By: Gary Nakamura

California Forests, Carbon Sequestration and Storage

Factoids - Conversion factors and equivalencies

1 **MBF** (10^3 board ft) logs = 8 green tons biomass = 4 BDT biomass ≈ 2 tons C ≈ 8 tons CO_2
1 bone dry ton (**BDT**) of chips, hog fuel = 2000 lbs (bone dry is 0% moisture content)
1 BDT = 2.0 green tons, assuming 50% moisture, wet basis
1 standard chip van carries 25 green tons (50% moisture, wet basis), 12 BDT.
1 BDT fuel will produce 10,000 lbs. of steam to generate 1 megawatt hour (MWH) electricity
1 BDT wood = 75 gal cellulosic ethanol

Carbon - 1 lb wood ≈ 0.5 lb C ≈ 2.0 lbs CO_2 ; 1 lb CO_2 ≈ 0.25 lb C (0.27)

1 BDT wood = 17 million BTU (British thermal units, heat 1 lb water 1 deg F)
1 million BTU = 12.5 therms gas = 10 gal fuel oil = 0.045 tons coal = 293 kWh electricity
(120 lbs wood) (@80% efficiency) (@70% eff) (@60% eff)

Carbon dioxide (CO2) sequestration by trees -

Air weighs 1.2 kg/m^3. Air is 0.0383% CO_2. CO_2 constitutes 0.4596 g/m^3 air.
To photosynthetically fix 1 kg (2.24 lbs) C, a tree would absorb 3.67 kg CO_2, 8000 m^3 air, 280,000 cu ft air, assuming complete absorption of the CO_2 by the tree.

An acre of forest growing 500 board ft wood/acre/year would be absorbing 2,000 lbs C/yr (8,000 lbs CO_2) from a volume of air 5740 ft (1.1 mile) over the acre (43,560 sq ft, a football field).

A human breathes 9000 litres of air per day, 32 cu ft/day or 11,700 cu ft/yr.

Tree and forest growth and carbon sequestration

A moderately productive California forest will grow 500 board ft (bf) wood/ac/yr ≈100 cu ft/ac/yr ≈ sequestering 1000 lbs C/ac/yr ≈ 4000 lbs CO_2/ac/yr.

CA 2005 CO_2 output = 475 million metric tons. 25% reduction 2020 = 174 metric tons CO_2.

California forests and carbon sequestration							22-Jun-07
Growth						roots = 25% of above grnd biomass	
Ownership	Acres 10^6	MBF/ac/yr	MBF total	t C total	t CO2 total	t C total w/roots	t CO_2 total w/roots
NF	8.2	0.5	4.1	3.6	13.2	4.5	16.6
Ind	4	0.5	2	1.8	6.5	2.2	8.1
NIPF	3.7	0.5	1.85	1.6	6.0	2.0	7.5
Total, all forests/year, 10^6 tons			8.0	7.0	25.7	8.7/year	32.1/year
Stocking - current inventory							
NF	8.2	20	164	144.3	529.7	180.4	662.1
Ind	4	12	48	42.2	155.0	52.8	193.8
NIPF	3.7	8	30	26.0	95.6	32.6	119.5
Total, all forests, 10^6 tons			242	213	780	266	975

References: The Changing California: Forest and Range 2003 Assessment. Assessment Summary, October 2003. FRAP Report. http://www.frap.cdf.ca.gov/assessment2003
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CALIFORNIA TREE FARM COMMITTEE
Committee Secretary
George E. Belden
1777 Lakeside Dr.
Redding, CA 96001

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California Tree Farm News
FOREST LANDOWNERS OF CALIFORNIA

CALIFORNIA TREE FARM COMMITTEE ADMINISTRATION

Chairman
William E. Snyder
P.O. Box 944246
Sacramento, CA 94244-2460
916-653-4298

Committee Secretary
George E. Belden
1777 Lakeside Drive
Redding, CA 96001
530-229-3798
E-mail: lake1777@pacbell.net

Pine Region
Lennart L. Lindstrand, Jr.
W.M. Beaty & Associates
P.O. Box 990898
Redding, CA 96099-0898
530-243-2783

