of two built at Squaw Butte by veterinarians Kermit J. Peterson and Richard S. Stroud and animal scientist Robert J. Raleigh to learn more about anaplasmosis. Considered fourth among the top 10 most important bovine diseases in the United States by the American Cattlemen's Association, anaplasmosis is caused by *Anaplasma marginale,* a blood parasite.

The major way the parasite is transmitted to cattle, particularly in eastern Oregon, is believed to be by *Dermacentor andersoni,* a tick common among cattle. Infected animals suffer the symptoms of extreme anemia. Red blood cells are destroyed. The animal breathes rapidly and becomes weak; older animals are particularly susceptible. Often an animal survives as long as it is not moved or put under stress. Later, when these infected animals are driven or stressed, they may die.

The three scientists set up the two platforms to see if cattle kept from ticks in a known anaplasmosis area would get anaplasmosis, perhaps from a flying insect.

Metal discs were welded on each pipe support of the platforms and oil was kept in the discs to prevent ticks from reaching the platforms. A 4-inch ring of sticky insect adhesive was painted below each disc. A fence kept the platform animals from direct contact with other animals.

The platforms were about two miles apart. Neither had any protection from flying insects.

On April 29, Holstein anaplasmosis-negative calves 4 to 5 months of age were trucked from the Willamette Valley to the platforms—10 to each. Three calves were isolated in a dry lot on a meadow ranch 40 miles away, to be used for replacement in case of platform loss.

The controls, 10 Hereford cows and their 11 calves, were pastured in the area around the north platform. The calves, about six months old, were negative to the anaplasmosis card agglutination test (CAT). All 10 cows were positive.

At the south platform, 10 similar cows and calves were pastured as controls. Nine of the cows were CAT positive and one negative. All calves were negative.

Platform calves were fed pelleted feed. Water was trucked to platform and control animals. Water for the control animals was maintained in tanks just outside the platform fence so they had to visit the platform area at least once a day.

ff calves like platform living

At three-week intervals, blood samples were collected. The CAT and other tests were conducted on each sample.

"Results showed that all calves maintained on the tick-proof platforms remained negative to the CAT," said Peterson. "No *Anaplasmosis marginale* bodies were observed in the tests."

Seven of the 11 control calves in the area around the north platform and 4 of the 10 near the south platform developed positive titers to the CAT.

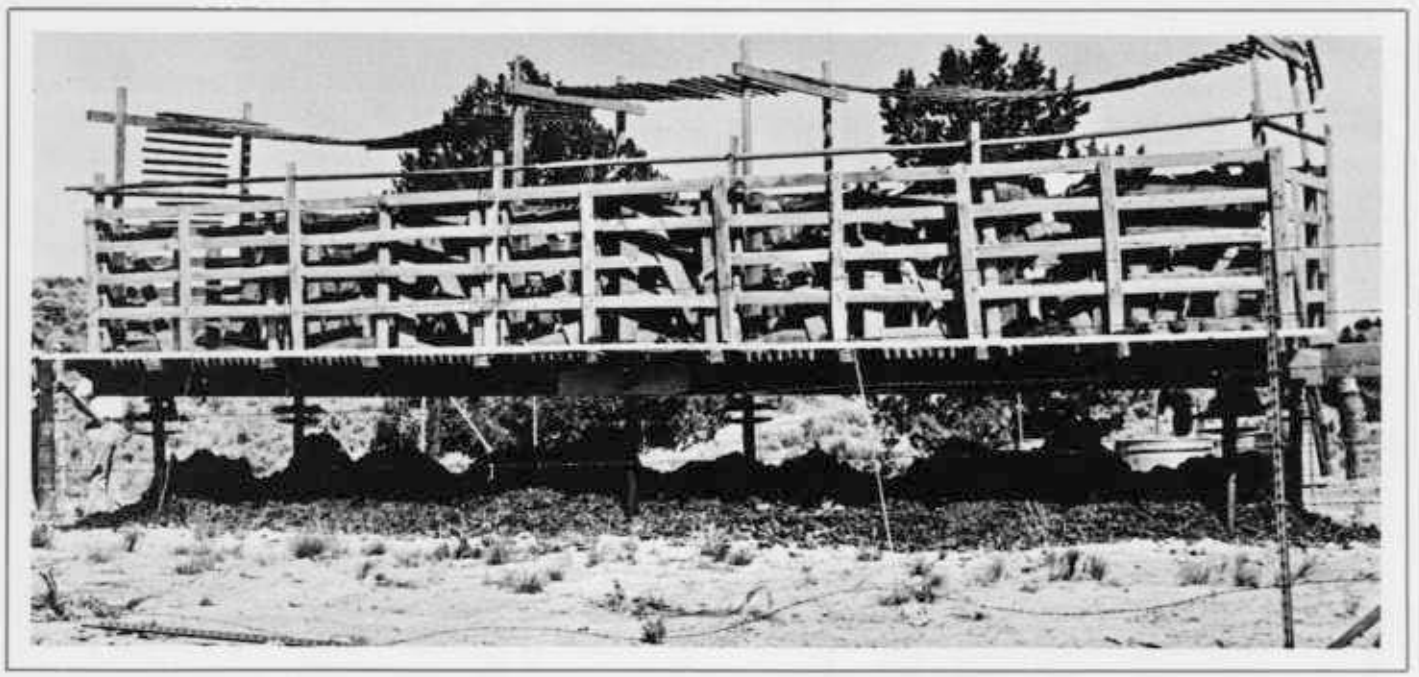
"This trial demonstrated that flying insects did not transmit anaplasmosis from latent carrier cows to the susceptible platform calves during the summer range grazing period," said Peterson.

