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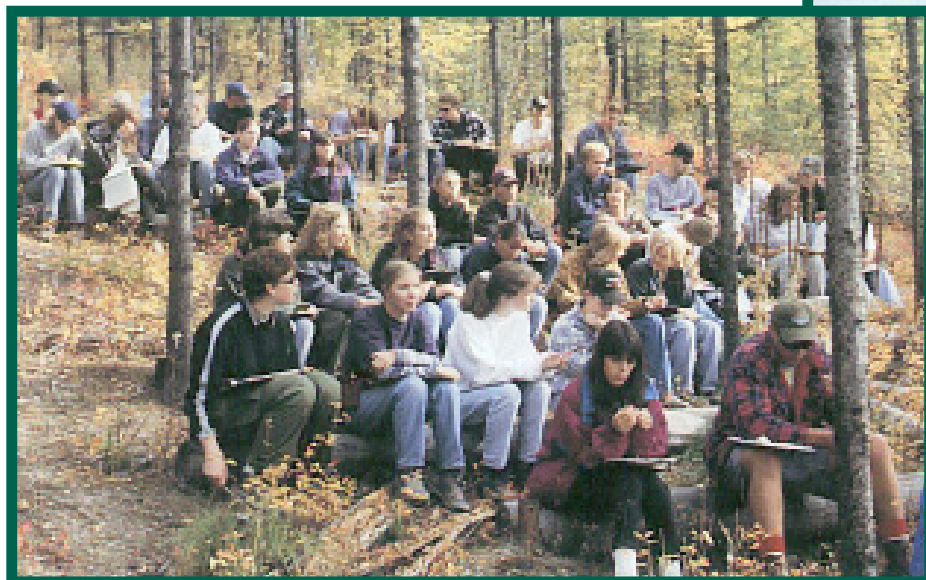
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Miller Creek Demonstration Forest Ecology Activities—a Teachers Supplement to the Field Guide

Bill Schustrom
Reed Kuennen
Raymond C. Shearer



The Authors

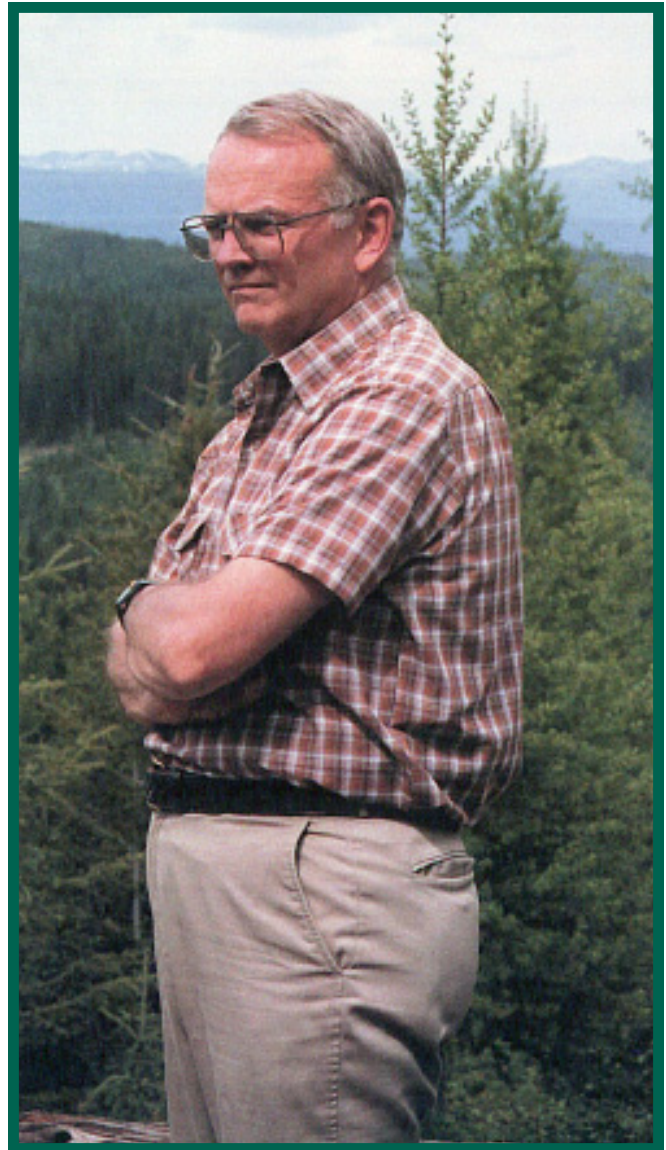
Bill Schustrom has taught 36 years in Oregon and Montana. Currently he teaches environmental science and advanced biology at Whitefish High School, Whitefish, MT 59987; during the summer he is a Naturalist, Glacier National Park.

Reed Kuennen, was Wildlife Biologist, U.S. Department of Agriculture, Forest Service, Flathead National Forest. She teaches environmental science and biology at Whitefish High School, Whitefish, MT 59807-8089.

Raymond C. Shearer is Research Silviculturist, Rocky Mountain Research Station, U.S. Department of Agriculture, Forest Service, Missoula, MT 59807-8089.

Acknowledgments and Cooperators

Results of research on the Miller Creek Demonstration Forest have practical application in teaching science whether in primary or secondary grades or college level. Concepts described in the companion "Field Guide" can be adapted to conservation education in the field or classroom. This "Teachers Supplement" is an application of how Forest Service research may be applied in high school biology classes. Scientists worked with teachers transferring new technology and information to develop these teaching materials. This effort is an example of benefits derived from the Partnership Agreement between the Forest Service and the National Science Teachers Association. The authors thank teachers at Whitefish (Montana) High School for their review and help in preparation of the initial draft of this supplement, and personnel at Rocky Mountain Research Station at Bozeman, MT, for preparing text, tables, and figures for publication, and at the Ogden, UT, (Publications Staff) for their skill and interest in a layout that enhanced the usefulness of this and the companion "Field Guide." Especially, we thank the Publications Staff in Ogden for its enthusiastic assistance and extra effort in producing this unique General Technical Report.



Bill Schustrom on Unit East-3, 29 years after treatment, inspires his students through practical application of biology in the classroom and on-the-ground learning.

Cover Photographs: Students of Bill Schustrom's advanced biology class assembled in the "Amphitheater," located on Unit South-13, which was burned by wildfire August 24, 1967.

In the evening of August 7, 1968, a prescribed fire on clearcut East-3 reduced the amount of slash, litter, and duff and enhanced quick establishment of a new forest by natural regeneration.

Rocky Mountain Research Station
324 25th Street
Ogden, UT 84401

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Miller Creek Demonstration Forest Ecology Activities—a Teachers Supplement to the Field Guide

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Ecology and Learning

Ecology is the study of interactions between organisms and their environment. The ecologist seeks to understand all interactions taking place in an undisturbed area well enough to predict consequences of changes, either natural or initiated by humans.

The United States Forest Service is responsible for multiple-use management of millions of acres of publicly owned lands. Lands managed by the Forest Service are considered one of our country's major natural resources, providing for timber, wildlife, water, recreation, range forage, and wilderness. Throughout our history as a nation, our Federal lands have been a source of wealth as well as spiritual inspiration.

During the 1960's the Forest Service and other Federal agencies charged with managing lands came under increasing criticism for certain management practices, such as clearcutting (fig. 1). In response, Congress passed (in 1969 and 1976) two laws that significantly impacted land management decisions and policies.

The National Environmental Policy Act (NEPA), which went into effect in 1969, requires that Federal land managers carry out a



Steve Wirt

Figure 1—Needles of western larch on stump within a clearcut harvested in 1967, Miller Creek Demonstration Forest.

three-phase study of management areas before multiple-use activities can be initiated:

1. Do a thorough inventory determining abiotic and biotic factors.
2. Do an assessment determining interactions between these abiotic and biotic factors.
3. Use the inventory and assessment data to determine a desired future condition (goal of the ecologist).

In 1976 Congress passed the National Forest Management Act (NFMA). This law also has three key parts:

1. Establish standards and guidelines for management (size of harvest units, number of live trees and snags, and so forth).
2. Determine land allocations to prioritize uses.
3. Establish desirable outputs, such as volume of timber or amount of forage an area should produce.

These two laws blend well with the study of ecology and with the development of outdoor learning activities that provide students with unforgettable and meaningful learning experiences. Through their work with biologists, silviculturists, researchers, and others working in land management, students can see how book learning is relevant to the real world. Real world learning experiences are the best kind for students (or anyone), and the impacts can be great.

The Miller Creek Demonstration Forest, with its multiple research units and mature forests, provides an outstanding setting for environmental education (fig. 2). As noted in the Miller Creek

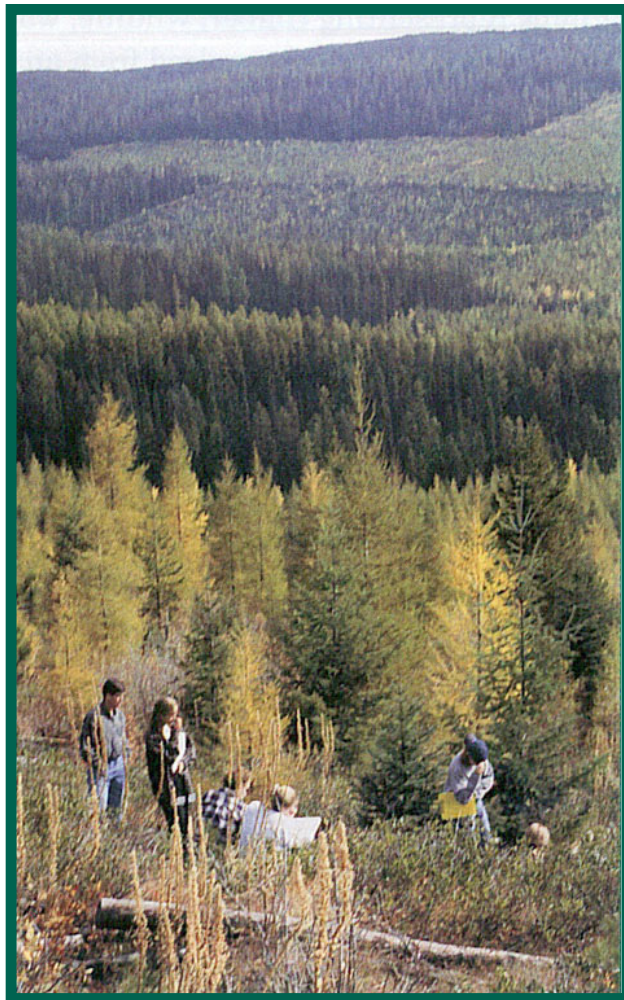


Ray Shearer

Figure 2—Participants in a field workshop held June 14, 1991 at Miller Creek Demonstration Forest discuss ecosystem management opportunities for the watershed while viewing the Miller Creek drainage from Council Rock.

