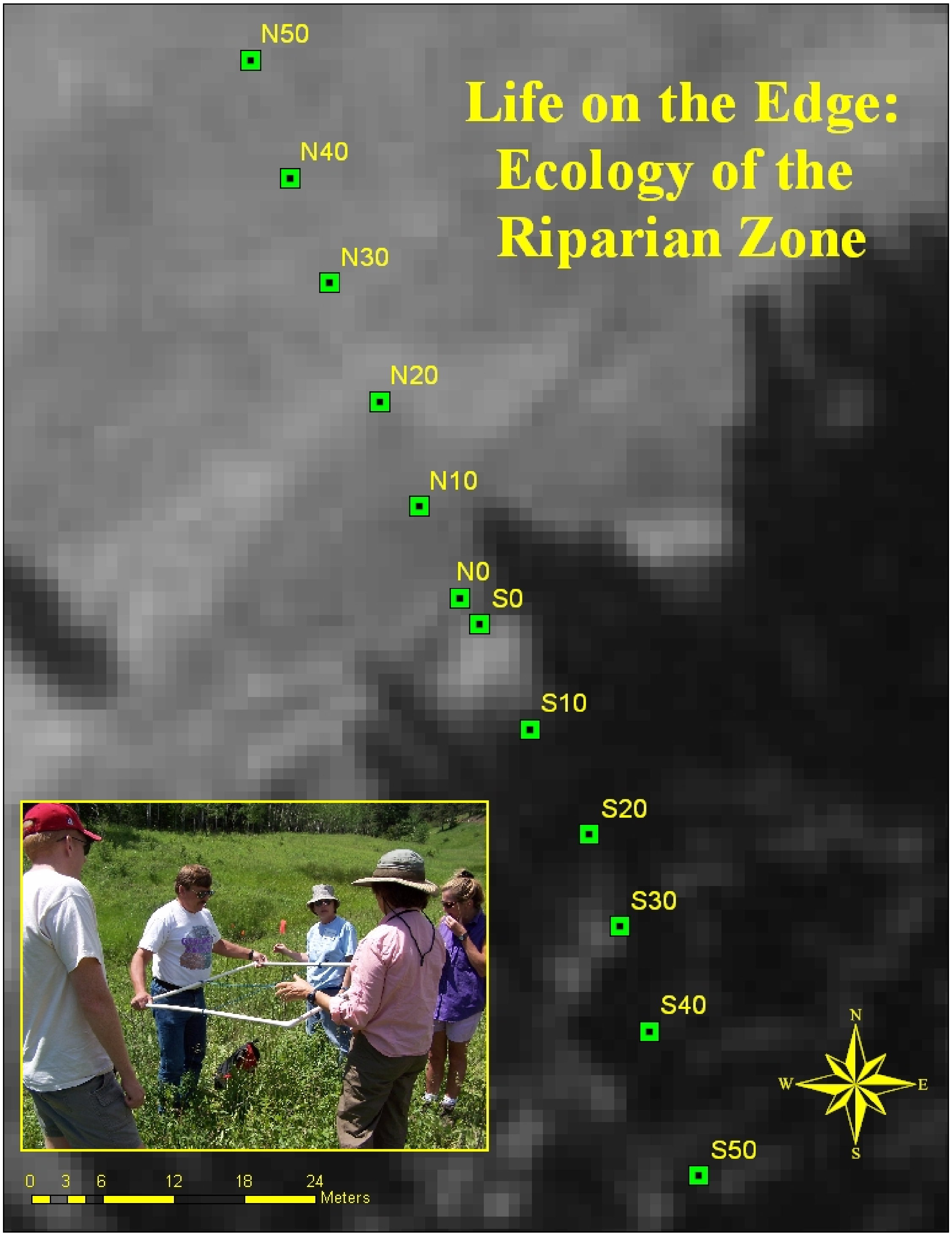

Life on the Edge:
Ecology of the
Riparian Zone
N50
N40
N30
N20
N10
N0
S0
S10
S20
S30
S40
S50
0 3 6 12 18 24
Meters
N
W
E
S

<u>Title</u>: Life on the Edge: Ecology of the Riparian Zone

<u>Team Members</u>:

Tracy Andersen	Barney Peterson	Dan Howard
Lowell Bailey	Margaret Peterson	Genny Healy
Edie Clark	Annette Rafferty	Jamie Fanous
	Nathan Schwalen	Rick Rudy

<u>Research Question</u>:
Does plant and insect diversity change with distance from the stream?