Northern District
Hal Bowman
4000 Hope Lane
Dunsmuir, CA 96025
530-235-2590
hbowman@snowcrest.net

Southern District
Leon Manich
California Reforestation
22230-A Colorado River Blvd.
Sonora, CA 95370
209-588-1920

Central District
Steve Andrews
Applied Forest Management
200 Litton Drive, #210
Grass Valley, CA 95945
530-274-6455

Southern California District
Eric Oldar
2524 Mulberry Street
Riverside, CA 92501
951-320-6125

Redwood Region
Daniel Cohoon, Chairman
@ Able Forestry
1410 Second Street
Eureka, CA 95501
707-445-4130

Mid-State Region
Robert Rogers
1525 Glenwood Dr.
Ukiah, CA 95482
707-463-0396

Tree Farm Mission

To promote the growing of renewable forest resources on private lands while protecting environmental benefits and increasing public understanding of all benefits of productive forestry.

March 2008

California Tree Farm News

Dedicated to providing useful information to Tree Farmers and family forest owners.

THE ELUSIVE RED FOX

By Jennifer Carlson

INTRODUCTION AND STATUS

Red foxes (*Vulpes vulpes*) in California have had a sorted history, depending upon which part of the state you live in. To explain the entire story would depend on how much time you had to listen, so I won't bog down on those details here. However, one thing is for sure – northern California is home to the only currently known population of the native state-threatened Sierra Nevada red fox (*Vulpes vulpes necator*). This only native subspecies of red fox historically occupied the high elevations of the Sierra Nevada and Cascade ranges throughout California and is now only known to exist in the Lassen Peak Region of Northern California. The other population of red fox found in California is, for unknown reasons, restricted to occurring in the lowlands of the Central Valley and some coastal areas in the San Francisco Bay Area and southern California. This lowland population was thought to be of exotic origin from Europe, although recent work has indicated that foxes found in the lowlands of the northern Sacramento Valley (north of Sacramento metropolitan area) may be more closely related to the native Sierra Nevada red fox than the exotic strain of foxes found to the south (Perrine et al. 2007). Currently, further genetic studies are being conducted on the Sacramento Valley red fox populations to determine their status.

The Sierra Nevada Red fox (SNRF) was listed as threatened under the California Endangered Species Act (CESA) by the California Fish and Game Commission in 1980. A five-year status report for red fox in1987 recommended that the threatened status be retained due to lack of new information on the species and increasing threats including logging activities, grazing, and human disturbance (CDFG 1987). Schempf and White (1977) stated that red fox research was of greater conservation concern than any other of the forest carnivores studied including wolverine. Little work has been conducted on SNRF in California since the late seventies. The most recent study to date was conducted by a doctorate student at UC Berkeley that

(Continued on page 3)

BIOMASS FROM FOREST THINNING, PART 2

George E. Belden

Co-generation power plants utilizing wood waste/ biomass are scattered throughout California. From fruit tree chips in the southern San Joaquin Valley to conifer chips in the Cascade Mountains, these power plants are all burning woodchips to generate steam to produce electricity. Because Tree Farmers are interested in the final disposition of their uncommon wood product, I asked David C. Allen, Wood Chip Procurement Forester for Honey Lake Power, to write about that power plant.

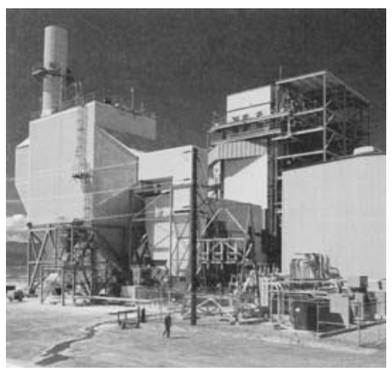
HONEY LAKE POWER

David C. Allen

Honey Lake Power is a 34-megawatt combined biomass and geothermal electric power generation facility located in the desert near Wendel, 25 miles east of Susanville. The plant, which began operation in 1989, is owned by a partnership and operated by the general partner, CMS Generation of Jackson, Michigan.

