An Introduction to the H. J. Andrews Experimental Forest

The H. J. Andrews Experimental Forest is located in the rugged Cascade Mountains approximately 50 miles (80 km) east of Eugene, Oregon. It is 15,815 acres (6400 hectares) in size and ranges from 1350 feet (412 m) to 5350 feet (1630 m) in elevation. The landscape is deeply dissected and heavily forested. Pristine stands of old-growth forest with dominant trees in excess of 400 years of age cover about 45 percent of the Andrews Forest with the remainder in younger age-class forests; the most common forest types at lower elevations are dominated by Douglas-fir, western hemlock and western red cedar. Going up in elevation, western hemlock is gradually upland by Pacific silver fir, and Douglas-fir and western red cedar decline in importance. Upper elevation stands consist of mixtures of true firs and mountain hemlock. Approximately one third of the Andrews Forest has been logged or manipulated for research as shown in the following table.

Forest Type	Areas in Acres (hectares)		
	Undisturbed	Logged/Manipulated	Total
Low elevation douglas-fir--western hemlock	3363 (1362)	2807 (1136)	6170 (2498)
Mid-elevation transitional	3959 (1603)	1331 (539)	5290 (2142)
Upper elevation true fir-mountain hemlock	2756 (1115)	981 (379)	3737 (1512)
Non-forest types	618 (250)	-- --	618 (250)
Grand Totals	10,696 (4330)	5119 (2072)	15,815 (6402)

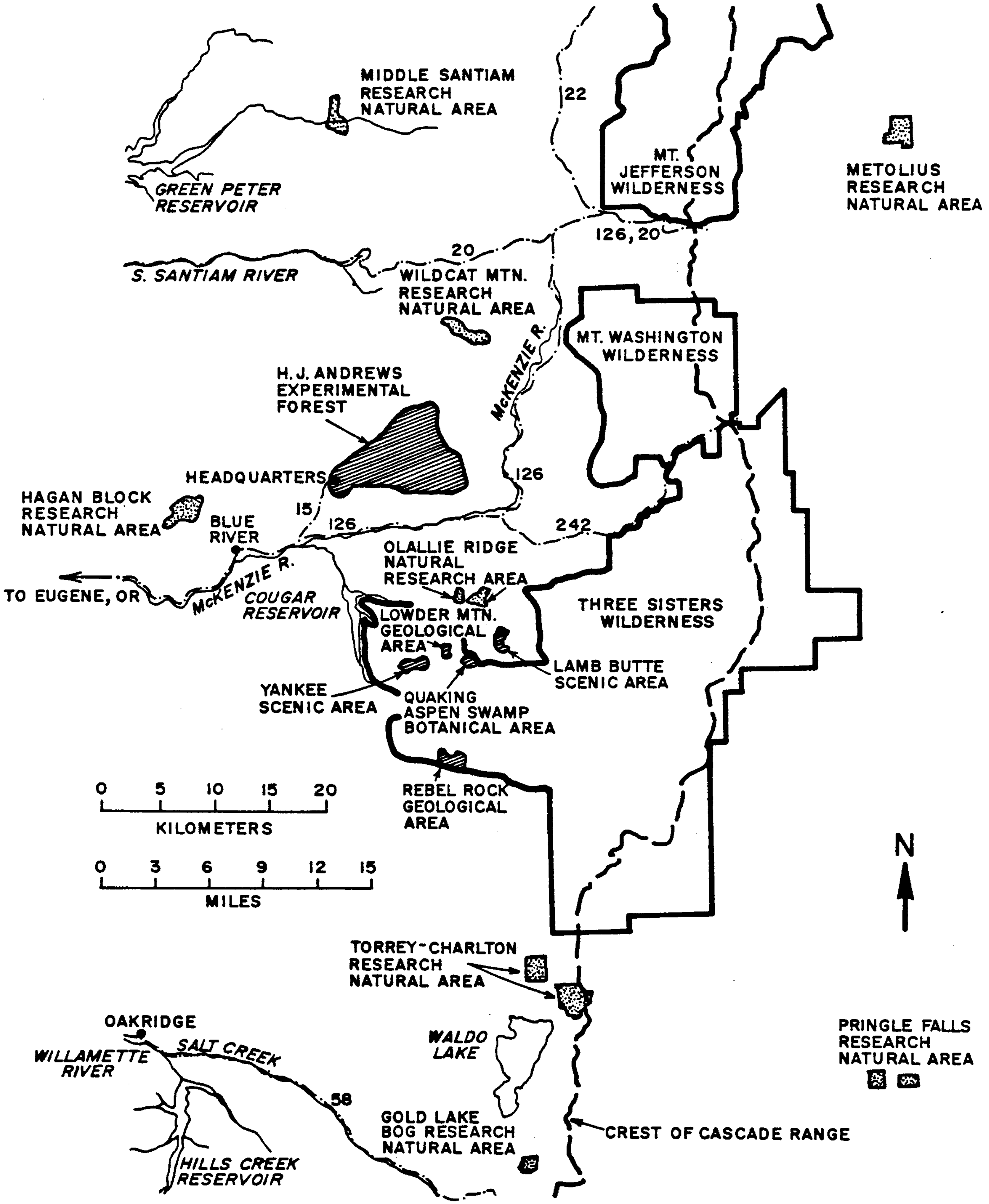
The maritime climate is mild with wet winters and cool, dry summers. Annual precipitation normally exceeds 100 inches (2540 mm) and is concentrated in the winter. Deep snowpacks are common above 3300 feet (1000 m). Little or no rain falls during July and August.