<u>Hypothesis</u>:
Plant and insect diversity decreases with distance from the edge of the stream.

<u>Site</u>:

West of the lower pond; North and south sides of the creek with minimal variation in topography.

<u>Equipment and Materials</u>:

¼ meter sq. quadrant	sweep nets	ice cube tray
100 meter tape	kill jars	Petri dish
Flags	zip loc bags	binocular microscope
GPS unit	marking pens	field guides
Thermometer	hand lens	insect forceps
Data sheets	digital camera	computer/Excel
GIS software	nail polish remover	Shears
Cotton balls		

<u>Quality Control</u>:

- Protocols by consensus:
    - Consistency on both sides of the stream
    - Switch sites by collection teams and advising scientists
- Practice plot survey as a team
- Reconvene team and refine protocol by question and answer
- Insect sorting and quantifying all done by the same person
- Data entry back-up check by two team members
- Write-up back-up by two team members

<u>Procedure and Methods</u>:

1. Transect was defined by running a 100m tape across, and perpendicular to, the creek and marking endpoints 50m from the flowing edge of the creek on each side.

2. Flags were placed every ten meters, beginning at the flowing edge of the creek and identified as N-50, N-40, N-30, N-20, N-10, N-0; S-50, S-40, S-30, S-20, S-10, and S-0.

3. Sampling was done between 9:00 a.m. and 6:00 p.m., hours of greatest insect activity.

4. The quadrat frame (1 meter square) was dropped at each point along the transect with the marking flag in the outer corner.

5. Immediately the flag-quadrant was swept a total of 6 times, back and forth, making contact with the ground during each sweep.

6. Insects were shaken down to the bottom of the net and the net inverted into the kill jar laced with acetone. After the insects stopped moving, they were transferred to zip loc bags to be quantified and identified later.

7. A digital photo of each site was taken and sketch of it made in the lab notebook.

8. A thermometer was placed in the center of each sample quadrant.

9. Number and species of all plants found in the .25 m quadrant were counted and recorded by clipping or pulling each clump or main stem. Start with the most abundant grass species and use shears to cut away clumps as they are counted. Species were differentiated and recorded as P-1, P-2, and etc.

10. One member of each team recorded readings and plant counts as they were made.

11. GPS position readings were taken for each site (latitude and longitude in decimal degrees, and elevation in feet).

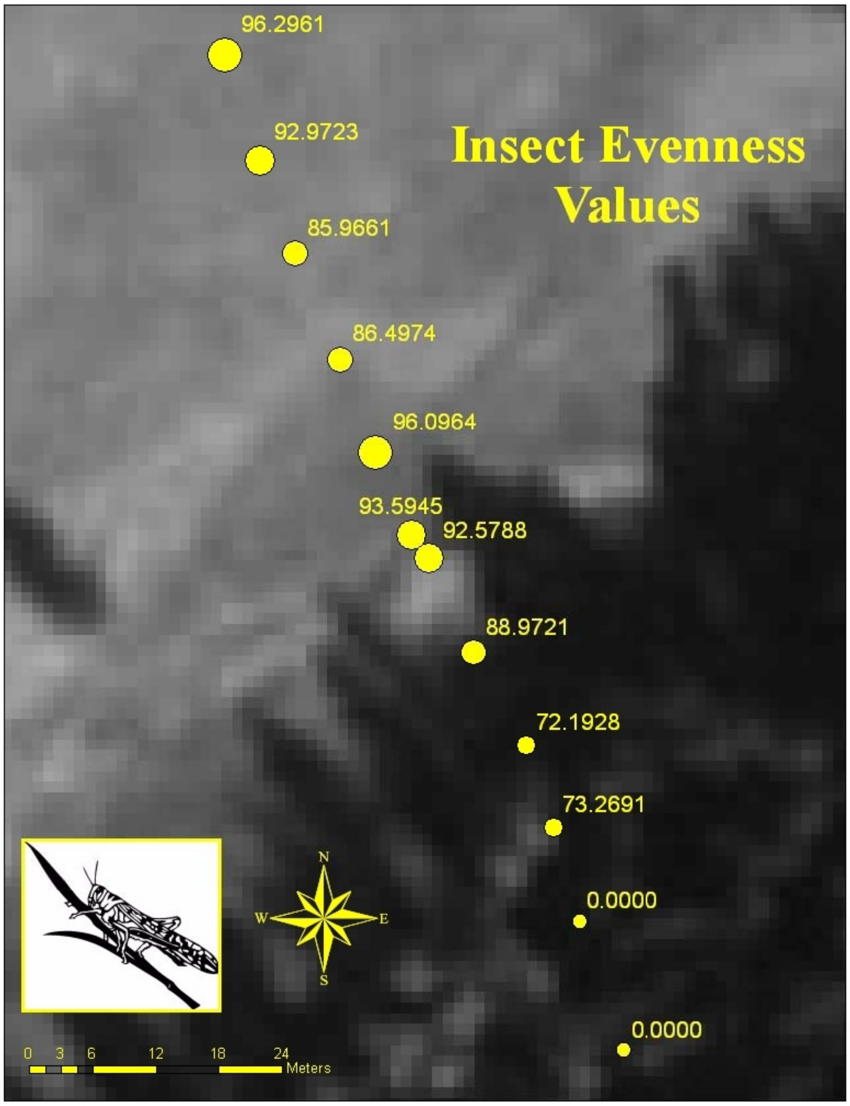
12. Insects collections were transferred to Petri dish, viewed through dissecting microscope, sorted using forceps, and counted for kind and number of each kind.