HLP provides its full energy production to Pacific Gas & Electric Company under a 30-year power purchase

(Continued on page 2)



The Honey Lake Biomass & Geothermal Power Generation Plant.

HONEY LAKE

(Continued from page 1)

agreement. Combining energy from an onsite geothermal well with combustion of waste biomass in a single boiler to drive a turbine and generator which produces electricity. The power is connected to the regional grid where PG&E distributes it to its customers in the region.

At full power, the plant consumes 580 bone dry tone (40 truckloads) of biomass daily and generates sufficient electricity to supply 30,000 homes. HLP employs 25 full-time personnel and generates approximately 60 additional support positions in fuel supply, trucking, parts & equipment supply, and contract maintenance.

During its development and startup, HLP negotiated biomass supply agreements with regional forest landowners which formed the foundation of its fuel program. The last 1980s through mid-1990s were years of prolific timber harvesting on both private and public timberlands in California. Honey Lake Power, along with the ten other biomass power plants in northeastern California, enjoyed relatively plentiful fuel supplies from within their local procurement areas, each generally a circle of about 50-mile radius. A dramatic change was initiated in 1994 with the federal government's adoption of the Northwest Forest Plan, which integrated traditional forestry with "ecosystem management," resulting in drastically reduced harvest levels on federal lands. Western state governments implemented policies and forest practice rules that, to varying degrees, reflected the intent of the Plan. By 1998, the impact of the changes became widely felt, with competition sharpening and biomass becoming as much a commodity as a waste material. Today, timber and biomass harvesting on the three national forests adjacent to HLP are at 20% of their 1989 levels, harvesting on private lands has decreased, and more than 75% of wood used in California is imported from other states or countries. Sawmill and logging infrastructure, which includes biomass supply, has diminished. As a result, competition for biomass fuel has increased procurement distance and cost.

In response to the changes in our biomass fuel base, HLP has reduced power generation to conserve fuel and initiated innovative programs designed to increase supply. To expand the fuel supply, HLP established a rail tie disposal program in cooperation with Union Pacific Railroad which supplies 20% of the plant's fuel requirement. HLP pioneered harvesting of western juniper, a non-commercial, rapidly-spreading tree species that grows on several million acres in northeastern California and bordering areas of Oregon and Nevada. That program has provided our plant over 300,000 tons of biomass to date. To increase access to scarce trucking, HLP acquired and leases chip vans to some suppliers, installed a 12,000 gallon diesel tank to provide at-cost fuel to our truckers, and initiated a "frequent trucker program" which rewards drivers with a free tank of diesel fuel for every 30 loads of biomass delivered.

HLP's energy resource is 100% renewable and greenhouse-neutral, meaning that there is no carbon released from our geothermal source, and carbon released from biomass combustion is in balance with carbon absorbed by living trees, as opposed to fossil fuels, which release carbon into the atmosphere after millions of years of sequestration, with no equivalent recycling mechanism.

RED FOX

(Continued from page 1)

initiated an intensive field project in 1999 in the Lassen Peak region of northern California. Perrine's population estimate for the Lassen Peak region was very small, perhaps no more than10-15 individuals. This estimate could be higher given the potential for foxes occurring in areas that have not been surveyed yet (Perrine 2005).

Description

The red fox is a relatively small canid with an elongated muzzle, large pointed ears, and **a round bushy tail with a noticeable white tip at the end of it** (Aubry 1997). The tail is usually as long as the body. There are three known color phases that vary from red to silver and black, or a cross phase. The red phase is the most typical with reddish- brown fur on the upper body with the cheeks, chin, throat, and abdomen white in color. The silver phase can vary in color from silver to black with silver tipped guard hairs giving the coat a "frosted" appearance. The cross phase appears to incorporate both red and black phase characteristics, with a grayish-brown coat and long black guard hairs. The silver and cross phase of the red fox occur in California. The cross phase was the dominant phase in the Sierra Nevada as well as in the Lassen region (Grinnell 1937, Perrine 2005). Other fox species that can be confused with the red fox is the smaller gray fox (*Urocyon cinereoargenteus*). Gray fox are grizzled gray above, with rusty fur on lower sides, chest and back of hear. The throat and belly are white. The tail is the easiest way to differentiate from a red fox with a black dorsal stripe and black-tipped tail, compared to the white-tipped tail of the red fox.

