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Student Research - Electromagnetic Field Effects on Succor Creek Desert Shrubs

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ELECTROMAGNETIC FIELD EFFECTS ON SUCCOR CREEK DESERT SHRUBS

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Abstract

There have been indications that exposure to electromagnetic fields produced by voltage power lines have permanent effects on living organisms. I found studies on electromagnetic field effects on rodents and humans, but there has been little research done with plants. The purpose of my study was to record any measurable effects on desert shrubs in an area of Succor Creek, Oregon, produced by an adjacent 500 KV power line.

Plants studied were sagebrush, saltbush, bitterbrush and greasewood. I ran fifty meter transects in ten areas and did shrub population counts and height measurements. Leaf samples were collected and leaf chlorophyll measured. The results indicate measurable differences in all shrubs except sagebrush. These variations occurred between 0 and 20 meters from the power line. This is where the electromagnetic field was the strongest at 3.0 KV/meter.

Introduction

Two natural substances, amber and loadstone, have aroused interest since ancient times. Amber is tree sap that, over many centuries, has turned solid. The ancient Greek saw that it had a curious property — if rubbed hard against a piece of material, it can attract nearby objects. Loadstone is a mineral that also has unusual properties — it attracts iron. The histories of amber and loadstone are the early histories of electricity and magnetism. The first connection between electricity and magnetism was discovered by Oerstad in 1820. He proved that electric currents formed circular magnetic fields. Strong electric currents have the ability to produce strong magnetic fields (Rutherford, et al, 1981).

Biologists have done research to discover the effects of electromagnetic fields on living organisms. Certain fresh water bacteria orient and move in preferred directions in magnetic fields. When the magnets are reversed, the bacteria make U-turns and move in the opposite direction. Electron microscope examination of these bacteria revealed the presence of granules containing iron within their cell membranes. Honeybees can be influenced by very minor fluctuations in the earth's magnetic field. Marine sharks, skates and rays are extremely sensitive to weak electromagnetic fields. They respond to voltages as low as .01 microvolts. Birds have also been shown to orient to the earth's magnetic field on cloudy days when the sun was not available to use as a compass. Their orientation was completely messed up by attaching collars around their necks which used electric currents to set up minor magnetic fields (Tenforde, 1979).

Studies on higher animals have mostly been limited to laboratory animals.

Reports of electromagnetic field effects mainly concerned effects on blood composition, on the immune system, brain function, behavior, growth and activity.

Battelle Northwest Laboratories in Richland, Washington, have been studying electromagnetic field effects on animals since 1975. This followed a 1972 report by Soviet scientists who said workers around their high voltage lines were being affected. Battelle studies exposed animals twenty hours a day to 1.5 kilovolts per square meter for three weeks. They observed changes in the animals' nervous systems, quicker recovery from stress, effects on the pineal glands and in breeding cycles. They would like to limit exposure to electromagnetic fields for people working or living around high voltage lines from 500 to 760 kilovolts (KV) (Idaho Daily Statesman, 1984).

In 1981, a 500 KV line, which crosses through central Malheur County, Oregon, in the area of Succor Creek was built by Pacific Power and Light Company. This line was located away from human populations and lies mainly on Bureau of Land Management lands. The only known studies done to date on the effects of the produced electromagnetic field have been done on rodent populations. In the literature research on the topic of electromagnetic fields, I found no references to the effects of these fields on plant life. So the purpose of my study was to survey desert plants in the vicinity of this high voltage line to see if the plants were being affected.

Materials and Methods

I ran 50 meter transects starting from directly under the center high voltage line. Five transects were run going south from the center line and five going north from the center line. Areas were selected at random but in all areas vegetation had not been disturbed by man when the power lines were built or since. Four desert shrubs were selected for study. There were: sagebrush *(Artemisia tridentate),* bitterbrush *(Purshia tridentata),* saltbush *(Atriplex confertifolia)* and greasewood *(Sarcobatus vermiculatus).*

The transects were run by laying down a fifty meter tape at right angles to the power lines and counting and identifying every shrub it went over. Each shrub was also measured for height with a meter stick at the highest point and data recorded. Since there did not seem to be any major variations in data gathered from the north and south transects, this data was averaged together. The number of each shrub type was calculated for each ten meter interval away from the center line and the data graphed (Figure 1). The heights of each type of shrub were also averaged for each ten meter interval away from the center power line (Figures 2, 3, 4, 5). Plant leaves were also collected from sagebrush, saltbush and greasewood in each ten meter area within the transect and placed in labeled plastic bags. Bitterbrush did not have leaves at that time of the year so no samples could be collected. Chlorophyll tests were run on the leaf samples and results averaged. One gram samples of leaf were weighed out on a Mettler analytic balance. The leaves were placed in boiling water for three minutes to kill the plant cells. The leaves were then placed in test tubes with 10 ml of ethanol (reagent grade) and placed in a water bath for 5 minutes. Leaf fragments were then removed from each tube. The resulting solutions were read in a Bausch and