13. All data for each species was entered on a spreadsheet: # species per plot, # of individuals per species, and the total number of individuals per plot.

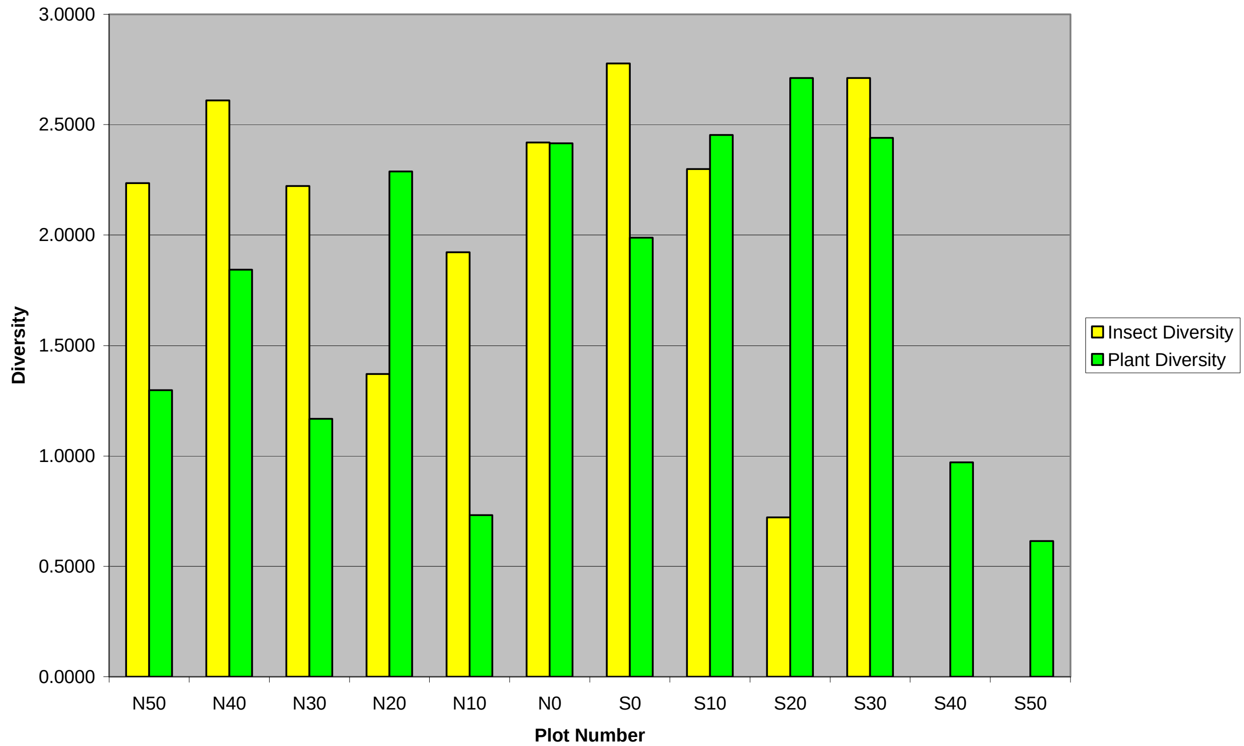
14. Use the Shannon Biodiversity Index and the aforementioned data to calculate species richness.