"Ample opportunity was present since 19 of the 20 cows ranging in close proximity to the platforms were infected. No insect repellents were used on any of the study cattle and the platform calves had no protection from flies, mosquitoes or other flying insects."

"It appears the tick (Dermacentor andersoni) is the source of anaplasmosis transmission on the Squaw Butte Range."

Next year, the scientists plan to repeat the trial. One of the platforms will be moved to the Squaw Butte Experiment Station's Section 5 in a lowland area near the Malheur River and lakes to determine if there could be another means of transmitting the blood parasite in this area.

"The populations of ticks and flying insects including biting flies are affected by weather so the animals' exposure to them may not be equal every year," said Peterson. "Another year's data will tell us a lot more about anaplasmosis in Oregon."



Five-foot, tick-proof platforms kept 10 experimental calves from developing anaplasmosis.

Black bears live alone and like it

Frederick G. Lindzey is on a first-name basis with several wild black bears. He also knows a lot about their personal and social lives. The Oregon State University researcher should. He has been meeting them on their own ground for nearly two years.

It's all part of a study through the Oregon Cooperative Wildlife Research Unit at OSU. Lindzey hopes to learn enough about black bears to insure their continued wise management.

Since 1972, he has been doing field studies of black bear on Long Island, a part of the Willapa National Wildlife Refuge along the Washington coast just north of Astoria. The eight-square-mile island, once a hunting area for the Chinook Indians, offered an ideal location for Lindzey's research because there is limited interaction between the island's bears and those on the mainland.

During the field research, Lindzey trapped or snared and tagged 23 bears with help from his wife, Stephanie, who also documented the work with photographs. The researcher then attached small radio transmitters to most of the animals so he could monitor their movements. He also measured, weighed, tattooed, took blood samples and checked the bears for parasites before releasing them. Twelve to 18 months later, the bears were again caught and many of the same measurements were taken to determine performance during the study period.

The radio transmitters allowed Lindzey to keep track of the bears as they moved about on the island. Their movements—day and night—were plotted several times every 24 hours.

Lindzey found that black bears do not like to socialize—either among themselves or with man—and that there is no basis for fearing black bears. Except for mating and the sow-cub relationship, their main social policy appears to be one of avoidance. Conflict is used only when all else fails, said Lindzey.