Rapidly flowing mountain streams are the primary type of aquatic ecosystem on the Andrews Forest. Streamflow follows the precipitation pattern with winter maximum flows three orders of magnitude larger than summer minimum. First and second order streams under natural conditions are dominated by coarse woody debris and receive large annual inputs of litter which provide the energy base for the aquatic organisms. Larger order streams have an increasing proportion of the energy base provided by in-stream photosynthesis, but processed organic matter (litter) washed down from the smaller tributaries remains an important part of the energy base.

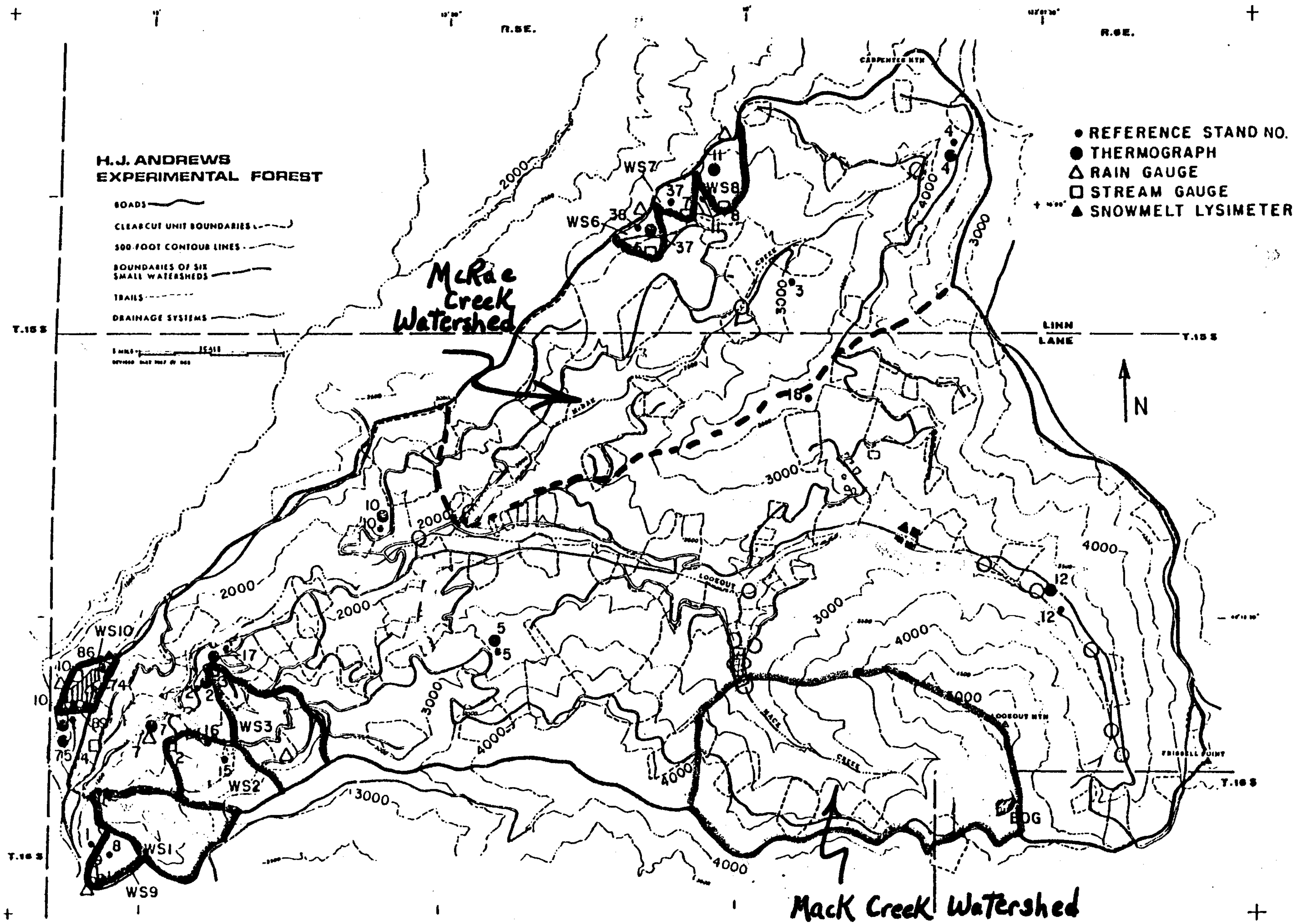
The Andrews Forest was established by the U.S.D.A. Forest Service in 1948. Research efforts focused on logging and regeneration in the 1950's, shifted to a watershed emphasis in the 1960's and to an ecosystem orientation in the 1970's. Research use of the site expanded rapidly in the 1970's, with National Science Foundation support. In 1977, Oregon State University and the Forest Service agreed to jointly administer the site with the common management objective of enhancing research and educational use. The success of this joint management is apparent in the continuing expansion of the overall program, which includes basin and applied research.