Field Guide (Latham and others 1998), “There is a story to be told here about forest change and the role of disturbance (primarily fire) in that change.” At Miller Creek we learn how forest lands recover best after clearcutting and prescribed burning, or after wildfire. The ultimate outcome, through research, is to ensure a sustainable forest environment for the future, here and in similar forests elsewhere.

Miller Creek is the home of a large mature forest with some western larch, Douglas-fir, and Engelmann spruce in excess of 200 years old. There are also clearcut areas that were treated in 1989. In 1967 many units were burned by wildfire or clearcut and burned using a prescribed fire plan. Several decades of forest disturbance, through both natural and human-caused processes, have altered the structure and composition of much of the area. Through years of study on these sites, researchers are developing principles for ecosystem management that can be shared with students (fig. 3) through activities that have far-reaching impacts—way beyond the walls of the classroom.



Bill Schustrom

Figure 3—Whitefish High School advanced biology students on clearcut and burned Unit South-8, Miller Creek Demonstration Forest.

The learning activities found in this supplement have been developed for high school students. Each activity can, however, be modified to accommodate both middle and elementary school students.

Learning Activities

The Miller Creek experience offers the opportunity to explore ecological concepts. After basic concepts are explored in the classroom, students study the Miller Creek ecosystem in the field (fig. 4). Field activities include inventories of biodiversity; identification of interactions between organisms; and Miller Creek's terrestrial, aquatic, and physical environments. Data are gathered using several sampling techniques, including: plot sampling of trees and other vegetation, aerial photo interpretation, electrofishing, small mammal live-trapping, water testing, and stream sediment coring. Students then analyze the data and learn how data are used to make management decisions.

In the field and classroom, classes are divided into five interest groups representing timber, wildlife, water, recreation, and wilderness. Using knowledge acquired from analyzing their field data, each group is required to develop a plan to best use resources in the Miller Creek area based on that group's interest. These plans are then presented to other groups for discussion and approval. Conflicts arise almost immediately and students begin to realize the complexity of the world in which they live as they work to resolve their differences.



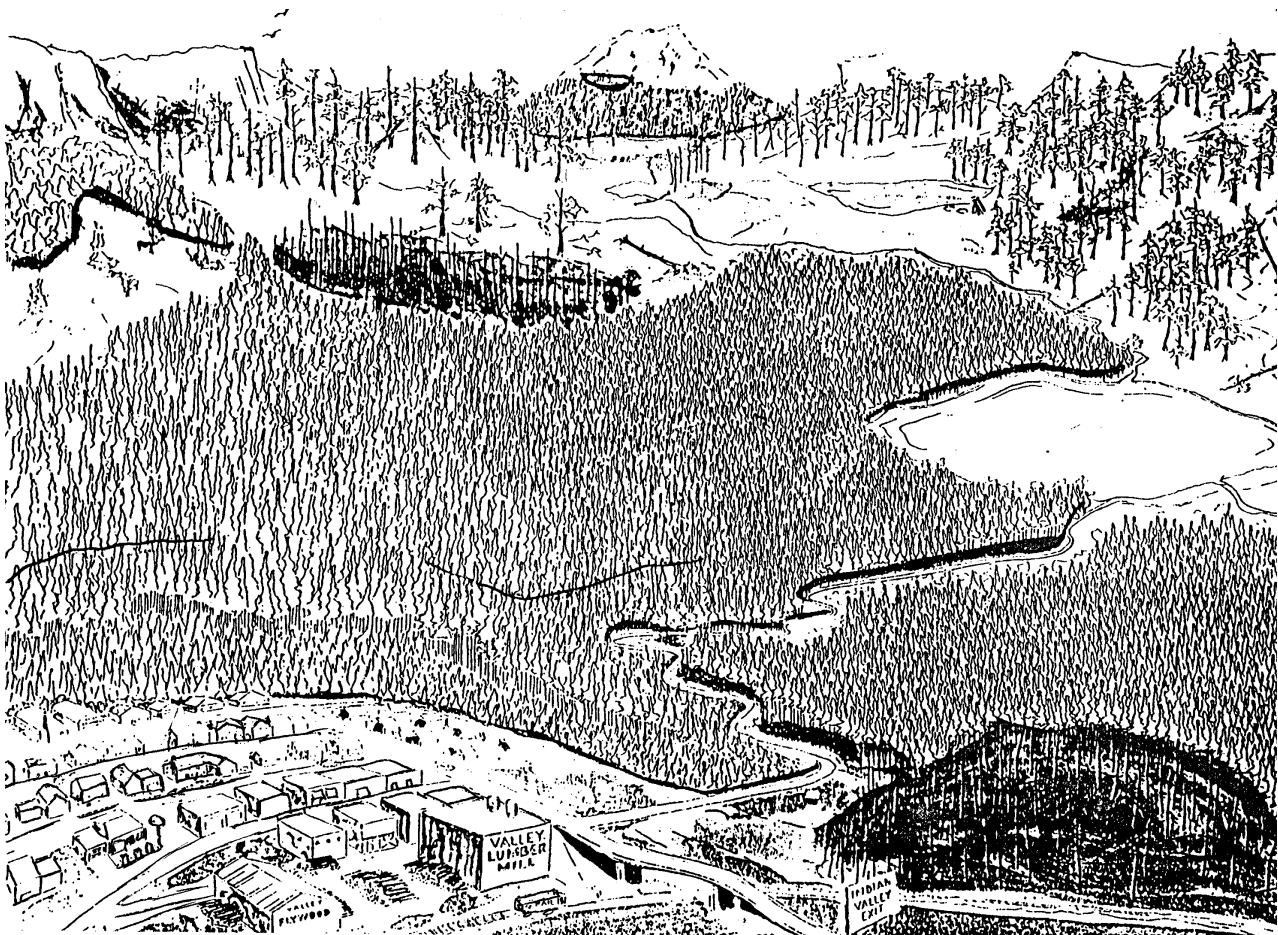
Ann Arbor Miller, Whitefish Pilot

Figure 4—Whitefish High School advanced biology students on wildfire burned Unit South-13, Miller Creek Demonstration Forest.

- Activity 1**—Tree Plot Sampling—tree species, diameter, height, age, condition, growth rate.
- Activity 2**—Wildlife Habitat Analysis—field reconnaissance, aerial photo interpretation, browse.
- Activity 3**—Wildlife Sampling—small mammal live trapping.
- Activity 4**—Aquatic Habitat Analysis—Hach kit water tests, insect collection, sediment coring.
- Activity 5**—Fish Sampling—electrofishing.
- Activity 6**—Recreation and Wilderness—developing a recreation plan for Upper Stillwater Lake campground and LeBeau Research Natural area.
- Activity 7**—Sustainability—Walk through Miller Creek Demonstration Forest discovering forest change over time and evaluating effects of human’s activities.
- Activity 8**—Multiple-use Planning.

Learning Objectives

1. Students will define ecology and the goal of the ecologist.
2. Students will identify and explain the levels of biological organization studied by the ecologist (such as population, community, and ecosystem).
3. Students will master Chi-Square and T-test statistics and be able to use these methods to validate data they have collected.
4. Students will understand how ecology is related to the National Environmental Policy Act mandate to inventory, assess, and identify desired future conditions for a land area.
5. Following collection and evaluation of data, students will apply their knowledge to create a utilization plan for timber, wildlife, water, recreation, and wilderness in an area (fig. 5).
6. Through field activities, students will have opportunities to work with professional foresters, recreation specialists, hydrologists, and fisheries biologists.



USDA Forest Service print

Figure 5—Representation of a community dependent upon sustaining the surrounding ecosystem; its clean water, forests, wildlife, recreation, and wilderness.

Activity 1: Tree Plot Sampling

Pre-field Class Time: Two 50-minute classes

- Introduce the plot sampling concept using a lab activity.
- Introduce the use of a two-choice tree key to be utilized in the field for tree identification.

Field Time: 3 to 4 hours plot sampling clearcut and mature forest areas. Students work in groups and rotate from plot to plot; after 1½ to 2 hours students rotate to clearcut or to mature forest area or vice versa.

Follow-up Class Time: 50 minutes answering follow-up questions dealing with field activities.