There is a pecking order. Females with cubs appear dominant to those without cubs. Yearlings just starting out on their own are at the bottom of the order and usually are careful to stay clear of all adults.

Lindzey also studied the bears' denning and food habits.

During the late fall and winter months the bears spend most of their time in dens sleeping, although there is no true hibernation. Favorite spots for dens are under fallen logs and old stumps. The bears will usually dig a hollow beneath the stump or log and bring in boughs for cushioning.

Cubs are born in late January or early February and usually stay with their mothers until they are 15 or 16 months old. A well-planned den has a nursery area for the cubs as well as a bed for the mother.

The bears are opportunists in their eating habits. In early spring they start with young grasses and move on to termites, ants, and huckleberry blossoms as the season progresses. Then they go on to salal blossoms, false dandelion, and skunk cabbage. Fawns unfortunate enough to be stumbled upon also are eaten.

The bears' most important food is berries. Currants, elderberries, salmonberries, red and black huckleberries, and cascera berries are

abundant on the island and are responsible for fattening the bears for another denning season when there is little to eat.

In another phase of the research, Lindzey is collecting jaws and female reproductive tracts of bears harvested in Oregon. From the specimens, he is gaining an insight to age structure and reproductive characteristics of the bears. Age is determined by slicing a tooth and counting growth rings. The rings are created by annual layering of cementum around the tooth.

The reproductive tracts (uterus and overies) tell Lindzey if the bear was pregnant when killed, what percent were bred, how many young they would have had, age at which they first bred, and whether they had had previous pregnancies.

When the two phases of research are complete in about one more year, Lindzey will have a comprehensive picture of the black bear's lifestyle—information that should benefit both bear and man when put to use in long-range management plans.

Top: Female black bear captured in an Aldrich foot snare tugs to free herself. Center: As part of his experiment, Lindzey injects the bear with a general antibiotic. Bottom: Bear weight is measured for a second time. Tattoos allowed the scientist to identify individual bears.

Pecking pole planning pondered

How many pines would a woodpecker peck if a woodpecker would peck pines?

The large, crested pileated woodpecker might pick several pines to peck every year, according to Evelyn Bull, a graduate wildlife student who has recently completed a two-year study of the red-crested birds at the Starkey Experiment Station in the Blue Mountains of Northeastern Oregon.

During spring and summer for the past two years, the young graduate student combed the forest on horseback imitating the woodpecker's call with a loud "whucker, whucker." She located 13 pairs of birds and started searching for their nesting, roosting, feeding and drumming sites in large dead trees known as snags.

Snags and woodpeckers work closely together in the chain of forest ecology. By drilling into the dead trees for food, the birds help reduce insect populations, most notably carpenter ants and wood-boring beetle larvae.

Pileated woodpeckers also excavate roost and nesting cavities in the snags. These are transient sites which the birds leave after the dwelling's usefulness has passed. The vacated roosts and nests are later inhabited by a variety of forest tenants including bees, sparrow hawks, owls, bluebirds, flying squirrels and wood rats.

Until this study, little was known about how critically woodpeckers select their nesting sites. According to the young scientist, the pileated woodpecker is choosy about trees he selects to carve for his home. The most preferred snags are Ponderosa pine and larch. The average nest snag diameter is 30 inches at breast height, with an average snag height of 68 feet. Nests are generally hollowed out at approximately 40-feet. Bull found the majority of nest snags were hard, had no bark and had broken-off tops. The surrounding area usually had a high density of snags and live stems per acre relative to non-nesting sites.

The size consideration of snags is important to the future of forest management. Logging procedures, especially clear cutting, leave few snags in the forest for use by the birds.

"Consideration must be made for future snags, specifically large ones," Bull reports. "Mature trees must be left in timber sales so in future years new snags will replace those that fall.

"To give some idea of what a large snag will mean in terms of years: it takes 180 years to grow a 24-inch live Ponderosa pine in a forest like the Starkey Experiment Station. This means maybe there will be some 24-inch snags, but this will be far short of the 30-inch diameter average of nest snags now used by pileated woodpeckers."