During 1983, 87 scientists and 51 graduate students were involved in research at the Andrews Forest. Fifty-six separately funded projects used the site; if broken down into subprojects, well 100 studies could be listed. Total research expenditure is large, over $1,750,000 during 1983. The major contributors are:

Agency/Source	Amount
National Science Foundation	$ 855,000
Pacific Northwest Forest and Range Exp. Stat.	$ 401,000
Oregon State University	$ 170,000
Bureau of Land Management	$ 110,000
Department of Energy	$ 96,000
Other	$ 121,000
Total	$1,753,000



MIDDLE SANTIAM RESEARCH NATURAL AREA
22
MT. JEFFERSON WILDERNESS
METOLIUS RESEARCH NATURAL AREA
GREEN PETER RESERVOIR
126, 20
20
S. SANTIAM RIVER
WILDCAT MTN. RESEARCH NATURAL AREA
MT. WASHINGTON WILDERNESS
McKENZIE R.
H. J. ANDREWS EXPERIMENTAL FOREST
HEADQUARTERS
126
HAGAN BLOCK RESEARCH NATURAL AREA
15
126
242
BLUE RIVER
OLALLIE RIDGE NATURAL RESEARCH AREA
TO EUGENE, OR
McKENZIE R.
COUGAR RESERVOIR
LOWDER MTN. GEOLOGICAL AREA
THREE SISTERS WILDERNESS
LAMB BUTTE SCENIC AREA
YANKEE SCENIC AREA
QUAKING ASPEN SWAMP BOTANICAL AREA
REBEL ROCK GEOLOGICAL AREA
0 5 10 15 20
KILOMETERS
0 3 6 9 12 15
MILES
N
TORREY-CHARLTON RESEARCH NATURAL AREA
OAKRIDGE
SALT CREEK
WILLAMETTE RIVER
WALDO LAKE
58
PRINGLE FALLS RESEARCH NATURAL AREA
GOLD LAKE BOG RESEARCH NATURAL AREA
CREST OF CASCADE RANGE
HILLS CREEK RESERVOIR


H.J. ANDREWS
EXPERIMENTAL FOREST
ROADS
CLEARCUT UNIT BOUNDARIES
500-FOOT CONTOUR LINES
BOUNDARIES OF SIX SMALL WATERSHEDS
TRAILS
DRAINAGE SYSTEMS
REFERENCE STAND NO.
THERMOGRAPH
RAIN GAUGE
STREAM GAUGE
SNOWMELT LYSIMETER
N
R.5E.
R.6E.
T.15S
T.16S
LINN
LANE
McRae Creek Watershed
Mack Creek Watershed
WS1
WS2
WS3
WS6
WS7
WS8
WS9
WS10
2000
3000
4000
EDG
CARPENTER MTN
LOOKOUT MTN
FRISSELL POINT

Community name	Abbreviation
Tsuga heterophylla zone	
Pseudotsuga menziesii/Holodiscus discolor	Psme/Hodi
Pseudotsuga menziesii-Tsuga heterophylla/Corylus cornuta	Psme-Tshe/Coco
Tsuga heterophylla/Castanopsis chrysophylla	Tshe/Cach
Tsuga heterophylla/Rhododendron macrophyllum/Gaultheria shallon	Tshe/Rhma/Gash
Pseudotsuga menziesii/Acer circinatum/Gaultheria shallon	Psme/Acci/Gash
Tsuga heterophylla/Rhododendron macrophyllum/Berberis nervosa	Tshe/Rhma/Bene
Pseudotsuga menziesii/Acer circinatum/Berberis nervosa	Psme/Acci/Bene
Tsuga heterophylla-Acer circinatum/Polystichum munitum	Tshe/Acci/Pomu
Tsuga heterophylla/Polystichum munitum	Tshe/Pomu
Tsuga heterophylla/Polystichum munitum-Oxalis oregana	Tshe/Pomu-Oxor
Transition zone	
Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Berberis nervosa	Tshe-Abam/Rhma/Bene
Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Linnaea borealis	Tshe-Abam/Rhma/Libo
Tsuga heterophylla-Abies amabilis/Linnaea borealis	Tshe-Abam/Libo
Pseudotsuga menziesii/Acer circinatum/Whipplea modesta	Psme/Acci/Whmo
Abies amabilis zone	
Abies amabilis-Tsuga mertensiana/Xerophyllum tenax	Abam-Tsme/Xete
Abies amabilis/Vaccinium membranaceum/Xerophyllum tenax	Abam/Vame/Xete
Abies amabilis/Rhododendron macrophyllum-Vaccinium alaskense/Cornus canadensis	Abam/Rhma-Vaal/Coca
Abies amabilis/Vaccinium alaskense/Cornus canadensis	Abam/Vaal/Coca
Abies procera/Achlys triphylla	Abpr/Actr
Abies amabilis/Achlys triphylla	Abam/Actr
Abies procera/Clintonia uniflora	Abpr/Clun
Abies amabilis/Tiarella unifoliata	Abam/Tiun
Chamaecyparis nootkatensis/Oplopanax horridum	Chno/Opho