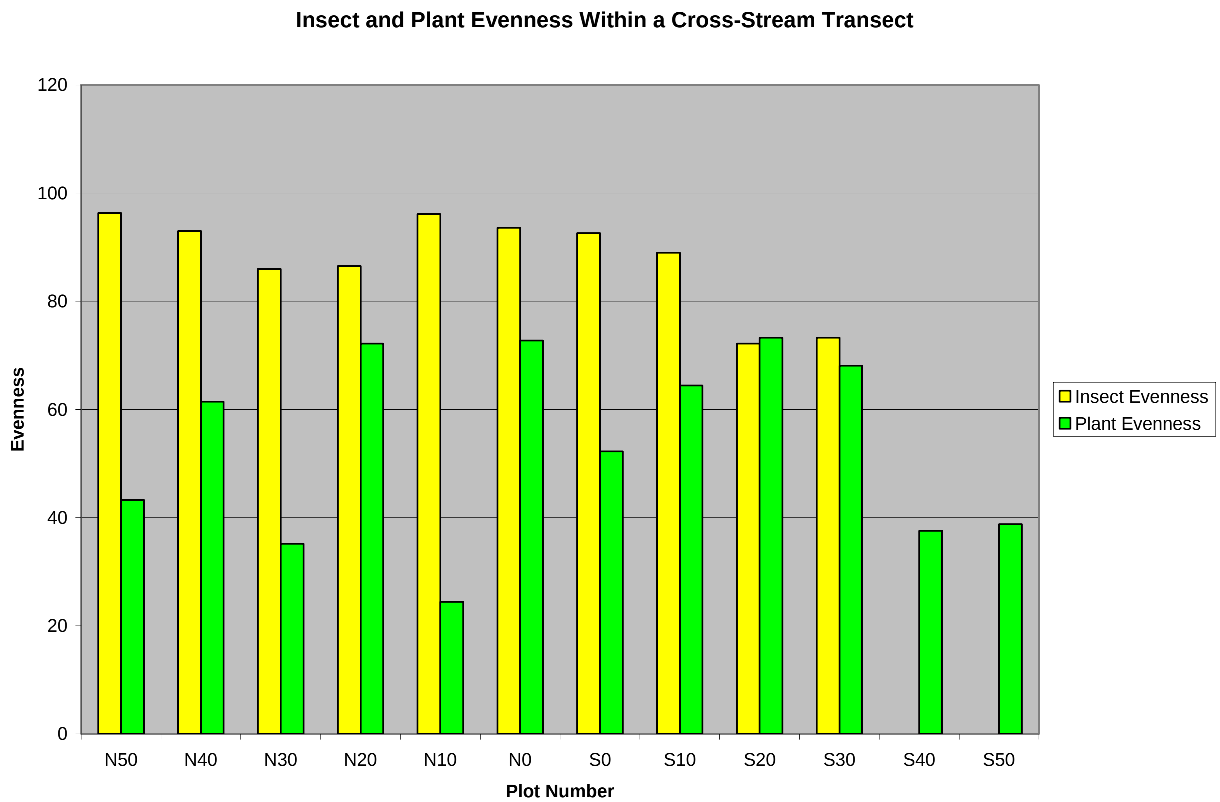
15. Conclusions were developed by group consensus based upon discussion of results of data analysis.

<u>Data</u>:


Insect Evenness Values
96.2961
92.9723
85.9661
86.4974
96.0964
93.5945
92.5788
88.9721
72.1928
73.2691
0.0000
0.0000
N
W
E
S
0
3
6
12
18
24
Meters

Insect and Plant Diversity Within a Cross-Stream Transect





See also Appendix A: Raw data worksheets

Discussion:

1. A definition of "riparian zone" needed to be established. The following was finally chosen as meeting our needs: Narrow strips of land that border creeks, rivers,…Because of their proximity to water, plants species and topography of riparian zones differ considerably from those of adjacent uplands.[1]

2. Consensus within the group is that the riparian zone at our site is limited to the area on south side of the stream defined by the edge of the conifer forest and on the north side by the steep cut-bank indicating high water erosion and flood plain development.

3. It is not necessary to identify plants and insects by species for this type of study. We used the system I-1, I-2… for insects and P-1, P-2… for plants at each sample site. This would make it easier to replicate this project with students.

4. Killing insects for sorting was deemed necessary because of the quantity of moving insects collected and the difficulty of getting accurate sorts and counts when they were alive.