She believes the pileated woodpecker and timber management can be compatible, but, she adds, "there must be a realization that these snags are definitely needed, not just to benefit the pileated woodpeckers, but also for the other woodpeckers and cavity nesters.

"One alternative to the clear cut is leaving patches of trees that will not be harvested or treated in any way. They will be left to maintain a specific habitat type otherwise being lost," she concluded.

Snags now standing in the Northeastern Oregon forest where the pileated woodpecker was studied are conducive to the birds nesting, feeding, roosting and drilling habits. But what would happen to the birds and their chain of forest wildlife in other, more highly utilized forests is uncertain.

Evelyn Bull hopes that new forest management procedures will help preserve the future of the pileated woodpecker's pine-pecking practices.

Shift change on incubating eggs.

High rise nest snag provides dwelling space for pileated woodpeckers and other cavity nesters.

Artificial streams tell fish story

Two Oregon streams are never bothered by flooding.

Both are models, built by scientists from the Department of Fisheries and Wildlife to study the effects of elevated temperatures on the survival and growth of young salmon and trout. Elevated temperatures can result from forestry, industrial and agricultural practices.

The two streams at the Oak Creek Laboratory near Corvallis are identical. The water in one is heated about 7 degrees Fahrenheit higher than water in the other unheated Control stream. Four riffle-pool sections in each stream were built to simulate the bed of a typical woodland creek in which juvenile salmon and trout live before migrating to sea.

Each stream is 32 feet long, 4 feet wide and 2½ feet deep. The water comes from a nearby tributary of Oak Creek which runs out of McDonald Forest. Large pumps in each unit circulate water between the two sections, creating water velocities much like those in a natural stream. Water is exchanged to maintain water quality. Waste water runs into a trapping facility, eventually returning to the stream.

The streams provide a laboratory for experiments with fish and their glass walls offer an open look at the activities of a biological community. That is the reason fisheries scientist Peter Bisson used the complex to study the survival and growth of juvenile chinook salmon at an elevated temperature.

In 1972, 425 fry were stocked in each stream and a year later, 200 per stream.

"There was a high mortality at first but ordinarily in nature the same is true," said Bisson. "We are not sure why but think some small fish never make a good transition to feeding from living off the egg yolk."

About two-thirds of the young chinook were lost in the first two months. By the end of their first summer, only about 30 fish were left in the heated stream compared to about 100 in the control.

Every three weeks the fish were seined from the streams, anesthesized, weighed and measured. Samples were pumped from the stomachs of some and analyzed to check on food preferences.

Also studied were invertebrates—mayfles, midges, stone flies, caddis flies, snails and worms were the most common—with samples taken from riffles and pools on the bottom of the stream and from organisms drifting passively with the flowing water.

To estimate the amount of food available to fish in the streams, organisms were separated from plants and dead organic matter in the

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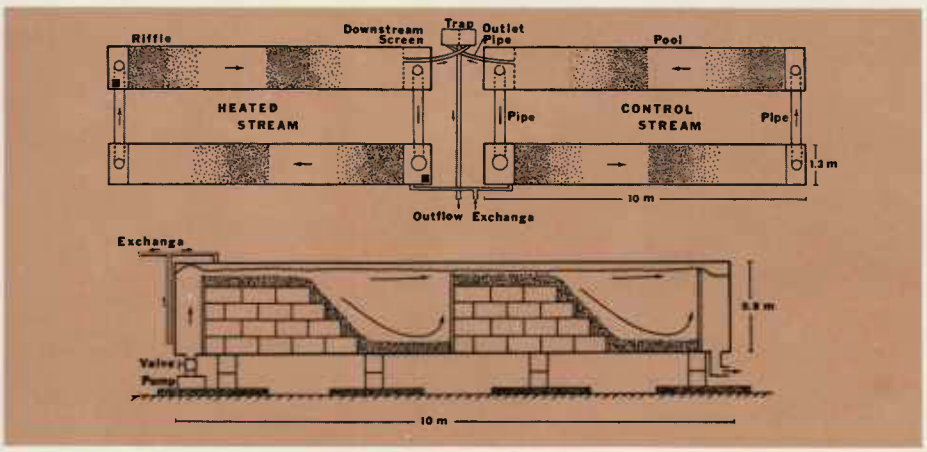


Top: Overhead view of heated and control streams
Bottom: Diagramatic cross-section view of tanks. Brick area indicates riffle formation and open area shows pools. Natural streambed materials cover the bottom.

