Hastings Natural History Reservation

A Biological Field Station
Museum of Vertebrate Zoology
University of California, Berkeley
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Hastings is a Reserve in the University of California Natural Reserve System

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Weather Report

"Just another gorgeous day in Carmel Valley". Day after day in January, this was true and we failed to see rain. Rain fell on six days, for a total of 3.67" which brings our annual total to 11.52", relatively droughty. Frost was observed on 13 nights and most days were very clear. Finch Creek is now flowing all the way through the Reserve to the Martin Road bridge, but our spring remains dry. Manzanita are flowering and the hills are starting to green up. Most annuals have sprouted the grasslands. Salamanders and newts took advantage of each of the rainy nights when they were very active. Water in Blomquist Pond dropped nearly a foot below the outlet and Laguna Conejo dried back to a single smaller pond.

Leaping Lizards and Lichens...

One of the significant research projects underway at Hastings involves lichens.One of our long term studies involves the smoky green, lacy lichen Ramalina menziesii. Known locally as "Spanish Moss", the dramatic drapery on our our oaks, buckeye and other trees are a symbiotic association of fungi and green algae. Algae provide the photosynthesis for food and fungi provide the framework- the body of the lichen. And no, they do not kill the trees. Various trees provide lichens a place to hang out. In turn, the Ramalina have a dramatic impact on what goes on below them. Just exactly what these lichens are doing in the ecosystem keeps Jean Knops more than busy.

Jean Knops, resident graduate student at Hastings, is working with Dr. Tom Nash (Arizona St. Univ.- Botany) and Dr. Bill Schlesinger (Duke Univ.- Botany) to understand the importance of these lichens in the blue oak woodlands of central California. In December of 1989, this crew and others (including alumni of this project) showed up for a week of hard work. Twenty trees were stripped of lichens with rakes, brooms, brushes and some nimble footwork on long ladders. This was an enormous volume of lichen- enough to fill several trucks. Twenty trees were used as controls and were not stripped of lichen. Rich Evans, a local Carmel Valley resident, was hired to build a deer fence around this group of trees and then Jean set to work in 1990.

Much of Jean's work is to find how the lichens hanging in the trees influence rainwater as it falls to the roots below the trees. In contrast to the leaves (which drop each fall) lichens provide a huge net, filtering the air all year with a surface area at least several times that of the oaks. Lichen collects airborne bits of dust, dried sea aerosols, gases and other nutrients. Lichens are a major part of the oak woodland, weighing in about 700 pounds/acre (about the same as kg/hectare) and growing at the remarkablly fast rate of 20% each year. Rainfall dripping through the canopy including the lichens ("throughfall") shows a deep brown color. Throughfall below trees barren of lichen resembles weak tea while rainwater collected in the open is crystal clear. Obviously, the lichens have been collecting many nutrients which are then rinsed into the soil where they might be available to the trees.

Some of the rainfall never makes it past the trees to the ground. About 15% is intercepted by trees without lichens. Trees with lichens hold about 30% of the rainwater which would be measured in the open. Sometimes this simple weight of wet lichens is enough to pull down dead branches. Some might see this as damage to the trees, but as Jean has found, there are some benefits to trees bearing their lichen load.

Some nutrients absent in the throughfall water are apparently kept by the lichens. Sulfur is used by the lichens to grow tissue and appears to be held in the lichens and trees. Other nutrients are found in rain collected under lichen-laden trees at levels which indicate they are collected by lichens and passed on to the soil in the throughfall water. These include several forms of nitrogen (NO3, Organic Nitrogen), calcium, magnesium, sodium and chloride. Our proximity to the ocean probably accounts for the latter three elements, and soil dust could account for the calcium. Nitrogen can be tied up in small dust particles, particularly aerosols formed over the ocean and from internal combustion engines. As we have comparatively little input from engines, our lichens are thriving. Ramalina menziesii formerly grew on trees in the foothills east of the Los Angeles basin but they are now gone, a victim of excessive nitrogen and other pollutants in the smog. Some lichens are extremely sensitive to low levels of pollutants and are thus important as indicators of good air quality.

We see that lichens capture windblown nutrients that otherwise would have gone over or through our woodlands. As lichens drop off the trees, they add nutrients to the soil. There is a steady state of nutrients; in most ecosystems nutri-

ents coming in eventually rinse out, like a water bucket leaking at a rate which just matches a dribble being poured in so the water level stays constant. Lichens make the bucket larger. Well, how much of which nutrients do lichens add to an area?