5. In order to standardize the collection process the team decided to use only sweeping for collection of insects because during the amount of time required to separate profuse vegetation to find and collect insects on the ground, many could move into and out of the sample site, skewing the data.

6. To count and sort vegetation in plots N-50 through N-10 and S-50 through S-10, team members pulled or clipped plants and bunches to get the most accurate count. However, at plots N-0 and S-0 roots were left intact and plants were snipped at ground level. This helped prevent disturbing root masses that control erosion.

7. Sample site N-10 contained an animal burrow which left the ground covered with disturbed soil and therefore yielded a smaller number of plant kinds and total plants.

8. Our scientist-advisor suggested using the Shannon Index for calculating diversity, as opposed to the simple Simpson Diversity Index. There is a

website into which we can plug our numbers and get calculations made for species richness, evenness, and diversity. (See Appendix D for glossary)

9. At the time net-sweeping was done, the number of species of insects was sometimes more limited than we found it to be (through observation) at a later time.

10. Group discussions led to consideration that net-sweeping the whole one square meter quadrat and then inventorying only one-quarter square meter quadrant for plants would provide a truer insect sampling because of the difficulty of accurately sweeping only the smaller plot.

11. The team acknowledged that surveying several adjacent transects up and down the course of the stream could have provided sufficient additional data to disprove the null hypothesis.

12. There were acknowledged differences within our transect and among sample sites in slope, ground water release, habitat type and exposure to sunlight.

Conclusions/Interpretations:

Since there were differences in habitat type within the transect, slope, exposure to sunlight, and groundwater release, we expected that there would be differences in diversity. Observation suggested increased diversity close to the creek. We did a statistical analysis of the data to determine if the results supported our hypothesis. We used the chi square test to compare what we observed with what we expected. If the result had met the 0.05 significance level we could have been 95% certain that our hypothesis was correct. However, the results were not sufficient to reject the null hypothesis- i.e. that diversity does not change with distance from the edge. Therefore the data did not support our hypothesis that diversity decreases with distance from the edge of the stream in a riparian zone.

We feel that one way to improve the statistical accuracy of the data would be to survey multiple transects up and down the course of the stream. Another way to increase the validity of the data would be to use a larger quadrat: $1m^2$ instead of $.25\ m^2$, to sample the insects. $.25\ m^2$ worked well for the plants, but was too small for the insects.

Also, many insects escaped our sweep nets, e.g. ground beetles, and ladybugs, which flew away before being captured. This could be remedied by adding pitfall traps and sticky cards.

An additional variable also needs to be considered: 2005 has been an unusually wet year, and it may be that the abundant moisture has led to less variation between the usually drier meadow and the more moist conifer forest.

Next Questions:

1. How does species composition vary between the various habitats represented within our 100 meter transect (conifer forest, north facing meadow, wet meadow, and south facing meadow.)

2. Are there differences in the soil moisture between plots and if so what is the effect of this on diversity?

3. Do soil types influence the plant and animal diversity found in riparian zones?

4. What affect would sampling the macro invertebrate population of the stream have on the results of the diversity survey?

5. What is the effect of elevation on diversity?

6. What is the effect of invasive species (thistles) on the plant and animal diversity within this zone?

7. What is the effect of light on the diversity (some sample sites being under the conifer forest canopy)?

8. What effect does human activity and land use have on the diversity of plant and animal species (road, cut-banks, and run-off)?

9. What is the anthropogenic history of this site and how does this affect the biodiversity?

10. How does animal presence and activity (other than insects) in the transect influence plant and animal diversity? (Example: droppings from grazing animals.)

Sources:

1. Malheur Experimental Station, Oregon State University, www.cropinfo.net/riparian.htm

2. Cox, George. 2002. General Biology Laboratory Manual, New York, McGraw Hill.

3. http://math.hws.edu/javamath/ryan/DiversityTest.html

4. http://terraserver-usa.com

Appendix A: Raw Data Sheets

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-0

Date:6/27/05	Temp: 83°
Time: 10:54	Weather: Partly Cloudy
Location: Cal-Wood	Height of Vegetation:
Latitude:	Litter Sample Taken
Longitude:	Soil Sample Taken
Elevation:	

Insects

	Type	Abundance
1	N0-I01	2
2	N0-I02	1
3	N0-I03	3
4	N0-I04	1
5	N0-I05	1
6	N0-I06	1
7		
8		
9		
10		
11		