New help for hop crops: sterility

Sterility may be the answer to production problems facing Willamette Valley hop growers.

Two lines of triploid hops, having all the yield advantages of seeded hops but genetically sterile because they have three sets of chromosomes instead of the normal two (a diploid), are being developed by Alfred Haunold, USDA Agricultural Research Service at OSU. The new lines are particularly promising as a replacement for Fuggle, one of the main hop varieties grown in the Willamette Valley and well accepted by certain brewers.

Fuggle is an early maturing, good-flavored hop, but it is lower yielding than Brewers Gold, Bullion or Cascade, the other major hop varieties grown in the Willamette Valley.

To stimulate yields, growers place enough males in their hop yards to produce hops with an 8 to 16 percent seed content. Pollination makes larger cones, stimulating yield by 25 to 40 percent, and the seeds add to the weight of the hops sold. However, brewers prefer seedless hops and pay a premium for them. They contend that seeds may have an adverse effect on beer flavor.

The two new triploid lines promise to offer both seedless hops and increased yields. Yields are stimulated by pollination, but no seeds are produced because triploids have an extra set of chromosomes causing a natural abortion to keep most seeds from developing after pollination.

Haunold developed the triploids by first doubling the number of chromosomes in Fuggle females to make tetraploids. Instead of the normal two sets of chromosomes with 10 chromosomes in each set, the tetraploids have four sets of chromosomes.

In 1967, the tetraploids were crossed with several selected male hops containing the normal two sets of chromosomes. The resulting seedlings —some 800 of them—were the first triploids. The seedlings were grown in a field nursery in 1968 and 25 of the most promising ones were selected for yield trials. The two lines now under consideration were selected from this group.

For the last few years they have been tested extensively in the Willamette Valley, Idaho and the Yakima Valley. It appears they are best adapted to the Willamette Valley.

Preliminary evaluation has shown that the new lines are almost identical to Fuggle. The first large in-plant brewing trials will be done with this year's harvest. The brewing value (percentage of resins in the cone important for flavoring beer) is higher than that of Fuggle. They are close to Fuggle in growth type and cone morphology, but mature slightly later. Fuggle usually matures during the last week of August. The triploids mature the first week in September.

The triploid hops have sufficient resistance to downy mildew, sometimes a problem in the Willamette Valley. However, they are susceptible to Verticillium wilt, a weakness inherited from Fuggle. The experimental lines have not suffered any serious wilt problems yet. Incidences of wilt are being monitored on test plantings at several locations throughout the Willamette Valley. The few symptoms that have been observed were mild and appear to be influenced strictly by location of the planting. A fungicide that might offer Verticillium wilt control is being tested by C. E. Horner, USDA-ARS plant pathologist at OSU.

Yield potential for triploid hops is approximately 2,000 pounds per acre, compared to 1,350 pounds per acre for Fuggle. And they will be seedless. If Fuggle were grown seedless, yields would drop to less than 1,000 pounds per acre, said Haunold.

If this year's brewing trials go well, at least one of the triploid lines may be released as a new variety, after one more year of field testing.

Tansy ragwort ammunition - - - feed, genes

Nutrition and genetics may help Oregon livestock owners combat the deadly effects of tansy ragwort on cattle and horses.

The weed, which has proliferated in western Oregon and spread to many other parts of the state in recent years, is responsible for an increasing number of livestock deaths each year. Although cattle usually will not eat it voluntarily, dried tansy in hay and tansy in overgrazed pastures often is eaten.