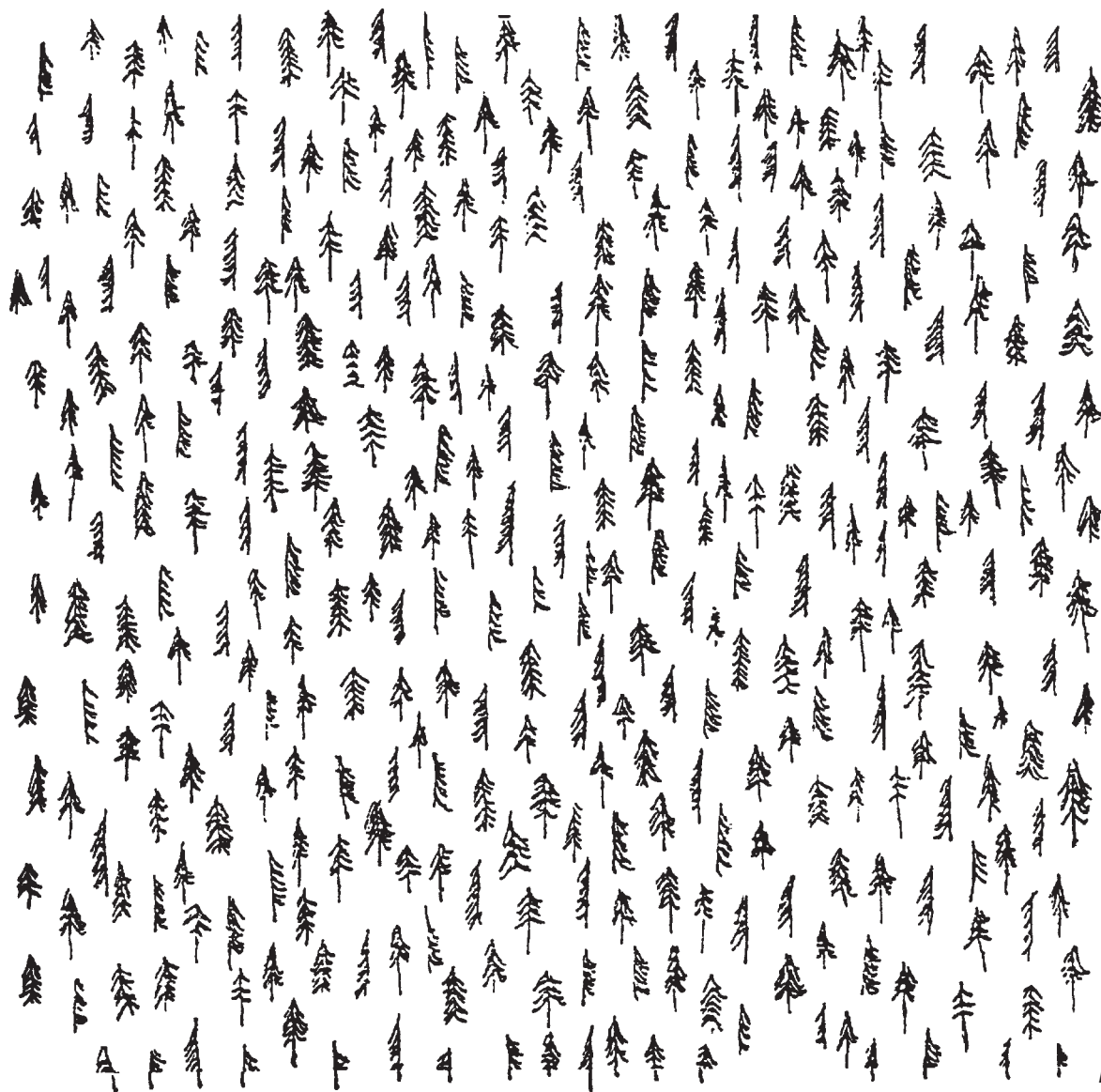
Remember, the United States Forest Service and other forestry agencies are charged with managing the millions of acres of forested and range land throughout the United States. The public demands that our lands be managed for the benefit of everything on them. The Forest Service calls this **MULTIPLE USE**, which is the management of land areas called **PLANNING UNITS** for the maximum benefit of all of the following environmental ingredients: timber, wildlife, recreation, wilderness, water (Aquatics), and fish.

Just finding out what kinds of trees and the numbers of trees in a particular planning unit is a huge task! It would take forever to go out and count and tabulate all of them; but we have to know what kinds of trees are found in the planning unit, how plentiful they are, if they are diseased, how they are growing, if they are reproducing well, and much more.

One technique used to find out about a planning unit is called **PLOT SAMPLING**. Additional techniques make it possible to gather information about all of the multiple-use categories. What we do is take small plots at various places throughout the planning unit and use the knowledge we gain on these to tell us about the entire unit.

Plot Sampling: Lab Activity Directions

In this activity students establish five randomly selected plots on the forest stand diagram (fig. 6) by tracing around a circle with a diameter of 1.51 inches. This “plot size” is 1/20th of the entire forest shown on the diagram. All trees whose base falls within each of the five plot boundaries are counted and identified. Plot numbers for each tree are tallied and a mean number for each is calculated. These numbers are then used to complete the attached **PLOT SAMPLING SURVEY**.



Bill Schustrom

- Plot 1 Plot 2 Plot 3 Plot 4 Plot 5 $\bar{x}$
-  Western Larch
 -  Subalpine Fir
 -  Western Redcedar
 -  Western White Pine

Figure 6—Theoretical one-acre piece of a mixed species conifer forest.

Plot Sampling Survey—Hypothetical Timber Stand

1. In your plot, how many of each type of tree?

Western larch_____ Subalpine fir_____

Western redcedar_____ Western white pine_____

2. What is the predominant species in the plot?

3. Should this be predominant in the whole plot?

4. Each plot is 1/20th of the entire acre square, so multiplying each answer in question 1 by 20 should tell how many of each tree species is in the 1 acre stand.

Do that and enter your answers below:

Western larch_____ Subalpine fir_____

Western redcedar_____ Western white pine_____

5. Now we will use our answers in question 4 to find out what percentage each “species” of tree comprises in the stand. To do this, first add up the total of all four kinds of trees in question 4. The number of trees TOTAL is_____.

6. Now divide that number into each answer in question 4 and that is the percentage of each tree in the stand. (Remember to move the decimal point.)

Your answers:

Western larch_____% Subalpine fir_____%

Western redcedar_____% Western white pine_____%

Now actually count the number of each species in the plot!!!

Western larch_____ Subalpine fir_____

Western redcedar_____ Western white pine_____

Do your **PLOT** answers agree with the **ACTUAL** count?

Explain why or why not on the back of this page.





Miller Creek Field Sampling Instructions

Our plots (fig. 7a) will be circular and will have a radius of 11.66 feet, giving them an area of 1/100th of an acre. In these plots students hold one end of their plot cord on a numbered stake; the other end is stretched out and the person holding it walks in a circle to establish the plot boundary.

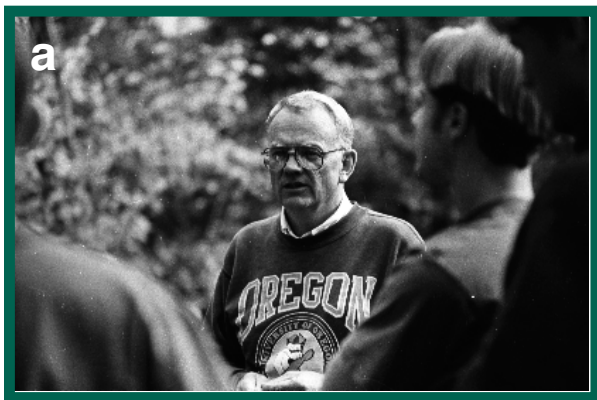
Within the boundaries of old growth forest, students will need to gather the following information for five plots:

1. Identify all the trees in each plot using key from Cooperative Extension Service (1985) (table1).
2. Count the number of trees in the plot (fig. 7b).
3. Age one tree in each plot using an increment borer (fig. 7c).
4. Look at tree cores from increment boring to see if tree growth is increasing or decreasing (fig. 7d).
5. Approximate the height of each tree by measuring one with a clinometer and estimate the others (fig. 7e).
6. Measure tree diameters at breast height (4.5 feet above ground) in each plot using a diameter tape.
7. Make general observations of:
 - a. Disease or insect infestation.
 - b. If trees appear to be good seed trees.
 - c. What animals (or their sign) were found.

Within the boundaries of the clearcut area, students will need to gather the following information for five plots (fig. 7f):

1. Identify all trees in each plot.
2. Count the number of trees in each plot.
3. Determine age by counting whorls of branches on seedlings.
4. Determine if trees were naturally seeded or if seedlings were planted.
5. Identify as many shrubs as possible.
6. Record any evidence of animals.

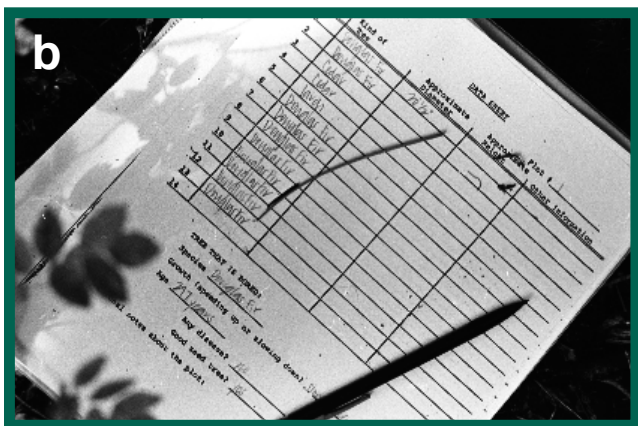
Clearcutting is a practice of cutting all trees in a certain area, rather than cutting just the trees that have been selected because of disease or maturity. The clearcutting process is usually followed either by: (1) piling the slash (unused wood and branches) with a bulldozer and burning the piles or (2) by burning the slash on the entire area. These treatments temporarily reduce competition of shrubs and forbs, expose soil to enhance germination of seed and survival of new tree seedlings, and decrease the amount of slash on the site. After slash treatment the clearcut is regenerated by either (1) natural reseeding from surrounding trees or (2) planting tree seedlings grown in a nursery.



Ann Arbor Miller, Whitefish Pilot



Ann Arbor Miller, Whitefish Pilot



Ann Arbor Miller, Whitefish Pilot



Ann Arbor Miller, Whitefish Pilot



Ann Arbor Miller, Whitefish Pilot



Ann Arbor Miller, Whitefish Pilot

Figure 7—(a) Bill Schustrom discusses field ecology exercise with his Whitefish High School advanced biology students at Miller Creek Demonstration Forest. (b) Data form for recording tree data. (c) Students taking an increment core in an old growth forest. (d) Student examining the increment core. (e) Student estimating the height on an old growth tree on the plot using a clinometer. (f) Students looking for conifer regeneration within a 0.01 acre plot on a clearcut.