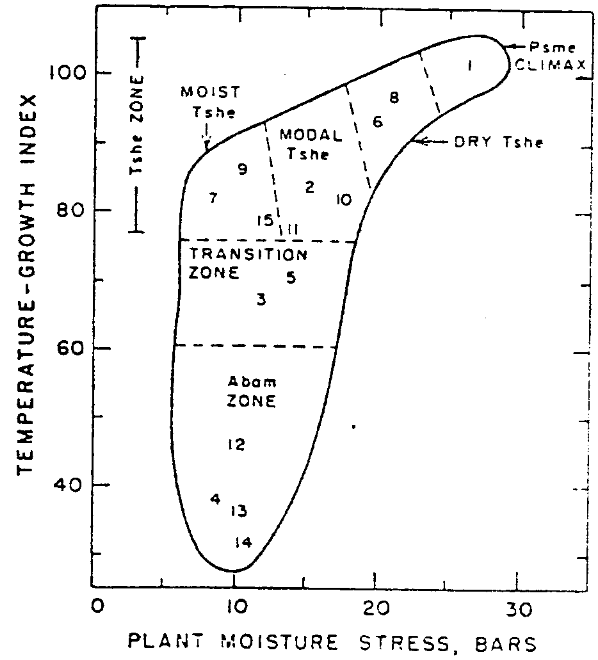


FIG. 7. Position of reference stands in a two-dimensional environmental field. Temperature is represented by Temperature Growth Index computed by the method of Cleary and Waring (1969). Moisture is assessed as the late-summer predawn moisture stress on conifer saplings