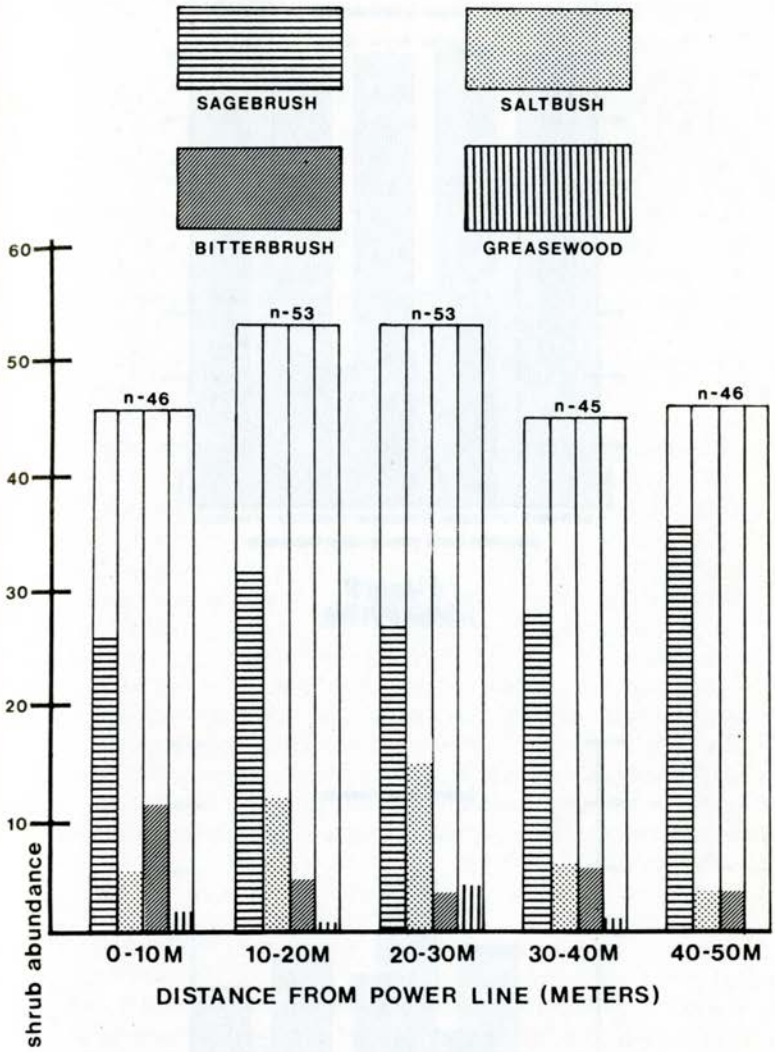
SAGEBRUSH
SALTBUSH
BITTERBRUSH
GREASEWOOD
60
50
40
30
20
10
shrub abundance
n-46
n-53
n-53
n-45
n-46
0-10M
10-20M
20-30M
30-40M
40-50M
DISTANCE FROM POWER LINE (METERS)