Table 1—Key to trees of Montana published by Montana Cooperative Extension Service (1985)

Key to the Trees of Montana	
1a. Leaves long and thin like needles; or small like scales, sometimes with one scale overlapping the next. Leaves never more than 1 cm wide. Leaves stay on evergreen trees in winter except for those of larches	2
1b. Leaves with broad and flat blades, more than 1 cm wide. Veins apparent on leaf blade. Leaves drop off deciduous trees in the fall	17
2a. Leaves like scales opposite in pairs, often overlapping like shingles on a roof	3
2b. Leaves like needles. Only fingers are needed to pull off single needles	4
3a. Branchlets flat or flattened. Cones oval or tulip-shaped when mature	Western Redcedar
3b. Branchlets not flattened. Cones berry-like when mature. Mature trees grow on dry sites	Rocky Mountain Juniper
4a. Needles most often in bundles, or in clusters at tips of knobs	5
4b. Needles always scattered singly along entire branch	11
5a. Needles in clusters of 15 to 50 on the end of a knob. Tree deciduous (all needles turn yellow and fall off for winter, making these trees appear dead)	6
5b. Needles in bundles of 2, 3 or 5. Persistent, needles stay on the tree year round. Bundles each have a sheath (a papery cover) around the base. Trees evergreen	7
6a. Young branches strongly hairy, the hairs long and tangled. Needles square in cross section. Cones at least 3.5 cm long. Trees short; of subalpine elevations	Subalpine Larch
6b. Young branches without long tangled hairs, or having only short, soft hairs; downy. Needles triangular in cross section. Cones rarely exceed 3.5 cm long. Trees tall; of middle and high elevations	Western Larch
7a. Needles in bundles of two or three. Cone-scales-tips end in a sharp, hard prickle. Bundle sheaths persistent	8
7b. Needles in bundles of five. Cone-scale-tips without sharp prickle, usually covered with pitch. Bundles sheaths fall off	9
8a. Needles mostly in bundles of three, more than 8 cm long. Cones more than 8 cm long, symmetrical; drop yearly	Ponderosa Pine
8b. Needles in bundles of two, less than 7 cm long. Cones less than 5 cm long, more or less lop-sided, and remain on tree for many years	Lodgepole Pine
9a. Needles 5 to 10 cm long, margin edge minutely toothed. Cones over 15-30 cm long, on stalks over 1 cm long. Trees of lower slopes and valleys	Western White Pine
9b. Needles 3 to 7 cm long, margin smooth. Cones less than 15 cm long, sessile. Trees of high elevations	10
10a. Cones cylindrical, 5 to 15 cm long, open when mature. Cones brown or tan when mature. East of continental divide in Montana	Limber Pine
10b. Cones spherical or oval in outline, 5 to 8 cm long. Cones purple when mature. West of continental divide in Montana	Whitebark Pine
11a. Needle tip ends in a drawn-out sharp point. Cones not present; seeds grow singly in a fleshy and red berry	Pacific Yew
11b. Needles tip notched or blunt, or sharp but not drawn out to a sharp point. Cones present, woody with seeds borne on each cone-scale, therefore cones or cone-scales from mature trees are always found on ground	12
12a. Branches more or less smooth where needles have fallen and left a scar (rub finger on leafless branchlets); needle scar visible, round and often slightly indented. Cones either erect on top branches of tree; or with three-forked bracts extending beyond cone-scales and hanging from major branches (rats tail)	13
12b. Branches rough where needles have fallen (finger catches when rubbed along leafless branchlet); needle scars not visible on tip of stalks. Cones never erect, always hanging and without three-forked bracts extending beyond cone-scales	15

(con.)

Table 1 (Con.)

Key to the Trees of Montana	
13a. Needles appear to be attached by flared “suction-cup” bases, leaving large, circular, and depressed needle scars. Needles blunt or notched. Cones erect, falling apart scale by scale when mature; therefore whole mature brown cones are not found under mature trees, only cone-scales	14
13b. Dormant terminal buds sharply pointed. Needles attached by minute bases, leaving small, oval, slightly raised needle scars. Needles pointed. Cones hang down, dropping whole when mature, therefore mature brown cones always found under trees. Three-forked bracts prominent and extend beyond each cone-scale (rats tail)	Douglas-fir
14a. Needles flat and curve upward on the upper surface of the branch. Trees appear spire-shaped from a distance. Needles blue green in color	Subalpine Fir
14b. Needles at tip of branch have white lines on lower surface only; upper surface green. Needles in two ranks (in two rows), the twig visible. Needles at right angle to the twig	Grand Fir
15a. Needles attached by conspicuous stiff and stubby stalks that remain on the branch after needles fall. Tree leader (the tip) erect. Needles square in cross section, can be rolled between fingers	Engelmann Spruce
15b. Needles attached by inconspicuous thread-like stalks that remain on the branch after needles fall (rub fingers along leafless parts of the branchlet feel your finger catch on the stalks). Tree leader droops	16
16a. Needles pointing out along twig sides (longer needles) and erect on twig top (shorter needles). Cones less than 2.5 cm long. Needles nearly flat; grooved and green on the upper surface, white beneath	Western Hemlock
16b. Needles pointing out in all directions and surrounding the twig. Cones over 2.5 cm long. Needles more or less three-sided; white on both the upper and lower surfaces. Trees of subalpine elevations	Mountain Hemlock
17a. Leaves in pairs directly opposite each other, 3-5 lobes and palmately divided. Twigs are bright purplish-red and the older bark is gray. Samaras fruits that become windborn “helicopters” when dispersed	Rocky Mountain Maple
17b. Leaves alternating, not directly opposite each other. Check leaves on older portions of branches back from branch tip	18
18a. Petioles flattened laterally, blades spade-shape, abruptly narrowed to the tip	Quaking Aspen
18b. Petiole cylindrical or channeled, can be rolled between the fingers	19
19a. Leaves have a long petiole and slight resinous, broadly lance-shaped blades 5-15 cm long. The gray bark is deeply furrowed. Is common along all of our rivers and lower creeks	Black Cottonwood
19b. Trees with white, peeling bark; leaves narrowly egg-shaped in outline (ovate) to a tapering point. Petioles most longer than 1.5 cm. Occasionally have a heart shaped base	Paper Birch

Mature Forest—Tree Plot Sampling

Data Collection

Plot Number	Tree Species	Diameter (inches DBH)	Approximate Height (ft)	Tree Condition





Height: Select one tree within each plot to measure height using the clinometer and then estimate the height of other trees within the plot. Put an asterisk by the tree you measure.

Condition: Study the crown for fullness, broken top, and health. Study the trunk for signs of insect or disease including conks, bark scars, or presence of pitch from insects.

Age: Select one tree within each plot and use the increment borer to determine its age. Try to select a range of tree sizes to bore. Be sure to select a healthy looking tree or your increment borer may get stuck. List ages below.

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Tree Species					
Age					
# Rings Last Inch					
Growth Rate					

Analysis of Data

Your plots are 1/100th of an acre. Calculate the number of trees per acre in each plot by taking the total tree number for the plot and multiplying by 100. Then find the average per acre.

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Avg.
Trees per Acre						

Calculate the amount of lumber in each plot using the attached volume table for subalpine fir (table 2). Find the volume for each tree in a plot and then sum your numbers to get volume per plot. Then find the average per acre.





Table 2—U.S.D.A. Forest Service, Region-One Scribner board foot volume table for subalpine fir from Timber Cruising Handbook (R1 2430-31)

**SUBALPINE FIR
SCRIBNER BOARD FOOT VOLUME**

DBH	TOTAL HEIGHT													
	040	050	060	070	080	090	100	110	120	130	140	150	160	170
10	29	39	49	59	69	80	90	100	110					
11	38	50	62	74	86	99	111	123	135	148				
12	47	61	76	91	105	120	134	149	163	178				
13	57	74	91	108	125	142	159	177	194	211				
14	68	88	107	127	147	167	187	207	226	246				
15	80	102	125	148	171	193	216	239	262	284	307			
16	92	118	144	170	196	222	247	273	299	325	351			
17	105	135	164	193	222	252	281	310	339	368	398			
18	120	152	185	218	251	283	316	349	382	414	447			
19	135	171	208	244	281	317	354	390	427	463	500	536		
20	150	191	231	272	312	353	393	433	474	514	555	595		
21	247	277	308	339	369	400	430	461	492	522	553	584		
22	259	292	326	360	393	427	460	494	528	561	595	628		
23	271	308	345	381	418	455	492	528	565	602	638	675	712	
24		324	364	404	444	484	524	564	604	644	684	724	764	
25		341	385	428	471	515	558	602	645	688	732	775	818	
26		359	406	453	500	547	594	640	687	734	781	828	875	
27		377	428	479	529	580	630	681	732	782	833	883	934	984
28			451	505	560	614	669	723	777	832	886	941	995	1049
29			475	533	591	650	708	766	825	883	942	1000	1058	1117
30			499	562	624	687	749	811	874	936	999	1061	1124	1186
31			525	591	658	725	791	858	925	991	1058	1125	1192	1258
32				622	693	764	835	906	977	1048	1119	1190	1261	1333
33				653	729	805	880	956	1031	1107	1182	1258	1334	1409
34				686	766	846	927	1007	1087	1167	1248	1328	1408	1488
35				720	805	890	975	1060	1145	1230	1315	1400	1485	1570
36				754	844	934	1024	1114	1204	1294	1384	1474	1564	1653
37					884	980	1075	1170	1265	1360	1455	1550	1645	1740
38					926	1026	1127	1227	1327	1427	1527	1628	1728	1828
39					969	1074	1180	1286	1391	1497	1602	1708	1813	1919
40					1013	1124	1235	1346	1457	1568	1679	1790	1901	2012
41						1174	1291	1408	1524	1641	1758	1874	1991	2108
42						1226	1349	1471	1593	1716	1838	1961	2083	2206
43						1279	1408	1536	1664	1793	1921	2049	2178	2306
44						1334	1468	1602	1737	1871	2005	2140	2274	2409
45						1389	1530	1670	1811	1951	2092	2232	2373	2514
46						1446	1593	1740	1887	2033	2180	2327	2474	2621
47						1504	1657	1811	1964	2117	2271	2424	2577	2731
48						1564	1723	1883	2043	2203	2363	2523	2683	2843
49						1624	1791	1957	2124	2291	2457	2624	2790	2957
50						1686	1859	2033	2206	2380	2553	2727	2900	3074
51						1749	1930	2110	2291	2471	2652	2832	3013	3193
52						1813	2001	2189	2376	2564	2752	2939	3127	3315
53						1879	2074	2269	2464	2659	2854	3049	3244	3438
54						1946	2148	2350	2553	2755	2958	3160	3362	3565
55						2014	2224	2434	2644	2854	3064	3273	3483	3693
56						2083	2301	2518	2736	2954	3171	3389	3607	3824
57						2154	2379	2605	2830	3056	3281	3507	3732	3958
58						2226	2459	2693	2926	3159	3393	3626	3860	4093
59						2299	2540	2782	3023	3265	3507	3748	3990	4231
60						2373	2623	2873	3123	3372	3622	3872	4122	4372



CLEARCUT-TREE PLOT SAMPLING

Plot Number

Data Collection - Record the number of seedlings in each species/height category.