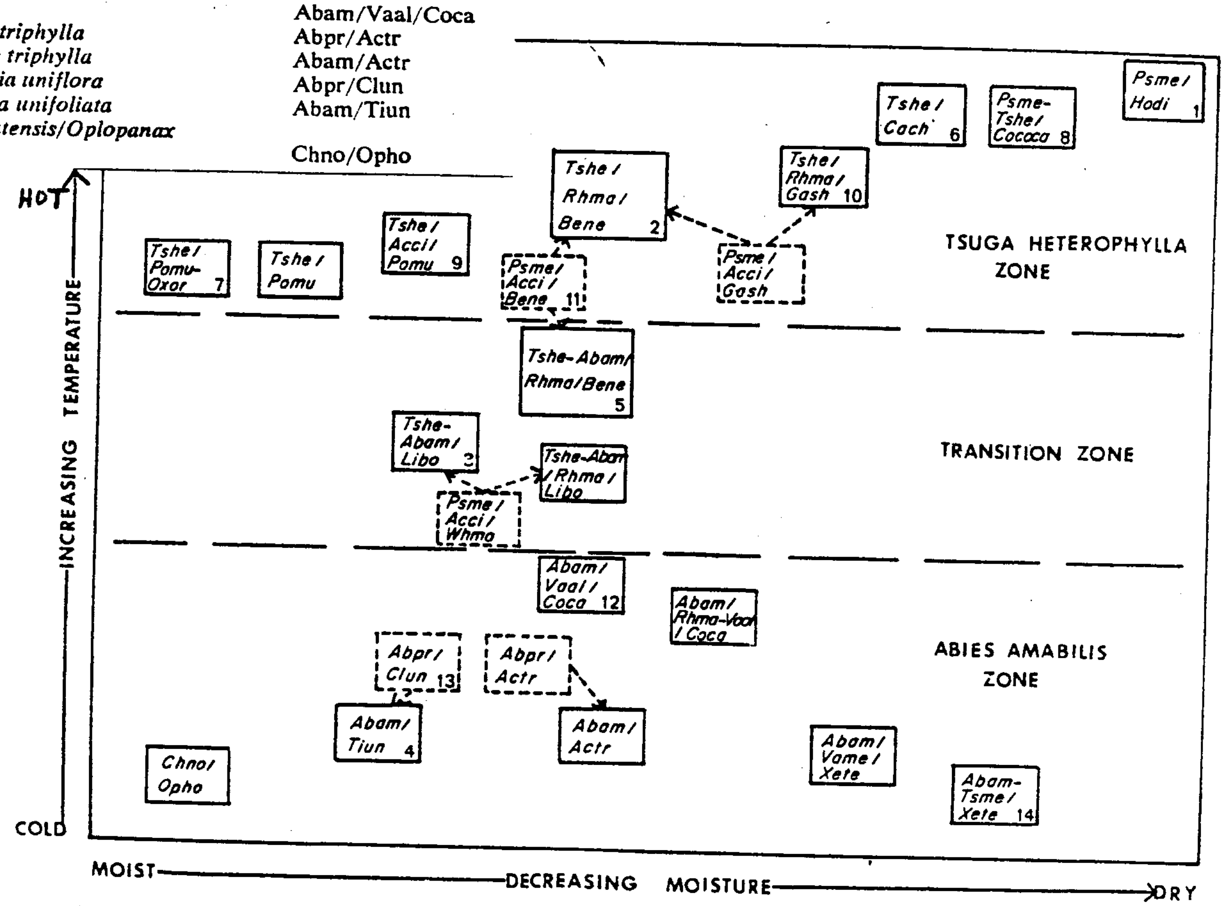
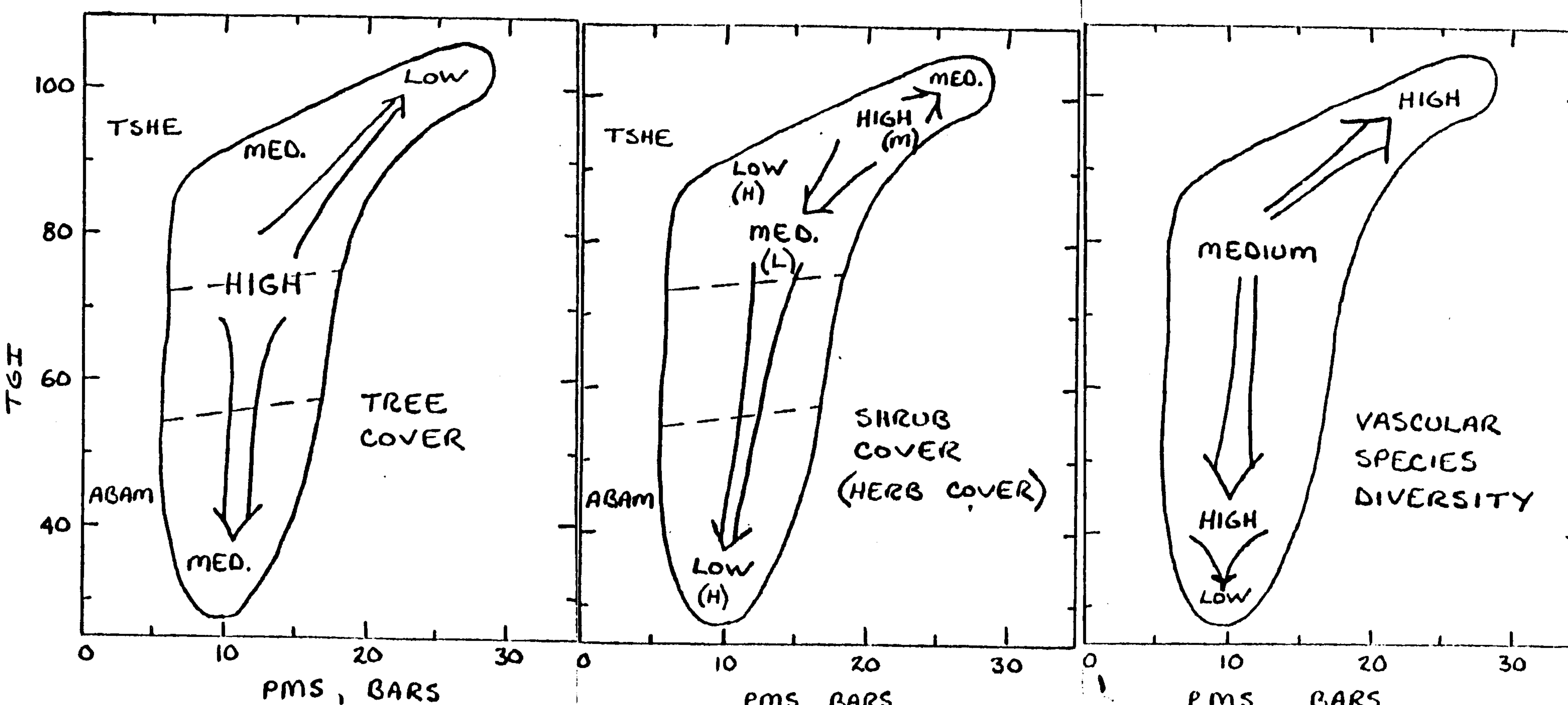
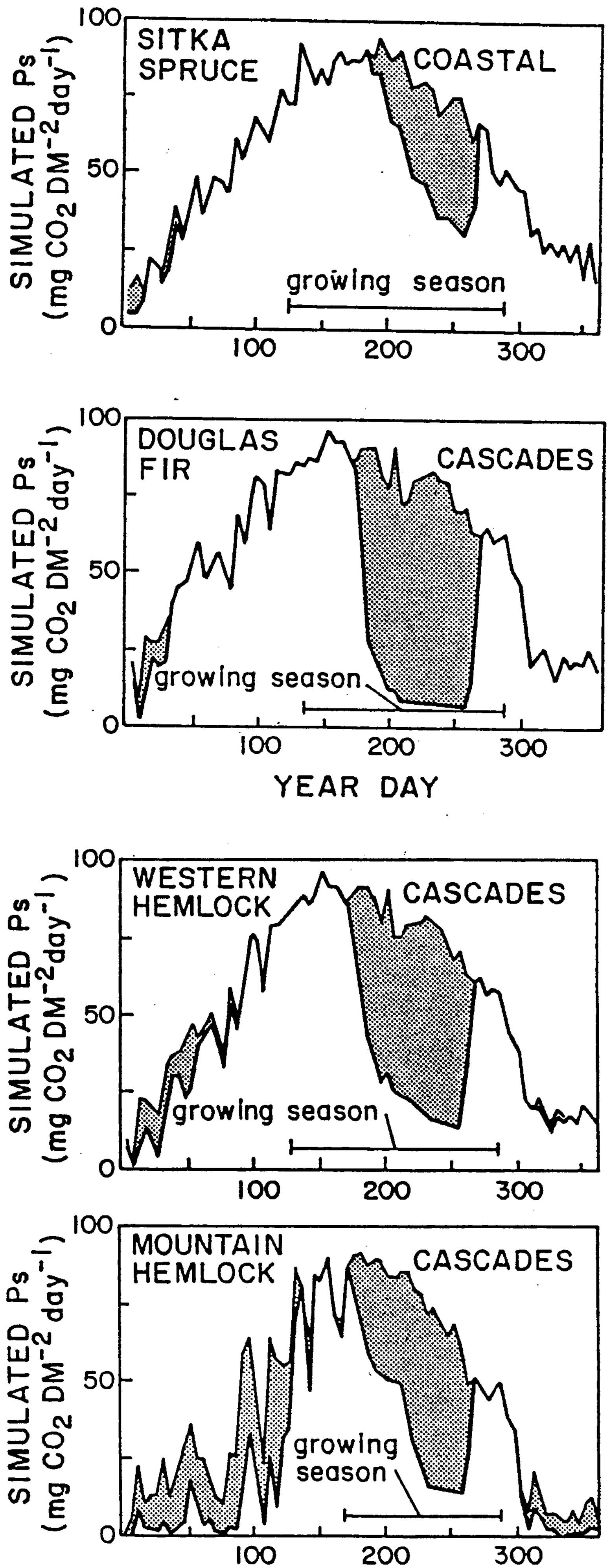
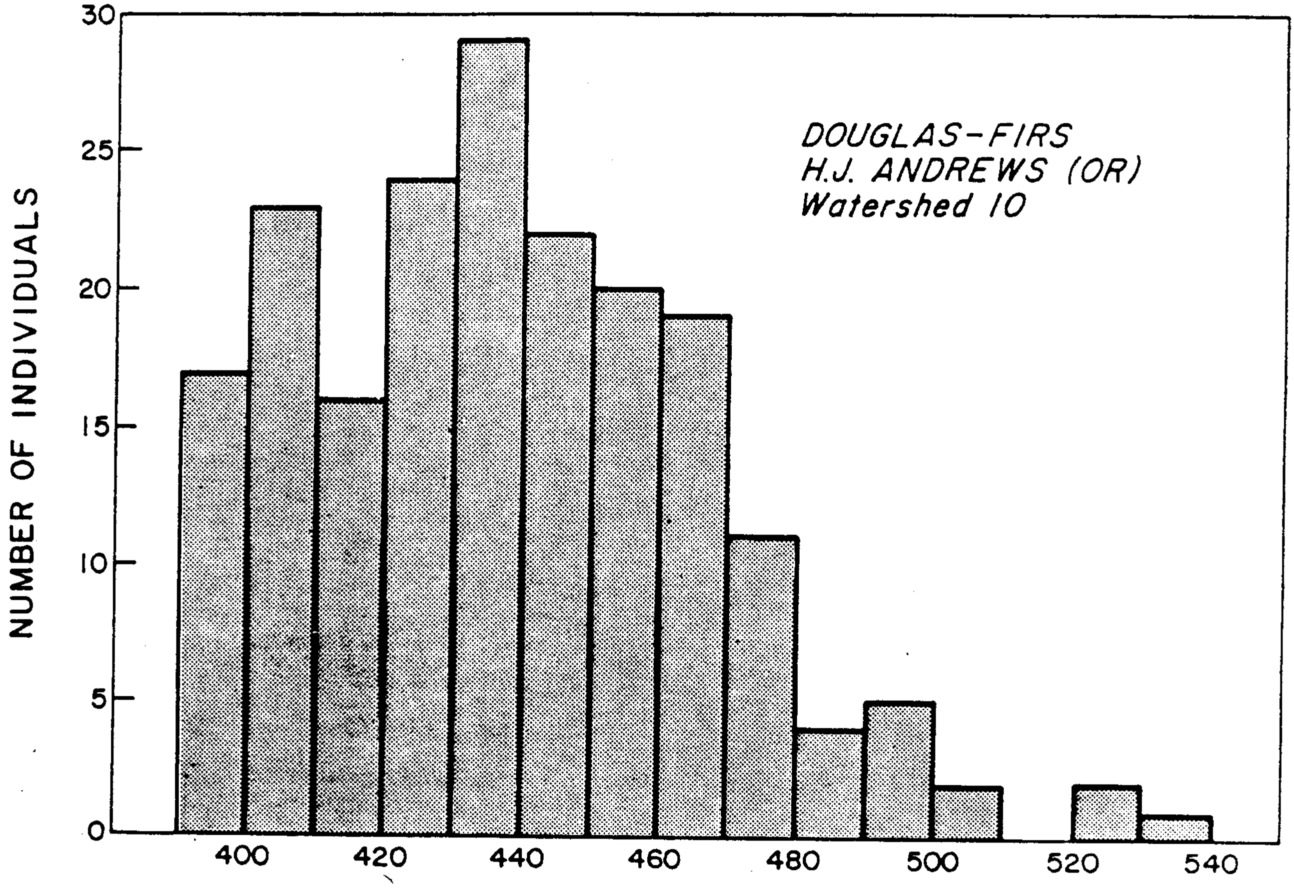
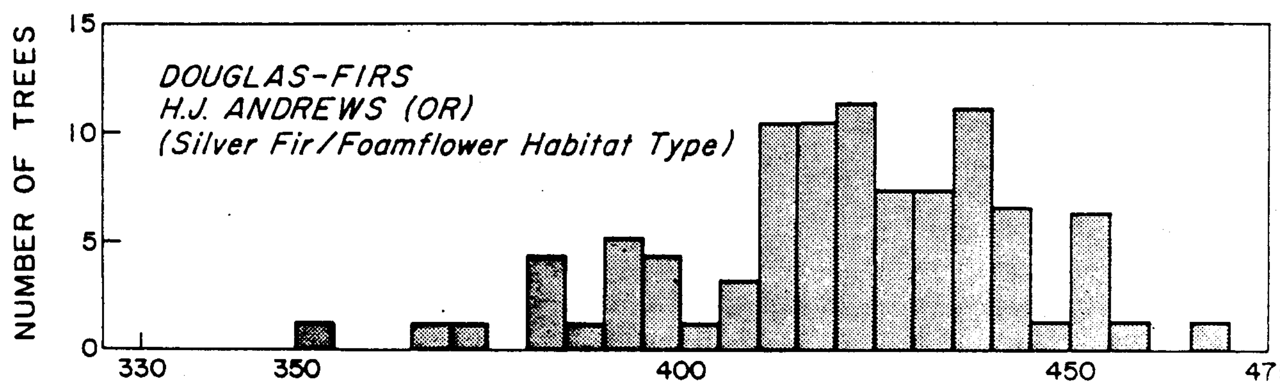