Figure 1

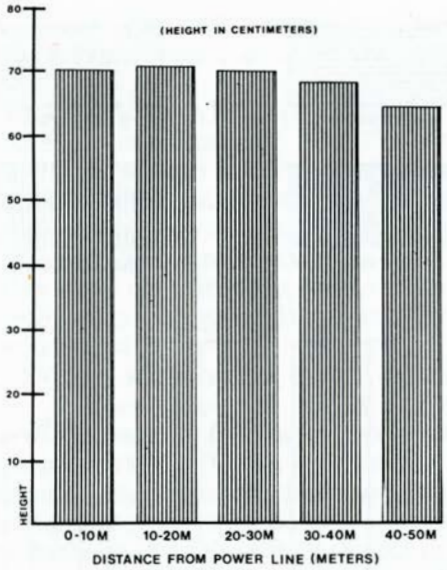

Figure 2
SAGEBRUSH

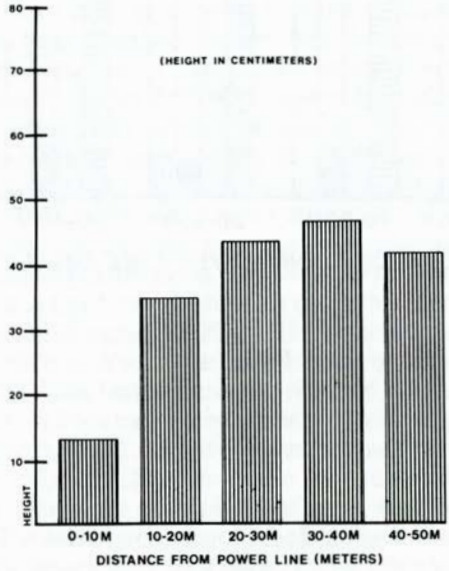

Figure 3
SALTBUSH

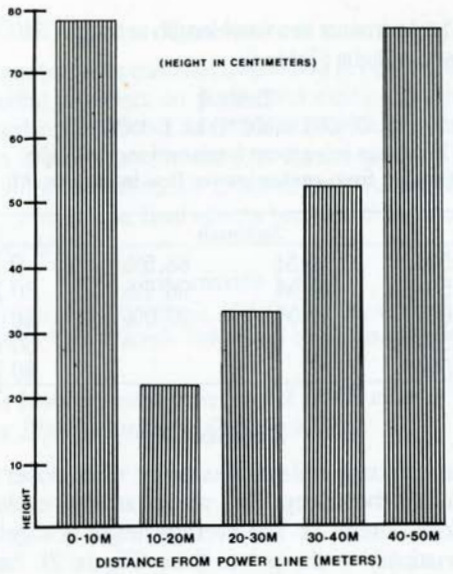

Figure 4
BITTERBRUSH

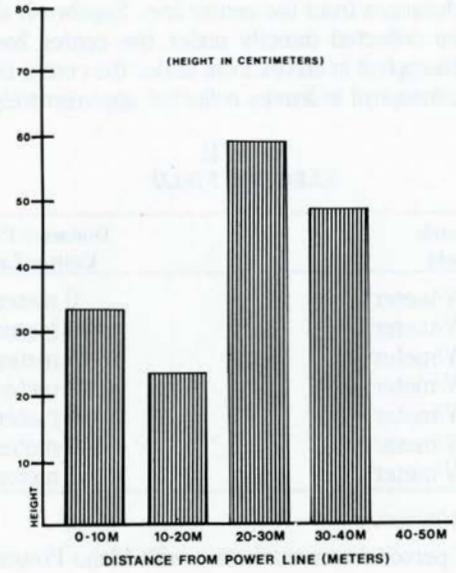

Figure 5
GREASEWOOD

Lomb Spectronic 20 colorimeter at a wavelength setting of 540. Data was read as percent transmittance of light (Table I).

Table I
LEAF CHLOROPHYLL CONTENT
Readings in percent transmittance of light
Distance from center power line in meters (M)

Sagebrush		Saltbush		Greasewood	
0 M	65.5%	0 M	88.5%	0 M	95.5%
10 M	70.5%	20 M	96.5%	10 M	88.0%
20 M	68.0%	40 M	97.0%	20 M	92.0%
30 M	70.5%			30 M	96.5%
40 M	71.5%			40 M	96.0%

Results

There were some variations in shrub abundance when closer to the power line compared to growing further away. This was most noticeable in saltbush and bitterbrush populations (Figure 1). The average height of sagebrush showed no variations due to proximity to the power lines (Figure 2). Saltbush within 10 meters of the power line were shorter (Figure 3). Greasewood and bitterbrush between 10 and 20 meters from the center line were shortest (Figures 4 and 5). This data correlates with the size of the electromagnetic field formed by the power lines (Table II). Data obtained from Idaho Power Company indicates the largest electromagnetic fields between 0 and 30 meters (Idaho Power Company, personal communication). The leaf chlorophyll tests varied in quantity between the plants and the distances from the center line. Sagebrush showed the most chlorophyll in leaves collected directly under the center line. Saltbush also showed the most chlorophyll in leaves from under the center line. Greasewood showed the most chlorophyll in leaves collected approximately 10 meters out from center line.

Table II
ELECTRIC FIELD

Electric Field	Distance From Center Line
1.00 KV/meter*	0 meters
2.35 KV/meter	10 meters
3.00 KV/meter	15 meters
2.55 KV/meter	20 meters
1.60 KV/meter	30 meters
1.18 KV/meter	40 meters
.31 KV/meter	61 meters

*KV/meter is kilovolts/meter

Data obtained from personal communication with Idaho Power Company

Conclusions

The electromagnetic field produced by the 500 KV power line near the Succor Creek road is having an effect on plant communities in close proximity to it. Saltbush and Bitterbrush showed measurable variation in abundance within the 50 meter transect areas. Three of the four shrubs growing in the area showed height variations within the 50 meter transect area. Additional studies should be conducted on electromagnetic field effects because of the increasing numbers of high voltage power lines.

Literature Cited

Rutherford, F.J., G. Holton and F.G. Watson. 1981. *Project Physics.* Hold Rinehart and Winston.

Tenforde, Tom S., Editor. 1979. *Magnetic Field Effects on Biological Systems.* Plenum Press, New York.

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