Plants

	Type	# Stems	DBH
1	N0-P01	16	
2	N0-P02	5	
3	N0-P03	25	
4	N0-P04	12	
5	N0-P05	1	
6	N0-P06	20	
7	N0-P07	125	
8	N0-P08	113	
9	N0-P09	45	
10	N0-P10	1	
11			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-10

Date:6/27/05

Time: 17:16

Location: Cal-Wood

Latitude:

Longitude:

Elevation:

Temp: 80°

Weather:Partly Cloudy

Height of Vegetation:

Litter Sample Taken

Soil Sample Taken

Insects

	Type	Abundance
1	N10-I01	1
2	N10-I02	1
3	N10-I03	2
4	N10-I04	1
5		
6		
7		
8		
9		

Plants

	Type	# Stems	DBH
1	N10-P01	5	
2	N10-P02	6	
3	N10-P03	1	
4	N10-P04	1	
5	N10-P05	2	
6	N10-P06	2	
7	N10-P07	156	
8	N10-P08	1	
9			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-20

Date: 6/27/05

Time: 17:09

Location : Cal-Wood

Latitude:

Longitude:

Elevation:

Temp:

Weather:

Height of Vegetation:

Litter Sample Taken

Soil Sample Taken

Insects

	Type	Abundance
1	N20-I01	1
2	N20-I02	1
3	N20-I03	3
4		
5		
6		
7		
8		
9		
10		

Plants

	Type	# Stems	DBH
1	N20-P01	19	
2	N20-P02	11	
3	N20-P03	32	
4	N20-P04	10	
5	N20-P05	80	
6	N20-P06	13	
7	N20-P07	1	
8	N20-P08	3	
9	N20-P09	1	
10			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-30

Date: 6/26/05	Temp: 86°
Time: 14:43	Weather: Cloudy
Location: Cal-Wood	Height of Vegetation: 40 - 60 cm
Latitude: N40.15314°	Litter Sample Taken
Longitude: W105.38072°	Soil Sample Taken
Elevation:	

Insects

	Type	Abundance
1	N30-I01	5
2	N30-I02	1
3	N30-I03	1
4	N30-I04	2
5	N30-I05	1
6	N30-I06	1
7		
8		
9		
10		

Plants

	Type	# Stems	DBH
1	N30 -P01	7	
2	N30 -P02	6	
3	N30 -P03	3	
4	N30 -P04	2	
5	N30 -P05	1	
6	N30 -P06	1	
7	N30 -P07	2	
8	N30 -P08	14	
9	N30 -P09	3	
10	N30 -P10	176	

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-40

Date: 6/26/05	
Time: 14:30	
Location	Cal-Wood
Latitude:	N 40.15304°
Longitude:	W 105.38079°
Elevation:	

Temp:	90° F
Weather:	Increasing Cloudiness
Height of Vegetation:	
Litter Sample Taken	
Soil Sample Taken	

Insects

	Type	Abundance
1	N40-I01	4
2	N40-I02	5
3	N40-I03	1
4	N40-I04	3
5	N40-I05	3
6	N40-I06	2
7	N40-I07	1
8		
9		

Plants

	Type	# Stems	DBH
1	N40-P01	138	
2	N40-P02	11	
3	N40-P03	18	
4	N40-P04	13	
5	N40-P05	8	
6	N40-P06	23	
7	N40-P07	2	
8	N40-P08	3	
9			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # N-50

Date: 6/26/05
Time: 13:03

Location : Cal-Wood
Latitude: N 40.15325°
Longitude: W105.38082°
Elevation:

Temp:78° F
Weather: Partly Cloudy, Windy
Height of Vegetation: 35-75 cm
Litter Sample Taken
Soil Sample Taken

Insects

	Type	Abundance
1	N50-I01	2
2	N50-I02	1
3	N50-I03	1
4	N50-I04	2
5	N50-I05	1
6		
7		
8		
9		

Plants

	Type	# Stems	DBH
1	N50-P01	96	
2	N50-P02	2	
3	N50-P03	6	
4	N50-P04	1	
5	N50-P05	1	
6	N50-P06	25	
7	N50-P07	1	
8	N50-P08	1	
9			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # S-0

Date:	6/27/2005	Temp:	84F
Time:	17:25	Weather:	Clear
Location	Cal-Wood	Height of Vegetation:	
Latitude:		Litter Sample Taken	
Longitude:		Soil Sample Taken	
Elevation:			