<u>Tree Species</u>	<u>Diameter Widest Point</u>	<u>Height</u>

Profile a single tree:

Age: _____ estimate by whorls

Height: _____

Diameter: _____

Insect/Disease: _____

Growth: _____ Speeding Up
 _____ Slowing Down

CLEARCUT-TREE PLOT SAMPLING

Plot Number

Data Collection - Record the number of seedlings in each species/height category.

<u>Tree Species</u>	<u>Diameter Widest Point</u>	<u>Height</u>

Profile a single tree:

Age: _____ estimate by whorls

Height: _____

Diameter: _____

Insect/Disease: _____

Growth: _____ Speeding Up
 _____ Slowing Down





CLEARCUT-TREE PLOT SAMPLING

Plot Number

Data Collection - Record the number of seedlings in each species/height category.

<u>Tree Species</u>	<u>Diameter Widest Point</u>	<u>Height</u>

Profile a single tree:

Age: _____ estimate by whorls

Height: _____

Diameter: _____

Insect/Disease: _____

Growth: _____ Speeding Up
 _____ Slowing Down

CLEARCUT-TREE PLOT SAMPLING

Plot Number

Data Collection - Record the number of seedlings in each species/height category.

<u>Tree Species</u>	<u>Diameter Widest Point</u>	<u>Height</u>

Profile a single tree:

Age: _____ estimate by whorls

Height: _____

Diameter: _____

Insect/Disease: _____

Growth: _____ Speeding Up
 _____ Slowing Down





CLEARCUT-TREE PLOT SAMPLING

Plot Number

Data Collection - Record the number of seedlings in each species/height category.

<u>Tree Species</u>	<u>Diameter Widest Point</u>	<u>Height</u>

1. Does there appear to be any difference in growth between the naturally seeded trees and the nursery seedlings?

2. Does the clearcut stand appear to have competition from the shrubs and forbs?

3. Is there any evidence of browsing by animals? (Look at the branches for nipped ends.)

4. Your plots are 1/100th of an acre. Approximately how many trees would there be per acre?

5. If the desired future condition is to have 300 stems per acre, would the clearcut need to be thinned in the future?

6. Do you feel that clearcutting is an acceptable management practice? Why or why not?

Profile a single tree:

Age: _____ estimate by whorls

Height: _____

Diameter: _____

Insect/Disease: _____

Growth: _____ Speeding Up
 _____ Slowing Down





Conclusions—Tree Plot Sampling in Mature Forest and Clearcut Areas

Answer the following questions comparing the mature forest and clearcut area. Look at your data and think about the things you have observed in your field sampling.

1. What was the average number of trees per acre?

Mature:

Clearcut:

2. What tree species is most abundant in each area? About what percentage of the total of all trees did it represent?

Mature:

Clearcut:

3. Was there any evidence of insects or disease in the trees you sampled? Describe it.

Mature:

Clearcut:

4. Does the rate of tree growth appear to increase or decrease as a tree gets older? Try to explain why this would occur.

5. What evidence of fire did you observe in your plots?

6. What evidence of wildlife did you observe in your plots?

7. It takes 4,500 board feet of lumber to build the average three-bedroom house. How many acres of mature forest (such as the one you sampled) would it take to build one house?

8. If you had to recommend a plan for treatment of each area, what would it be and why?

Mature:

Clearcut:

9. Did you collect enough plot data in each area, mature and old growth, to get a valid estimate of the number of trees per acre? Validate your answer using the statistical techniques you have learned in class.

Activity 2: Wildlife Habitat Analysis

Pre-field Class Time: 45 minutes—introduce concepts of biodiversity, niches, successional stages; slide show on wildlife sign identification.

Field Time: 1-½ hours—field reconnaissance of successional stages
½ hour—browse utilization survey

Follow-up Class Time: 45 minutes—calculating percent of area in each successional stage; cover classes

There are over 300 species of wildlife on the Flathead National Forest, so to manage for each one individually would be an impossible task. One way to manage for wildlife is to maintain biodiversity by providing a variety of habitats across a large landscape. Plant communities and their successional stages have unique sets of environmental conditions that are ecologically important as niches for wildlife species. Using the diagrams of successional stages and niches, students use figure 8 (Flathead National Forest Plan—Planning Documents, 1985) to evaluate the mix of successional stages needed to meet desired future conditions.

In this activity students will use a technique called “field reconnaissance,” where they write down their observations as they walk. Students visit sites in the Miller Creek area representing five forest successional stages, including grass/forb, shrub/seedling, sapling/pole, mature, and old growth. Each student is given a laminated, color aerial photograph (fig. 9) so that they can characterize the

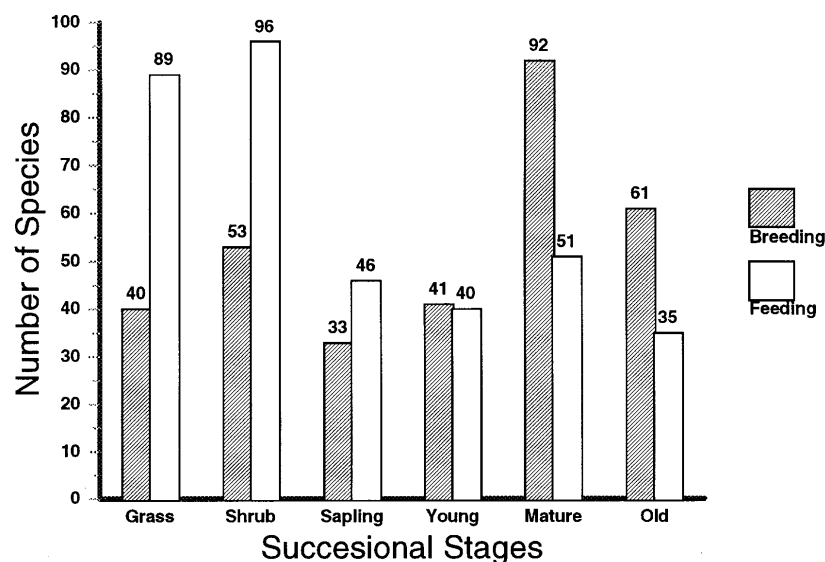


Figure 8—Influence of vegetation successional stages on breeding and feeding of animals, Flathead National Forest, northwest Montana (Flathead National Forest Plan—Planning Document 1985).

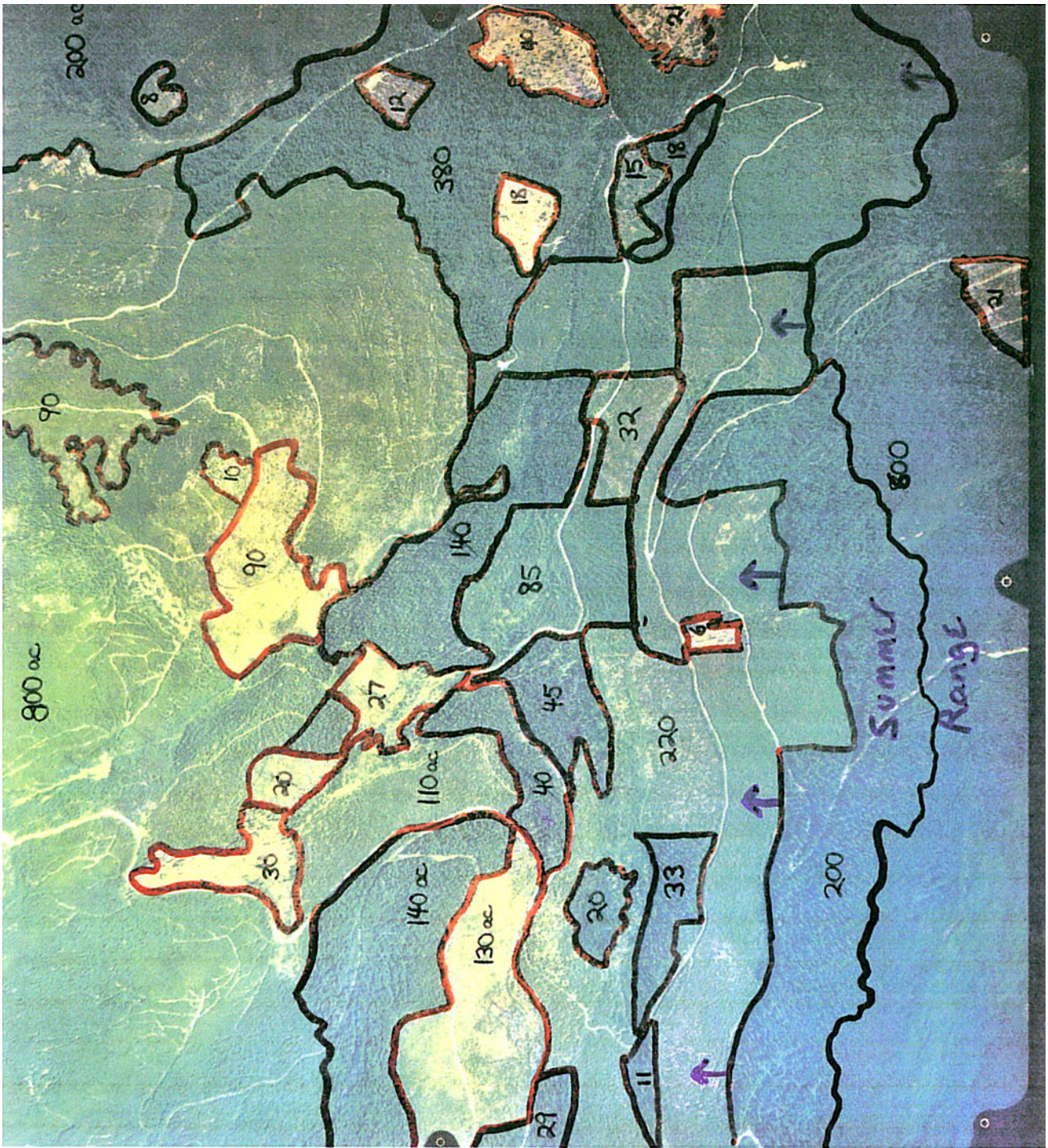


Figure 9—Aerial photo of part of the Miller Creek Demonstration Forest, August 29, 1992 (USDA Forest Service photo).

appearance of each site on the photo and then calculate the percentage of the total area in each successional stage once they are back in the classroom. As students walk through each site they will identify and note signs of wildlife use (fig. 10), including pellets/scats, tracks, browsing on shrubs/trees, cavities in snags, signs of feeding on stumps and down logs, and so forth. In the shrub/seedling area, each student picks a shrub and counts the number of browsed versus unbrowsed stems to get the percentage of browse utilization.