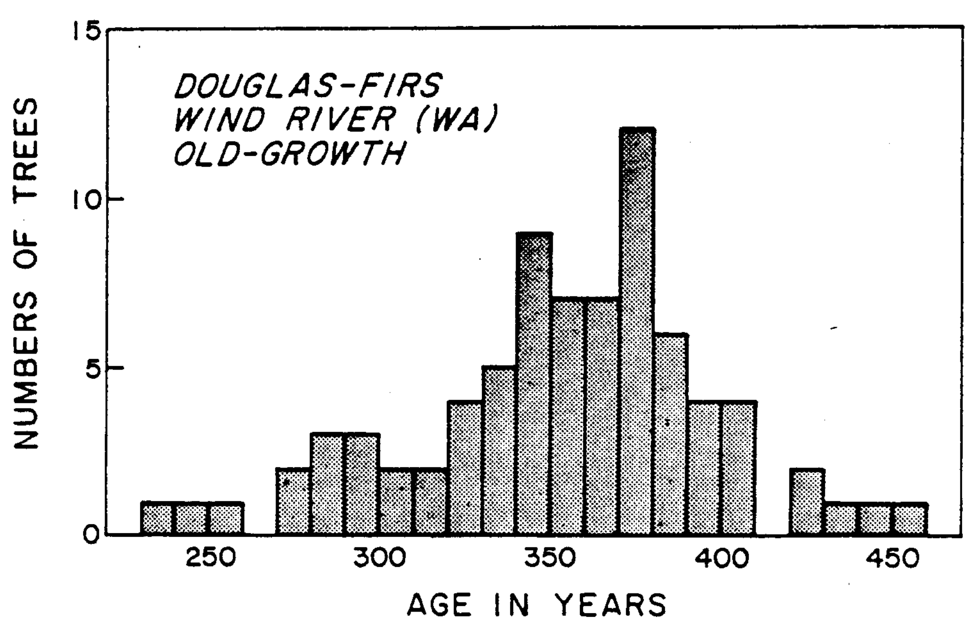
FIG. 2. Hypothesized relationships between forest communities and environment in the central western Cascades (Dyrness et al. 1974: Fig. 5). This figure is based on their vegetation ordination, somewhat modified by the intuition of the investigators. Communities enclosed with dashed borders are considered to be seral, the others, to be climax. Communities sampled in this study are identified by the reference stand number in the box. Abbreviations for communities are identified in Table 1.