Insects

	Type	Abundance
1	S0-I01	2
2	S0-I02	1
3	S0-I03	1
4	S0-I04	1
5	S0-I05	1
6	S0-I06	2
7	S0-I07	4
8	S0-I08	1
9		
10		
11		
12		
13		
14		
15		

Plants

	Type	# Stems	DBH
1	S0-P01	12	
2	S0-P02	1	
3	S0-P03	3	
4	S0-P04	154	
5	S0-P05	6	
6	S0-P06	34	
7	S0-P07	7	
8	S0-P08	5	
9	S0-P09	1	
10	S0-P10	1	
11	S0-P11	3	
12	S0-P12	9	
13	S0-P13	1	
14	S0-P14	4	
15			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # S-10

Date:	6/27/2005	Temp:	90F
Time:	17:34	Weather:	Clear
Location	Cal-Wood	Height of Vegetation:	
Latitude:		Litter Sample Taken	
Longitude:		Soil Sample Taken	
Elevation:			

Insects

	Type	Abundance
1	S0-I01	1
2	S0-I02	3
3	S0-I03	1
4	S0-I04	4
5	S0-I05	1
6	S0-I06	1
7		
8		
9		
10		
11		
12		
13		
14		
15		

Plants

	Type	# Stems	DBH
1	S0-P01	2	
2	S0-P02	9	
3	S0-P03	6	
4	S0-P04	5	
5	S0-P05	2	
6	S0-P06	2	
7	S0-P07	96	
8	S0-P08	7	
9	S0-P09	31	
10	S0-P10	3	
11	S0-P11	2	
12	S0-P12	8	
13	S0-P13	9	
14	S0-P14	1	
15			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # S-20

Date:	6/26/2005		Temp:	72F
Time:	14:47		Weather:	Windy, Ptly cldy
Location	Cal-Wood		Height of Vegetation:	55 Cm
Latitude:	N40.15263°		Litter Sample Taken	
Longitude:	W105.38052	°	Soil Sample Taken	
Elevation:	7576			

Insects

	Type	Abundance
1	S20-I01	1
2	S20-I02	4
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Plants

	Type	# Stems	DBH
1	S20-P01	9	
2	S20-P02	7	
3	S20-P03	1	
4	S20-P04	22	
5	S20-P05	3	
6	S20-P06	1	
7	S20-P07	1	
8	S20-P08	2	
9	S20-P09	11	
10	S20-P10	1	
11	S20-P11	26	
12	S20-P12	45	
13	S20-P13	some	
14			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # S-30

Date:	6/26/2005		Temp:	78F
Time:	14:11		Weather:	Windy, Ptly Cldy, increasing
Location	Cal-Wood		Height of Vegetation:	20 Cm
Latitude:	N 40.15273°		Litter Sample Taken	
Longitude:	W105.38054°		Soil Sample Taken	
Elevation:	7581			

Insects

	Type	Abundance
1	S30-I01	1
2	S30-I02	1
3	S30-I03	1
4	S30-I04	2
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Plants

	Type	# Stems	DBH
1	S30-P01	44	
2	S30-P02	2	
3	S30-P03	7	
4	S30-P04	8	
5	S30-P05	29	
6	S30-P06	3	
7	S30-P07	2	
8	S30-P08	3	
9	S30-P09	1	
10	S30-P10	1	
11	S30-P11	1	
12	S30-P12	3	
13			
14			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot # S-40

Date:	6/26/2005	Temp:	86F
Time:	13:26	Weather:	Partly Cloudy
Location	Cal-Wood	Height of Vegetation:	
Latitude:		Litter Sample Taken	
Longitude:		Soil Sample Taken	
Elevation:			

Insects

	Type	Abundance
1	S40-I01	0
2		
3		
4		
5		
6		
7		
8		
9		
10		

Plants

	Type	# Stems	DBH
1	S40-P01	51	
2	S40-P02	1	
3	S40-P03	7	
4	S40-P04	1	
5	S40-P05	1	
6	S40-P06	1	
7			
8			
9			
10			

Streamside Insect and Plant Diversity Data Sheet (Earthworks 2005)

Plot #	S-50

Date:	6/26/2005	Temp:	90F
Time:	13:03	Weather:	Sunny, Breezy
Location	Cal-Wood	Height of Vegetation:	27Cm
Latitude:	N 40.15237°	Litter Sample Taken	
Longitude:	105.38037°	Soil Sample Taken	
Elevation:	7590		