Once eaten, alkaloids in the tansy plant are metabolized by enzymes in the liver of the animal, producing pyrroles, a group of compounds that interfere with cell division in the liver. This damage to the liver is the cause of death in tansy-poisoned animals.

An animal suffering from tansy poisoning also suffers from edema—an accumulation of fluids in body tissue. Edema is caused by an imbalance between blood and body tissue protein content. Pyrroles block protein synthesis, dropping the concentration of blood protein which, in turn, is responsible for movement of fluid from blood to the tissues.

Yellow pigmentation of skin and membranes (jaundice) also is associated with tansy poisoning. Bilirubin, a compound produced from the breakdown of hemoglobin and normally excreted in liver bile, enters the blood stream when the liver is damaged and is responsible for the yellow pigmentation.

Once these symptoms of tansy poisoning become noticeable, it is too late to do anything for the poisoned animal. The symptoms can appear up to several months after the tansy has been eaten. Death usually follows quickly.

Oregon State University animal nutritionist Peter Cheeke believes that the nutritional state of an animal is an important factor in determining its resistance to tansy toxicity.

Research by Cheeke to determine why some animals are more resistant to tansy than others—horses and cattle are highly susceptible to tansy poisoning while sheep are not—suggests that the differences are caused by different levels of enzyme activity in the liver. Working with rats and Japanese quail, Cheeke found that the activity of enzymes that transform tansy alkaloids into pyrroles are lower in the highly resistant quail than in the more susceptible rats.

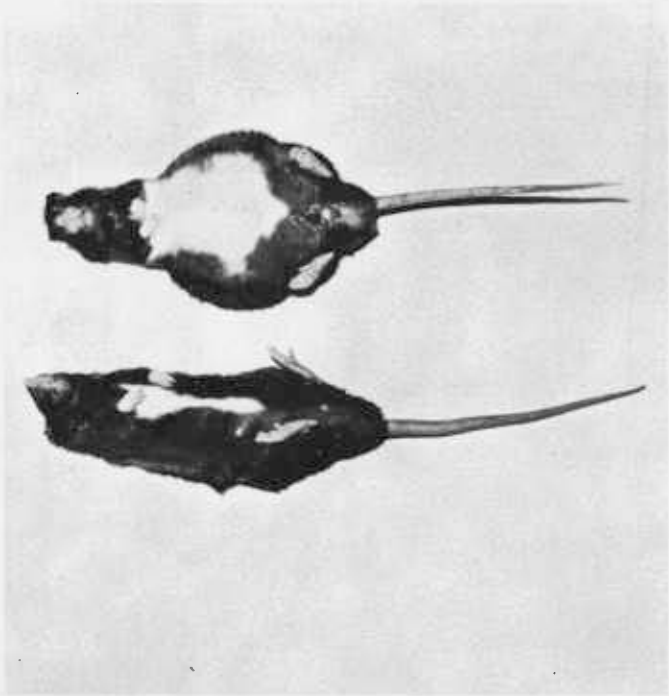
Work to correlate liver enzyme activity with incidences of tansy poisoning in other animal species is beginning. Horses, sheep, cows, rabbits, and other domestic and wild animals are on Cheeke's list of animals that will be checked for liver enzyme activity and susceptibility to tansy alkaloids by taking biopsies and performing laboratory tests with the tissue.

Tracing tansy poisoning to liver enzyme activity has provided the basis for the suspected relationship between nutrition and tansy poisoning.

Working again with rats because rat and cow livers are similar in metabolizing tansy alkaloids, Cheeke found that liver enzyme activity can be altered by changing the amount of protein rats receive in their diet. Dietary protein, particularly the sulphur-containing amino acid cysteine, gave some protection against tansy poisoning. Surplus cysteine appears to tie up the tansy pyrroles, keeping them from interfering with normal cellular functions. Effectiveness of feeding excess protein to prevent tansy poisoning appears to vary with age, however. It is most effective with young rats and least effective with adults.

Cheeke also has observed that there is a variation in enzyme activity and susceptibility to tansy poisoning among individual rats. He hopes to initiate a selective breeding project to develop a strain of rats resistant to tansy. If successful with rats. he believes the same thing eventually can be done with livestock.