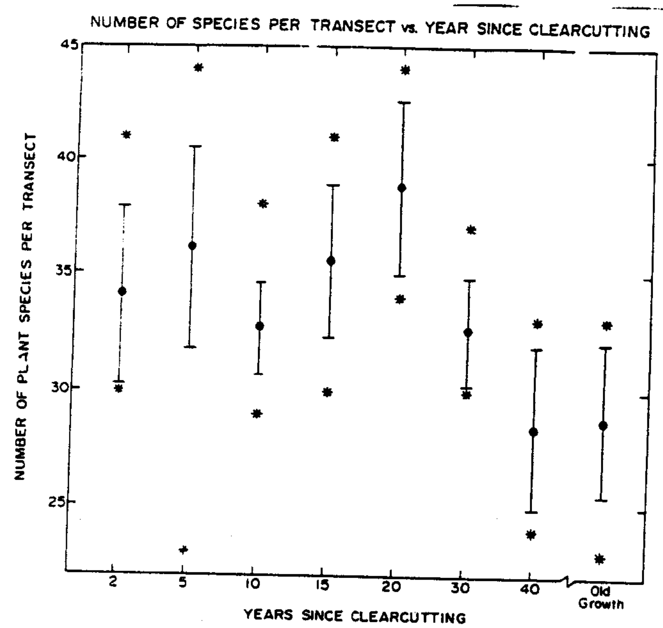

TGI
100
80
60
40
0
10
20
30
PMS, BARS
TSHE
ABAM
LOW
MED.
HIGH
MED.
TREE
COVER
TSHE
ABAM
MED.
HIGH
(M)
LOW
(H)
MED.
(L)
LOW
(H)
SHRUB
COVER
(HERB COVER)
PMS, BARS
HIGH
MEDIUM
HIGH
LOW
VASCULAR
SPECIES
DIVERSITY
PMS, BARS