Back in the classroom, students use the aerial photos to classify successional stages (table 3) for the entire photo coverage by extrapolating from the areas they visited. Then they calculate the percentage of the area in each successional stage and compare it to figure 8 to determine whether the Miller Creek area meets desired conditions for wildlife habitat diversity. Students also use their successional stage classification to calculate the percentage of open forage versus hiding cover versus thermal cover in summer range and winter range areas shown on the aerial photograph.



Steve Wirt



Steve Wirt

Figure 10—Common animals on Miller Creek Demonstration Forest, (a) Clark's nutcracker, (b) chipmunk.

Table 3—Successional stages identified on the aerial photograph shown in figure 9 dated 8-29-92 of Miller Creek Demonstration Forest analysis area by acreage.

Successional stage and appearance		Acres in each identified unit
Grasses/Forbs	Maybe a few shrubs and seedlings, but they don't dominate (dirt to pale yellow)	12
		40
		21
		18
		6
Shrubs/Seedlings	Shrubs and seedlings dominate (limey green)	55
		30
		20
		27
		90
		10
Sapling/Pole	Trees are 1 to 5 inches diameter at breast height Predominately may be mixed with shrubs (light green)	90
		800
		8
		32
Young	Trees 6 to 9 inches diameter at breast height Small dense crowns	220
		110
Mature	10 to 16 inches diameter at breast height A little bigger with denser crowns	200
		15
		600
		200
Old	17 inches plus diameter at breast height Large, visible crowns	140
		45
		40
		140
		380
		18
		200
		33
		11
		20
	29	
TOTAL		3,660 acres

Field Reconnaissance of Wildlife Habitat

Data Collection—Use this table to record observations for each successional stage.

Successional Stage	Photo Description	Vegetation Description	Wildlife Sign Observations
Grass/forb			
Shrub/seedling			
Pole-sapling			
Young			
Mature			
Old Growth			





Photo Data Analysis

Use the aerial photo (fig. 9) to classify successional stages for the entire Miller Creek area and total the acres in each successional stage. The numbers in each block on the photo show acres.

Acres Grass/Forb	Acres Shrub/seedling	Acres Pole/Sapling	Acres Young	Acres Mature	Acres Old Growth

Big Game Cover Analysis (Primarily Moose)

Using your aerial photograph (fig. 9), classify each area as open forage, hiding cover, or thermal cover. Then total the acres in each category for summer range (south of the arrows on the aerial photo) and for winter range (north of the arrows on the photo).

Range	Open Forage Acres	Hiding Cover Acres	Thermal Cover Acres
Summer			
Winter			

Conclusions

1. How does the mix of successional stages in the Miller Creek area compare to figure 8, showing what is desirable for wildlife species on the Flathead National Forest?
2. How can forests be managed to provide diverse successional stages over time?
3. Because signs of human activities are not appropriate in wilderness areas, how can these areas be managed to provide diverse successional stages?
4. Because many wildlife species prefer to nest or den near water (riparian areas), what special considerations should be made in these areas?
5. How many acres of timber could be harvested in the Miller Creek area in the future to achieve a desirable balance of cover for big game on winter range and summer range? (Use photo and desired cover forage ratios.)
6. Summarize the signs of wildlife you observed in the field.

Activity 3: Wildlife Sampling Small Mammal Live Trapping

Pre-field Class Time: 2 hours (teacher plus volunteers) setting out and pre-baiting traps

Field Time: 1 hour checking and collecting traps

Follow-up: 45 minutes—calculating small mammal population estimate

Counting animals is basic to the study of animal populations. Because small mammals such as mice and voles form the base of the food chain for many other animals, biologists have a high level of interest in population change over time.

The mark-recapture method is a commonly used technique for estimating populations. The method is based upon live-trapping, marking, and then later recapturing small mammals. After the first night of trapping, animals are marked and then released in the trapping area. Trapping is continued for an appropriate length of time (often 1 week) and the number of newly marked versus marked and recaptured animals is tallied after each trap night. An estimate of the total population is then calculated from the ratio of marked to recaptured animals.

In the pre-field activity, the teacher needs to spend approximately 2 hours setting out lines of small mammal live traps, spaced in a grid with approximately six paces between each trap. Thirty traps are placed within the mature stand and 30 are placed within the adjacent clearcut. It helps trap success if traps are “pre-baited” with a mixture of peanut butter and oatmeal the night before trapping is to begin. On the afternoon of the first field day, students help bait and set the traps. The second field day students split into two groups to check the traps, record all species caught, and collect the traps. The two groups share results and total the species caught for each site.

Population Estimation Lab Activity Directions

As a follow-up activity students will calculate a population estimate for deer mouse trapped over 6 nights at the Flathead Lake Yellow Bay Biological Station. Students cannot use their own data to do a population estimate, because more than 1 night of trapping is needed; however, use of the Yellow Bay data will help them to understand how an estimate is made.

Trap Data

I = time period	n1i = number marked	n2i = number trapped	mi = number mice recaptured	n1i x n2i
6/25	0	6	0	0
6/26	6	9	5	54
6/27	10	14	5	140
6/28	19	8	4	152
6/29	23	11	9	253
6/30	25	10	6	250

Equation for estimating the population*

N = population estimate

$\sum$ = sum

$$N = \frac{\sum (n1i \times n2i)}{\sum (mi)}$$

*If other statistics have been taught, students can use statistical equations to determine the accuracy of their population estimate.

Small mammals form the base of the food chain for many other species, including birds of prey and mammals such as coyotes, weasels, and other predators.

Small mammals live in a variety of habitats, and as such, they can be good indicators of biodiversity. In this activity students will live-trap small mammals within two areas, an old growth stand and an adjacent clearcut that was logged and broadcast burned in 1989.

[illegible]

Data Analysis

1. Which site had a higher number, or biomass, of small mammals?
2. Which site had greater diversity of small mammal species?
3. How was the availability of food different between the two sites?
4. How was the availability of nesting and denning sites different between the two sites?
5. Write a paragraph describing the overall differences in biodiversity between the two sites:



Activity 4: Aquatic Habitat Analysis

Pre-field Time: Two 50-minute class periods

Familiarize students with watershed size, plus the physical, chemical and biotic factors which are indicators of the health of aquatic ecosystems

Field Time: 3 hours to measure stream chemistry, flow, and make observations on the stream environment

Logging, road building, and fire have the potential to affect streams by changing their chemistry, flow rate or volume, and channel or bank characteristics. During the pre-field activities, students will use Forest Service maps of Miller Creek to draw the watershed boundaries. They will be introduced to the concepts of “cumulative effects” of human activities within a watershed boundary, as well as tests that can be conducted to indicate stream health.

Pre-Field Activity: Determining Watershed Boundaries

1. Using the Forest Service map, find Miller Creek and trace the stream (including all tributaries) upstream to its source.

2. Using your knowledge of topographic maps, draw lines around the boundaries of the Miller Creek watershed. Then, calculate the approximate number of square miles within your boundary.

3. Why is it important to know the boundaries of a watershed?



Water Sampling

Chemical tests: Use the Hach Kits to obtain the following data:

Factor	Site A	Site B	Site C
pH			
Dissolved Oxygen			
Ammonia Nitrogen			
Nitrates			
Alkalinity			
Hardness			
Carbon Dioxide			
Water Temperature			
Coliform (neg. or pos.)			

Physical Tests: Determining the Rate of Streamflow

- A. Measure and mark a 100-foot distance along a straight section of stream. Throw a 2 to 3 inch long stick in the water above your upstream marker. Record the number of seconds it takes to float from your upstream marker to the downstream marker.

100 ft/____secs. To float 100' = ____feet/second velocity

- B. Measure the width of the stream at three places within the 100 foot area. Add your three measurements and divide by 3 to get an average width.

____+____+____=____/3 = ____ft average width

- C. Find a place within your 100 foot section where the stream depth appears to be about average. Stretch a tape across the stream, perpendicular to the direction of stream flow, and measure the stream depth at three spots that are equidistant from each other on the tape. Add your three measurements and divide by 3 to get an average depth.

____+____+____ = /3 = ____ft average depth

- D. Use the measurements you have collected to calculate the stream discharge in cubic feet per second. Multiply the velocity by the average width and average depth.

____ft/sec x ____ft avg. width x ____ft avg. depth = cubic feet/second discharge



Stream Environment Observations

Plants - What kinds of plants are growing within the stream channel or overhanging it? Is algae growing on the rocks?

Stream bottom - What size rocks and gravel are dominant in your section of stream? Are the spaces between the rocks and gravels filled with silt?

Water - What is the color of the water? Is it clear or cloudy (turbid)?

Streambanks - Is there vegetation on the banks that shades the stream? Are there undercut banks that provide shade and shelter for fish?

Animals - Is there evidence of animal use along the streambank? How much has this affected the stream?

Data Analysis

1. Use your stream discharge calculation to determine the human population that this stream could support.
____ cubic ft/sec discharge x 7.48 gallons water in 1 cubic ft water = ____gallons/
second
____ gals/sec. x 60 secs. per minute = ____ gals per minute
____ gals/min. x 1440 minutes per day = ____ gals water per day
____ gals water/day divided by 200 gals/person/day = ____ people this stream
could support
2. Compare the results of your chemical tests to the chart that shows conditions needed to support trout. Is this a good “trout stream”? Explain your answer.
3. Does it appear that human activities have impacted the streambanks or channel? Explain.