John has been able to measure only phosphorus and nitrogen. For Hastings woodlands, Jean calculates 4 kg Nitrogen per hectare (100m x 100 m) per year and about 0.5 kg Phosphorus per hectare/yr. are added by lichens. On heavily fertilized farm soils, 50 kg N/ha/yr. are often added. On other parts of Hastings, deposition of about 0.7 kg/hectare/yr. of Nitrogen has been measured away from a forest canopy. So, the lichens in trees are not adding the kind of nitrogen you see in a corn field, but they are adding about five times as much nitrogen as would be added if they were not there. Where do these nutrients end up?

Most of the nitrogen ends up the oak trees. Oaks grow and hold the nitrogen in their tissue. Deer and other animals which eat the lichens and other plant material (acorns) move the nutrients around but do not export much unless they (or cattle) are harvested from the system. Generally, nitrogen used by animals ends up back in the soil organic matter through decomposition of their droppings. As an aside, Mark Stromberg recently found that soil nitrogen in grazed sites was almost twice that in ungrazed sites. Most likely, more nitrogen in grazed sites is tied up in the soil while more nitrogen in ungrazed sites is tied up in the abundant litter. Total nitrogen in either system may not be different; where it is located apparently differs. In general, the rate at which plants grow is limited by the rate at which nitrogen is made available by the break down of organic matter by decomposers in the soil. Total nitrogen in the lichen-covered oak woodland is in any event enriched.

Some animals collect organic matter and thus accumulate nitrogen in small patches. Harvester ants collect seeds from hundreds of yards around their homes, hull the seeds and dump the empty hulls around their nests. Acorn woodpeckers import acorns and spend most of their time around a granary tree, thus leaving most droppings around the tree. In these and other cases, the bright green patches around trees or nest piles indicate concentration of nitrogen in small patches in the ecosystem.

Phosphorus, as opposed to nitrogen, is probably not so limiting to plant growth. Phosphorus is rapidly tied up in complex, insoluble compounds in the soil. So, nitrogen and phosphorus are added by lichens to the ecosystem. There are many other nutrients needed by plants. Do lichens enhance any of these?

Jean will be looking. Jean has 40 trees, each with 5 large black plastic buckets. Each bucket collects anything that falls in. Jean empties each bucket each month and separates out the leaves, twigs, insects, lichen and "other". In the next year, Jean will analyze this material (over 5,000 samples!) for 5 or 6 other nutrients, compare these to nutrients in the soil and throughfall water and get back to us on what other effects lichens have on our oak woodlands.

Now about those leaping lizards.... Jean found Western Fence Lizards ("Blue Bellys") in many of his buckets. These buckets are knee high and there is no way the lizards could have climbed in on their own. Jean marked individual lizards and let them out. Many fell in again! Each was only found in a small area and the more insects he emptied from his buckets, the more lizards! Apparently these lizards leap out of their home trees reasonably often in their pursuit of bugs. John Barthell and Nancy Popkin have each seen lizards plop down out of the trees carrying large insects in their mouths. We will keep our eyes open, and ask you all to keep on the lookout for important documentation of this lizard behavior we can only conclude exists by inference.

Grassland News

In late January, germination was checked on all the planted sites. Only one species was growing significantly, Elymus glaucus. Others had germinated but remain very slight. All the fences have survived the month and the small electric chargers continue to fend off the deer and occasional cattle.

Data analysis continues. Comparisons of the soil nutrient data and gopher abundance are underway. Gophers are significantly reduced in grazed sites unless the percentage of sand in the soil is over 90%. Other significant differences between grazed and ungrazed sites are nitrogen location (more in grazed soils), phosphate (more in ungrazed soils), litter (more in ungrazed) and bare soil (more in grazed sites). Because these environmental variables so clearly indicate that grazed and ungrazed sites are radically different, we are re-analyzing our vegetation data based on these two groups. Germination tests for seed planted in December are underway at UC-Davis through the resources of Jennifer Menke.

Buildings

Architectural drawings of the new Bunkhouse were completed, incorporating changes for handicapped access and for fire protection. The campus fire marshal's office is reviewing the plans and they have required another site inspection for fire protection capacity of our water system.

Plans for the revised water system were submitted for review by a local contractor and a new cost estimate was provided. Dr. Frank Pitelka returned to Dean Gardner with this estimate for a request for the final part of the funding needed to replace the existing water system.

In addition to his usual routine, Mark Johnson brought our refurbished office/public restroom facility into usable condition. Some exterior painting remains to be done, but we now have a facility which can handle the demands of groups of visitors. This was a badly needed addition to the reservation, and it looks great. Thanks to Fanny Arnold for the support and to Mark for a great addition!

Reminder: Third Annual Hastings Open House on Sunday May 3! Barbeque ? More later.....