Breeding typically takes place between December and March with mating occurring sometime in February. Grinnell documented foxes mating on or around the first part of February. Den construction usually occurred around February 1. The length of gestation is usually 52-54 days. The birth of the pups would occur sometime the first part of April. The pups are fairly mobile by 12 weeks and moving outside and around the den site by mid to late June. The average litter size of SNRF is reported to be no more than 2-3 pups, which is a smaller litter size than documented for the exotic red fox.

Diet and Habitat associations (Taken from Perrine 2005)

Red fox can utilize different habitats seasonally. Detections within Lassen National Park were at lower elevations in the winter compared to summer detections. In the winter months, red fox moved lower in elevation and also utilized National forest and private timberlands. Mature closed-canopy forest was important to red fox in the winter months. Red fox was negatively associated with mid-sized closed canopy forest in the summer, and were detected most in the high elevation conifer community type. However, red fox were positively correlated with barren (devoid of vegetation, i.e. rock outcrops) areas during both the winter and summer.

Grinnell (1937) documented that SNRF preyed primarily upon small mammals including: mice, bushy-tailed woodrat, Douglas' squirrel, Belding's ground squirrel, alpine chipmunk, and white-tailed jackrabbit. Lagomorphs were common in the diet of red fox. Perrine (2005) used scats to determine the diet of SNRF. He found that pocket gophers (*Thomomys monticola*) were the most frequent prey in red fox diet, with increasing frequency until autumn. There was an absence of snowshoe hares in the diet of red fox in the Lassen Peak region. The remains of mule deer was most prominent in the winter and spring months reflective of scavenging. Shrews and moles were also found in the diet of red fox every season and only taken when food was scarce, given that they are insectivores and can be distasteful to carnivores. Manzanita berries were also found in the diet especially in autumn as they were available.

PHOTO BY DR. BEN SACKS

More information Needed

The Interior Timberland Program at the Department of Fish and Game in Redding is collecting more information about this species. We urge anyone that suspects that they have seen a red fox to contact me via email at jecarlson@dfg.ca.gov. or by phone at (530) 225-2754. Photographs and a map with an approximate location would be very helpful. For more detailed information and pictures of this species, visit our website at: https://r1.dfg.ca.gov/portal/itp (Click on wildlife species in the menu, then Sierra Nevada red fox).

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TREE FARMER QUIZ

1. *Name one western, one needle pine tree?*

2. *List two western, two needle pine trees?*

3. *List three western, three needle pine trees?*

4. *List three western, five needle pine trees?*

5. *Dioecious n*

   forest tree?

6. *Name one western conifer that produce*

ANSWERS: (1.) Pinyon. (2.) Lodgepole, Bishop, (3.) Ponderosa, Jeffrey, Digger, Knobcone, Monterey, Coulter. (4.) Sugar, Whitebark, Western White, Fox Tail, Bristlecone. (5.) Cottonwood, Aspen, Willow, Ash. (6.) Yew, Juniper, Nutmeg.

"FOREST-UNCOMMON PRODUCTS"

by Frank Barron

Everyday, you handle, put on your face, and even eat forest products that you don't recognize as such.

Wood flour and melamine resins using cellulose filler are used to make everything from football helmets to TV cabinets and even sausage casings. Turpentine and tall oil reclaimed from the paper-pulping process are used in paints, soaps, and polishes; related oils are used to make detergents, toothpaste, and shampoos. The anticancer drug, Taxol, is obtained from the bark of the Pacific Yew tree.

Torula yeast and artificial vanilla flavoring are by-products of the pulping process and are used in a variety of food products.

Wood alcohols are used in colognes and solvents. You didn't know that you had something in common with beavers and termites, did you? You eat trees!