Activity 5: Fish Sampling

Pre-field Activity: Completed along with activity 4.

Field Time: 2 hours sampling fish and macro-invertebrates

Follow-up Activity: Two 50-minute class periods to calculate fish population estimate and graph fish lengths and weights

Species and diversity of macro-invertebrates can be a good indicator of aquatic ecosystem health. Some invertebrates are intolerant of poor water quality while others tolerate a wide range of conditions. Trout populations depends upon the physical and chemical condition of a stream, as well as the macro-invertebrates that form the base of the food chain.

In this activity, students will be divided into two groups. One group will collect macro-invertebrates from Miller Creek using standard 1-meter kick nets. Macro-invertebrates will be sorted and counted in the field using ice cube trays and classification keys. Macro-invertebrates will be classified to the order, using common names. The second group will assist the fisheries biologist with electrofishing using the standard 100-meter, two-pass sampling technique. Two students will assist with netting fish while the others identify species and take length and weight measurements. Then the groups will switch and a second sample will be taken.



Data Collection—Macro-invertebrates

Common Name

Number







c_1 = # of fish >75 mm captured during first pass

c_2 = # of fish >75 mm captured during second pass

$$\text{Probability of first pass capture} = \hat{p} = \frac{c_1 - c_2}{c_1}$$

Note: $\hat{p}$ must be ≥ 0.60 or more electrofishing effort is required—this means a third pass.

$$\text{Population estimate} = \hat{N} = \frac{c_1^2}{c_1 - c_2}$$

$$\text{Variance} = v(\hat{N}) = \frac{(c_1^2)(c_2^2)(c_1 + c_2)}{(c_1 - c_2)^4}$$

$$\text{Standard deviation of variance} = \sqrt{v(\hat{N})}$$

$$95\% \text{ confidence interval for } \hat{N} = 2\sqrt{v(\hat{N})}$$

$$\frac{\text{Report format: } \hat{N} \pm 2\sqrt{v(\hat{N})}; p = ?}{\text{Density} = \# >75 \text{ mm}/100 \text{ m}^2 \text{ surface area}}$$

$$\text{Surface area} = (\text{length})(\bar{x} \text{ width})$$

Data Analysis

1. Use the equations for the two-pass sampling technique to calculate a fish population estimate, based on a 95% confidence level.
2. Enter your data on fish lengths and weights into the TI-82 calculator, using the LIST function. Use the STAT function and select #1, Var Stats, to calculate means for length and weight. Then use the STAT PLOT function to graph histograms and scatter plots for length and weight. Print your graphs.

Conclusions

1. Where did you find the greatest number of macro-invertebrates; in the pool, riffle, or run area? What are some possible reasons for your findings?
2. Using your data on numbers and diversity of macro-invertebrates, would you consider this stream to be “healthy”? Explain. (See attached sheet on indicators of stream health.)
3. Why is it important to estimate the fish population in a stream?
4. Are your samples adequate to estimate the fish population with a high degree of confidence?
5. Because fish length and weights indicate age, do your samples indicate a good range of ages in your fish population? Why is it important to know this?

Activity 6: Recreation and Wilderness

Pre-field Time: Two 50-minute class periods

1. Students will read selected parts of the Wilderness Act (later in this section) and answer questions on criteria for wilderness designation. They will also read a *National Geographic* article on wilderness values.
2. Students will see a presentation on “No Trace” Camping by a Glacier National Park backcountry specialist.
3. Students will brainstorm a list of recreation activities that people enjoy on public lands. They will see a slide presentation on the Recreational Opportunity Spectrum by a Flathead Forest Recreation Specialist.

Field-time: 3 hours, including driving time

Students will stop at the undeveloped campground at the north end of Upper Stillwater Lake and walk the trail to Finger Lake, bordering the LeBeau Research Natural Area (RNA).

Follow-up Activity: Two 50-minute class periods to develop and evaluate a recreation plan

People seek out public lands for a variety of recreation activities (see list below to assist with brainstorming activity). Often, user groups have conflicting viewpoints on the type of recreation activities that should be emphasized in a given area. As human use levels increase, activities may have impacts upon water quality, wildlife, and aesthetic values. In this activity students will be given a scenario where two recreational use groups have conflicting viewpoints on how an area should be used. Students need to evaluate the requests of the two groups and come to a decision as to how the area should be managed.

Student Problem

A group has contacted the Forest Service requesting that a developed recreation plan be produced for the LeBeau Research Natural Area and Upper Stillwater Lake campground. These people would like the Forest Service to consider development of snowmobile trails

as well as better camping and boating facilities. An opposing group has expressed its concern that the area not be developed. These people feel that the 5,000 acres in the LeBeau Research Natural Area should be added to the Wilderness System. This group is concerned that additional recreational developments could disrupt bald eagles and loons that nest in the area, elk and moose that winter in the area, and a wolf pack that has recently established itself in the area.

After walking through the area, students need to determine which group's request is best suited for the area and develop their own plan for recreational use. Students need to evaluate their plan's impacts upon water quality, wildlife, recreation, and wilderness.

List of Potential Recreation Activities

Hiking
Camping
Boating (motorized or non-motorized)
Fishing
Hunting
Sightseeing
Berry picking
Firewood gathering
Snowmobiling
Cross-country skiing
Horseback riding
ATV/motorcycle use
Backpacking
Wildlife viewing
Photography.

Analysis

Students will work in class to develop a recreation site plan for the Upper Stillwater Lake Campground, road, and trail into the LeBeau Research Natural Area.

Student questions to answer as they develop their plan:

1. Does all, or any portion of the area, meet the criteria for Wilderness as stated in the Wilderness Act? (Is the area large enough? What signs of man do you observe?)

2. Which, if any, recreational developments would you put in and what would they cost? (See next list.) Would you pay for them with user fees or would taxpayers foot the bill?

3. If you add recreational developments to the area, how would the increases in human use affect eagles, loons, elk, moose, and wolves?

4. How would increases in human use affect water quality?

5. What are some things you could do to lessen the impacts of human activities upon wildlife and water quality? What would these things cost?

6. If you decide not to put in new recreational developments, how would you justify your decision?

Recreational Development Costs (provided by Tally Lake Ranger District, 1995)

Fishing pier/boat dock	\$10,000
Camper hook-up with electric, water, sewer	\$10,000 per site
Fire grates	\$200 per site
Bear-proof garbage cans	\$100 per site
Group Dump Station	\$50,000
2 vault toilets	\$108,000
2 flush toilets with septic	\$270,000
Building with 6 showers	\$200,000
4 miles unpaved trail	\$25,000
½ mile handicapped-accessible trail (paved)	\$40,000
Paved parking lot	\$100,000
Sand for beach	\$10,000
Group pavilion with picnic tables	\$40,000
Person to dump garbage cans, change toilet paper, fix vandalism, etc.	\$1,500 per year

Benefits

The Forest Service usually charges \$8.00 per night for most developed campgrounds. Most campgrounds are open for 90 days per year. How much money would these “user-fees” generate?

Readings on Public Recreation: the Wilderness Act

The following is an excerpt from the book *Action for Wilderness*.

The Wilderness Act, passed by Congress in 1964 as a result of an 8-year campaign, was designed to provide a clear national policy that wilderness is a public value deserving protection for all time. All national forest roadless areas more than 5,000 acres in size were to be reviewed to determine which areas should be recommended to Congress for inclusion in the Wilderness System. The Forest Service recommended Wilderness areas as part of the forest planning process, but Congress has still not acted on some of the recommendations. Once an area is declared as Wilderness the designation becomes law, making these decisions highly controversial.

Agencies must look to the definition of wilderness set down in the Wilderness Act to assess whether roadless areas qualify for designation as wilderness. They must consider the following characteristics:

1. Land Ownership—the potential wilderness area must be Federally owned and private inholdings can only occur in a minor share of the area.

2. Condition—the land must appear to have been **primarily affected by forces of nature, with man's impact substantially unnoticeable throughout the entire unit. There may be no permanent improvements, including permanent roads. There may be no human habitation on the Federally owned land within the unit, and the unit should successfully maintain the natural community of life (Gillette 1972).**

3. Potential Use—the unit must have outstanding opportunities for solitude and a primitive and unconfined kind of recreation (Gillette 1972).

4. Size—the unit must be at least 5,000 acres in size or, if smaller, it must be large enough to be used but still feasibly preserved in an unimpaired condition (Gillette 1972).

5. Optional Features—these include features of interest for scientific (including ecological and geological features), educational, conservation, scenic or historical reasons.

Once a Wilderness area is designated, the act governs how it should be managed. Under no circumstances are permanent roads allowed in wilderness areas. The only commercial enterprises allowed are those serving recreation users, such as packers, outfitters, and guides. The agency administering the wilderness area can use motorized equipment, build structures, and build temporary roads only if necessary to preserve the wilderness and protect the safety and health of visitors. Prospecting for mineral resources is allowed if it is compatible with wilderness preservation. Water projects such as dams can be installed only if the president finds that they are in the public interest. Grazing of livestock is allowed under reasonable regulation.

Activity 7: Sustainability

Field Time: 3 hours

Follow-up Class Time: 5 days

The basic aim of forest management is to keep forest lands (and the other resources that interact with them) productive over the long term. **SUSTAINABILITY** involves continuity of forest growth, fish and animal populations, and stream productivity as well as a yield of products demanded by people.

In this activity, students walk on the interpretive trail through a series of management units in the Miller Creek area, observing similarities and differences resulting from different treatments. Students make periodic stops to discuss questions posed by classroom instructors and resource professionals (fig. 11).

Field Stops

Stop 1—The first stop is at the top of the trail on Road #2876 (See Latham and others 1998, *Wildfire Tours*, p. 11). Students look out over the Miller Creek drainage and observe a mosaic of forest areas of different ages and also resulting from different treatments. Miller Creek has a story to tell about forest change and the role of disturbance, primarily fire, in that change. In the mountainous terrain



Bill Schustrom

Figure 11—Ed Lieser, Silviculturist on the Tally Lake Ranger District, Flathead National, provides information from a professional's viewpoint to Whitefish High School advanced biology students.

at Miller Creek, fire has had a variable effect and creates forests in many stages of development. The long-term consequences of natural disturbances tend to enhance biological diversity. Research at Miller Creek has helped to explain the role of fire in western larch forests and to understand the extent to which human's management practices (like clearcutting and prescribed burning) mimic natural processes of disturbance.