In the meantime, Cheeke stresses that management is an important factor in reducing livestock poisoning from tansy ragwort. This includes proper pasture management to avoid overgrazing, adequate mineral supplementation for grazing animals, and care in hay production and buying, said Cheeke.



Accumulation of fluids in the body cavity of a rat poisoned by tansy ragwort, top, as contrasted to a normal animal, bottom.

WHEAT

(Continued from page 3)

"Steam cleaning of wheat, which would be expensive, is being considered," said Trione. "The Chinese say it would be all right if the TCK spores are removed or killed and if the nutritional value of the wheat is not affected by the treatment."

"One of the problems in checking the wheat for TCK spores is that it is easy to confuse spores of the smut fungi—common, dwarf, grass—because the spores of all three types look so similar under the microscope that even an expert cannot differentiate them when looking at only a few spores," said Trione.

To positively identify dwarf smut spores when only a few spores are available, Trione is working on the assumption that three types of spores are different chemically and will try to distinguish the chemical uniqueness of the dwarf smut spores.

"This is an important point because if the Chinese are misidentifying spores they may be rejecting shipments of wheat that would otherwise be acceptable," said Trione. "And it costs $10-15,000 per day per ship while the tests are being conducted."

Trione, who has been working on wheat smut problems at OSU for 10 years, also is trying another approach to control smut diseases of wheat. He has found that dwarf smut spores have naturally occurring substances that block germination of the spores. When exuded, these substances inhibit growth where spores are clustered but not where spores attach themselves singly to a wheat plant.

The problem is to extract, purify, and identify the unique chemicals and then test them in the greenhouse and in the field to see if they have the potential to control the dwarf smut disease.

STREAM

(Continued from page 13)

laboratory. Results were compared to relate seasonal changes in the amount of food available to invertebrates to seasonal changes of growth and survival rates of fish.

"We found that the production of young salmon was about twice as high in the unheated stream as it was in the heated one," said Bisson. "We believe this resulted from several factors."

First, there was more food available in the unheated stream, apparently because the warmer water was harmful to some invertebrates that live in cold streams.

Secondly, the warmer temperature promoted plant growth but the kinds of plants that prospered were not the kinds which the invertebrates preferred. In the warmer water, too, there was a heavy growth of filamentous algae that trapped fine sediments, making the stream gravel less habitable for some invertebrates.

"The elevated temperature also exacted a greater metabolic requirement from the fish," said Bisson. "Cold-blooded animals have to expend more energy in routine physiological maintenance when the temperature is increased so their growth was reduced, especially when food was scarce."

Bisson also carried out a separate study on survival of the chinook in early developmental stages including the egg and right after hatching. The mortality rate of eggs and the fry stages was about three times greater in the heated water than in the control stream.

"Our research on development was not original but it pretty well bears up what others have found: elevated temperatures—at least above 54 degrees Fahrenheit—can be harmful to chinook salmon eggs and fry," said Bisson.

The elevated temperature did benefit the young chinook in two ways.

Fish in the control stream had an infection rate of 80 percent or higher from a parasite, an intermediate stage of the "salmon-poisoning" fluke that infects young salmon and remains throughout life. In the heated stream, the infection rate was less than 10 percent.

Secondly, the higher temperature may have caused some invertebrates to leave the bottom and enter the drift, providing more food for the young salmon.

"The major contribution of our study is to simply identify the ways in which elevated temperature affects fish," said Bisson. "The information should be of interest to anyone interested in stream pollution."

The artificial streams are being kept busy. Bruce Halstead, a senior honors student, has investigated the behavior of chinook and coho salmon to see if the elevated water temperature affects the outcome of competition.

Robert Hughes, another young fisheries scientist, will study steelhead trout in the streams for a year and then may add a species of salmon to see how the elevated temperature affects the two species. Steelhead eggs will be incubated in the streams this winter.

Again the streams will simulate nature where young fish species do compete for food—and provide an open window to community developments.

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