Insects

	Type	Abundance
1	S50-I01	1
2		
3		
4		
5		
6		
7		
8		
9		
10		

Plants

	Type	# Stems	DBH
1	S50-P01	16	
2	S50-P02	1	
3	S50-P03	1	
4			
5			
6			
7			
8			
9			
10			

Appendix B:

Plot	Lat	Long	Elevation	Insect Diversity	ID Mean	Plant Diversity	PD Mean	Insect Evenness
N50	40.15328	-105.38080	7533	2.2359	1.7742	1.2977	1.7437	96.2961
N40	40.15319	-105.38076	7526	2.6101	1.7742	1.8429	1.7437	92.9723
N30	40.15311	-105.38072	7523	2.2222	1.7742	1.1676	1.7437	85.9661
N20	40.15302	-105.38067	7516	1.3710	1.7742	2.2882	1.7437	86.4974
N10	40.15294	-105.38063	7510	1.9219	1.7742	0.7324	1.7437	96.0964
N0	40.15287	-105.38059	7507	2.4194	1.7742	2.4165	1.7437	93.5945
S0	40.15285	-105.38057	7510	2.7774	1.7742	1.9880	1.7437	92.5788
S10	40.15277	-105.38052	7513	2.2999	1.7742	2.4538	1.7437	88.9721
S20	40.15269	-105.38046	7523	0.7219	1.7742	2.7113	1.7437	72.1928
S30	40.15262	-105.38043	7533	2.7113	1.7742	2.4407	1.7437	73.2691
S40	40.15254	-105.38040	7539	0.0000	1.7742	0.9712	1.7437	0.0000
S50	40.15243	-105.38035	7543	0.0000	1.7742	0.6144	1.7437	0.0000
				1.7742	0.848583191	1.7437	0.981521048	73.2030

Appendix C:

"The EarthWorks Biodiversity Data song"

Sung to the tune of "YMCA" by the Village People…

Lyrics Inspired by Barney Peterson, Idea for lyrics by Annette Rafferty
Lyrics by Lowell Bailey
Performed by the Ecology group of 2005

Data…that's what we all need now,
Collect Data..trap that darn little bug,
I mean Insect..darn it just flew away,
Catch it! It may skew – our – data….

Data…there's a place you can find,
I said Data, for all the bugs you can't find,
You can catch them…Down near the gurgling stream,
Around the - ri-par-i-an zone.
⊗ ⊗ ⊗ ⊗ ⊗
We'll get it yet - and we'll Drop, Sweep, Click, Kill
We have to catch it - just Drop, Sweep, Click, Kill
We will all persevere, we will use all our nets,
We will catch all of those insects!
We'll get it yet -and we'll Drop, Sweep, Click, Kill
We have to catch it - just Drop, Sweep, Click, Kill

You can build a transect, you can use a quadrat,
You can plot - them - on – G-I-S….
Data…that's what we all need now,
Collect Data..count up all of those plants,
But those thistles!..watch out how you count those,
If you don't - it - skews - your - data.
We Analyze! - It just won't make any sense….
And the Chi Square – can't tell where to begin,
But we'll use it – and watch our numbers mix,
And the Bio-di-vers-ity index….
⊗ ⊗ ⊗ ⊗ ⊗
We'll get it yet - and we'll Cut, Count, Bag, Sort,
We have to shear them - just Cut, Count, Bag, Sort,
We will all persevere, we will use all our shears,
We will count – all - of - those - small plants!
We'll get them - and we'll Cut, Count, Bag, Sort,
We have to shear them - just Cut, Count, Bag, Sort,
You can build a transect, you can use a quadrat,
You can plot them on G..I..S….
All You Teachers…we'll tell you this right away,
I said teachers! You can network today,
You can go there! You can have a good time,
Ideas that - will - blow – your mind
⊗ ⊗ ⊗ ⊗ ⊗
It's fun to share at Cal-Wood any day!
I'll tell you EarthWorks rocks us e-ver-y day
Whatever you want to do, EarthWorks will help you through,
Now can we - please - come - back - next year

Appendix D: Glossary of terms

Shannon –Weiner Index: a way to measure species diversity in an area comparing species richness and species evenness.

Species Diversity: A way to measure biodiversity which takes into account the total number of species and the evenness of the species.

Species Evenness: a measure of how equal the populations numerically.

Species Richness: the total number of different organisms present. It does not take into account proportion and distribution of each subspecies within a zone