In 1966, a 5,518-acre area in Miller Creek Forest had been selected as a site for cooperative research on the effects of logging and prescribed fire. Sixty 10-acre harvest units were located within 200- to 250-year-old forest areas and were to be logged in 1967 and 1968, followed by broadcast burning of slash. However, nature interrupted the researchers' plans with a wildfire on August 23, 1967, burning eight units that had already been clearcut and five units still planned for logging. Luckily, research plots had already been located, and measurements were taken prior to the wildfire, so studies on tree development and forest succession were able to continue, and are ongoing today.

Stop 2—Unit South-8 (Latham and others 1998, p. 11-12 and Wildfire Tour Supplement, p. 2-9): This site was clearcut, then broadcast burned on August 8, 1967; and then burned again by the wildfire on August 23, 1967. The fire was so hot on this south-facing slope that it burned most of the litter and duff covering the mineral soil.

1. As you look around, what observations do you make about conifer and shrub growth in this area? (Shrubs are really tall; the density of trees is sparse and they are not very tall.)

Follow up student observations with:

2. Why would there be more young larch near the one remaining patch of large trees? (The only seed source within 300 feet that survived the fire.)

3. How do you think the presence of these fast-growing ceanothus shrubs affected the regeneration of conifers? (They started growth much more quickly because their seed can wait in the soil for 300+ years and then sprout as soon as a fire comes through. They out-competed the trees for precious water and nutrients.)

4. Do you think it is good or bad that the trees are not growing very well here? (It depends upon your perspective. Wildlife biologists think it is great. Because there is such a high density of browse shrubs on a south-facing slope, it makes excellent winter range for moose.

This area has the highest winter density of moose known in the State of Montana. It worries foresters, however, because there is a law which says that all logged areas must be regenerated within 5 years after logging, in order to promote forest **SUSTAINABILITY**.)

5. Should foresters try to get maximum tree growth on every acre of forest land? Why or why not? (No! This would be detrimental to biodiversity and **SUSTAINABILITY** of other resources, such as wildlife.)

Stop 3—Unit South-13 (Latham and others 1998, p. 12-13; Wildfire Tour Supplement, p. 10-16; and Wildfire Chart Separate: This site was a 200-year-old forest burned by the wildfire on August 23, 1967 (fig. 12).

1. What do you observe about conifer and shrub growth in this area, compared to the one we just walked through? (Tree regeneration is abundant; there are many standing dead trees left from the fire (fig. 13). Where it has been thinned the trees are much taller than where it has not been thinned; in the unthinned area some young trees are dying.)

2. Why are the lodgepole pine and larch so dense here? (Trees were alive and had lots of seed when the fire came through; serotinous lodgepole pine cones opened quickly after the fire and were able to outcompete the shrubs, and now the shrubs have been shaded out.)



Ann Arbor Miller, Whitefish Pilot

Figure 12—Bill Schustrom instructs his Whitefish High School advanced biology students on wildfire burned Unit South-13, Miller Creek Demonstration Forest.



Ray Shearer

Figure 13—Unit South-13, 20 years after wildfire, recovered quickly with conifers and other vegetation.

3. How would long-term forest **SUSTAINABILITY** be affected if this entire area had not been thinned? (Much less volume of wood would be produced, affecting people’s supply and demand for forest products; would take longer to reach “old growth” stand conditions that many wildlife species need. Also, the volume of wood is spread over more trees when unthinned.)

Stop 4—Unit South-14 (Latham and others 1998, p. 13 and Wild-fire Tour Supplement, p. 17-22): This site started out like the one you just walked through, but after the wildfire it was salvage-logged and then the remaining slash was pushed into long windrows by a bulldozer. The windrows were then burned, and the area was seeded with larch from a helicopter.

1. Why do you think there are strips with very few trees, while in neighboring strips the western larch are very dense? (Where there were slash windrows, the fire got so hot it “cooked” the soil, delaying regeneration. Where the larch seed had good soil, it grew quickly.)

2. How did man’s manipulation of this site change its long-term **SUSTAINABILITY**?

Stop 5—Moose Pond and Unit W-1 (Latham and others 1998, p. 9-10, and Prescribed Fire Tour Supplement, p. 8-11): After getting back on the bus and driving up Road #9650 to the Moose Pond, students will walk a loop on the closed road around the Moose Pond to

the trail that goes through the old growth stand on the north side of the pond.

This pond is surrounded by hydrophytic (water-loving) vegetation that needs a unique combination of soil type and year-round moisture to survive and reproduce. Sites such as these add a lot to the biodiversity of Miller Creek and to the **SUSTAINABILITY** of moose populations. In a northwest Montana study of moose (fig. 14), researchers found that cow moose with calves would travel 25 miles from their normal home range to ponds like these, spend a week or so feeding on the aquatic plants, and then go back.

1. Why would the moose expend energy to travel so far with a calf? (The aquatic plants concentrate mineral salts such as calcium, which the cows need to produce milk.)

2. As you look across the pond, you see an older clearcut unit and a more recent one, but the bottom of the units do not go all the way to the pond. Why do you think the old growth trees were left around the pond? (Some wildlife species that use old growth prefer to nest or den near riparian areas; these big old trees provide thermal cover. People find the big old trees aesthetically pleasing and recreationists like to walk through diverse areas such as old trees next to a pond.)



Steve Wirt

Figure 14—Moose on the Miller Creek Demonstration Forest.

3. Unit W-1, the older clearcut, was not affected by the wildfire. It was logged, slashed and broadcast burned. It did not burn very hot, so the duff and litter were not destroyed. This allowed shrubs to resprout from existing roots and stems, making forage species such as willow, serviceberry, and buffaloberry available for wildlife. Have forest managers done a good job of maintaining biodiversity in this area? Have there been any negative effects in the long-term? (Yes, they have! There have been no long term negative effects.)

Stop 6—Council Rock: This is the last stop. Students look east-erly over the Miller Creek drainage (Latham and others 1998, p. 10-11 and Prescribed Fire Tour Supplement, p. 18-24).

1. How does Miller Creek demonstrate the “goals of the ecologist”?
2. What have you done over the past 2 days to inventory, analyze, and determine the desired future condition for this ecosystem?

Activity 8: Multiple-use Planning

Pre-field Time: 30 to 40 minutes

Although this activity is last, it needs to be introduced during the initial Miller Creek educational activities. After the concept of multiple-use (timber, wildlife, water, recreation, wilderness) have been explained and discussed, each student will be assigned one of the areas. The student's job will be to represent a Forest Service specialist in that area. (See learning activities section in introduction.) Students will form a list of things each specialist would be concerned about.

Field Time: variable

As students participate in each of the first seven activities they will be listening to professionals: foresters, biologists, and wilderness managers, about their work and how they accomplish assignments. Students will be collecting and analyzing data dealing with each multiple-use area. Although each student will be involved with all field activities, they need to make their primary focus the area assigned specifically to them.

Classroom: After the students return to the classroom, adequate time should be given to (1) research why their assigned multiple-use area is important, (2) analyze data collected in the field and to assess what interactions are taking place, and (3) propose a possible plan or "desired future condition" for the Miller Creek area based on research and field data analysis.

When these plans are completed, each "specialist" will then come together with at least one of the other four specialists to work as an interdisciplinary team. They will be charged to develop a comprehensive multiple-use plan. These plans are then presented orally to other groups or a panel of Forest Service professionals. Conflicts almost always arise and students realize the complexity of the world in which they live—and the need for research and thorough planning before change can be initiated.

Field Equipment Needs

Activity 1:

- 5 Clinometers
- 5 Increment borers
- 10 Plot stakes
- 10 12-foot ropes
- 5 Logger tapes
- 5 10-foot tapes (diameter at breast height and inches)
- 10 Tree keys

Activity 2:

- 10 Color aerial photos (4":1 mi scale) Miller Creek Research Plots

Activity 3:

- 60 Collapsible small mammal live traps
- 2 Rolls flagging
- 2 Jars peanut butter, mixed with oatmeal
- 1 Bag cotton balls
- 2 Pairs gloves
- 2 Collection bags
- 2 Small mammal ID guides

Activity 4:

- 2 FS topo maps of Tally Lake Ranger District
- 2 Hach kits
- 1 Tennis ball
- 1 100' tape

Activity 5:

- 4 Pair hip waders
 - 4 Macro-invertebrate keys
 - 2 Kick nets
 - 2 Buckets
 - 4 Ice cube trays
 - 4 Pairs tweezers
- Fish, Wildlife and Parks provides all the electrofishing equipment and measuring devices.

Activity 6:

- 10 Site maps of Stillwater Lake Campground
- 10 Felt-tip markers

Activity 7:

None needed

Activity 8:

Illustration of Miller Creek Community (1 per group)

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- National Geographic. 1985. Bob Marshall. May: 664.

Resource People

Glacier National Park
West Glacier, MT 59936
Backcountry Specialist
(406) 888-7800

Tally Lake Ranger District
1335 Hwy. 93 West
Whitefish, MT 59937
Recreation Specialist
Silviculturist
Wildlife Biologist
(406) 862-2508

Department of Fish, Wildlife, and Parks
490 North Meridian Road
Kalispell, MT 59901
Fisheries Biologist
(406) 752-5501

Flathead National Forest
1935 Third Avenue East
Kalispell, MT 59901
Fisheries Biologist
(406) 752-5200

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Miller Creek, on the Flathead National Forest in northwestern Montana, is a demonstration forest, showing up to 30 years of forest change. This teachers supplement to the educational field guide (*Miller Creek Demonstration Forest—a forest born of fire: a field guide*; Gen. Tech. Rep. RMRS-GTR-7, 1998) outlines eight field and classroom activities that teach students a wide range of ecological processes and principles. Included are instructions for teachers, instructions and demonstrations for students, and reproducible worksheets.

Keywords: prescribed fire, wildfire, wildlife, aquatic habitat, recreation, wilderness, multiple-use, sampling, education



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