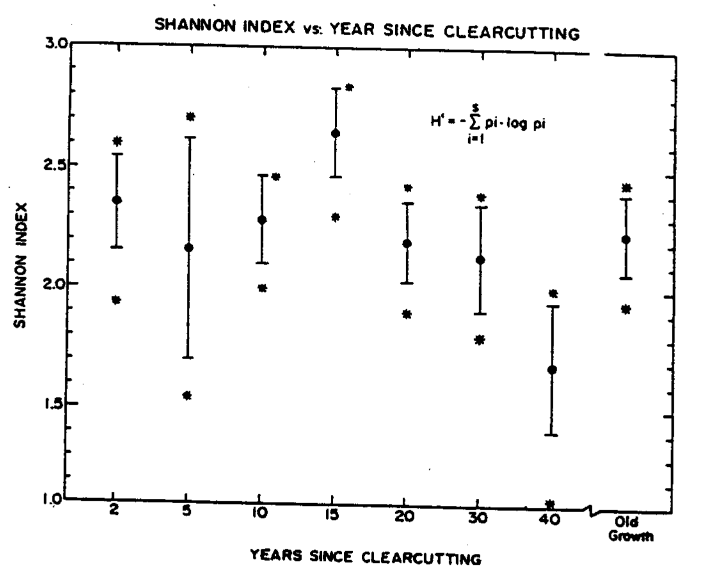

SITKA SPRUCE
COASTAL
growing season
DOUGLAS FIR
CASCADES
growing season
WESTERN HEMLOCK
CASCADES
growing season
MOUNTAIN HEMLOCK
CASCADES
growing season
SIMULATED Ps (mg CO2 DM-2 day-1)
YEAR DAY
0
50
100
100
200
300

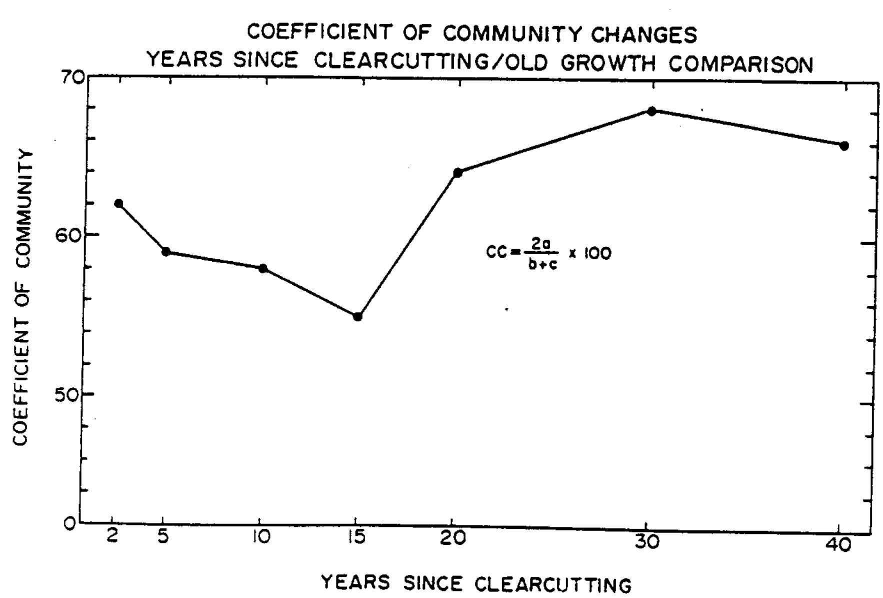

DOUGLAS-FIRS
H.J. ANDREWS (OR)
Watershed 10
NUMBER OF INDIVIDUALS
0
5
10
15
20
25
30
400
420
440
460
480
500
520
540


DOUGLAS-FIRS
H.J. ANDREWS (OR)
(Silver Fir/Foamflower Habitat Type)
NUMBER OF TREES
0
5
10
15
330
350
400
450
475


DOUGLAS-FIRS
WIND RIVER (WA)
OLD-GROWTH
NUMBERS OF TREES
0
5
10
15
250
300
350
400
450
AGE IN YEARS


NUMBER OF SPECIES PER TRANSECT vs. YEAR SINCE CLEARCUTTING
NUMBER OF PLANT SPECIES PER TRANSECT
45
40
35
30
25
2
5
10
15
20
30
40
Old Growth
YEARS SINCE CLEARCUTTING


SHANNON INDEX vs. YEAR SINCE CLEARCUTTING
SHANNON INDEX
3.0
2.5
2.0
1.5
1.0
$H' = -\sum_{i=1}^{s} pi \cdot \log pi$
2
5
10
15
20
30
40
Old Growth
YEARS SINCE CLEARCUTTING


COEFFICIENT OF COMMUNITY CHANGES
YEARS SINCE CLEARCUTTING/OLD GROWTH COMPARISON
COEFFICIENT OF COMMUNITY
70
60
50
0
$CC = \frac{2a}{b+c} \times 100$
2
5
10
15
20
30
40
YEARS SINCE CLEARCUTTING

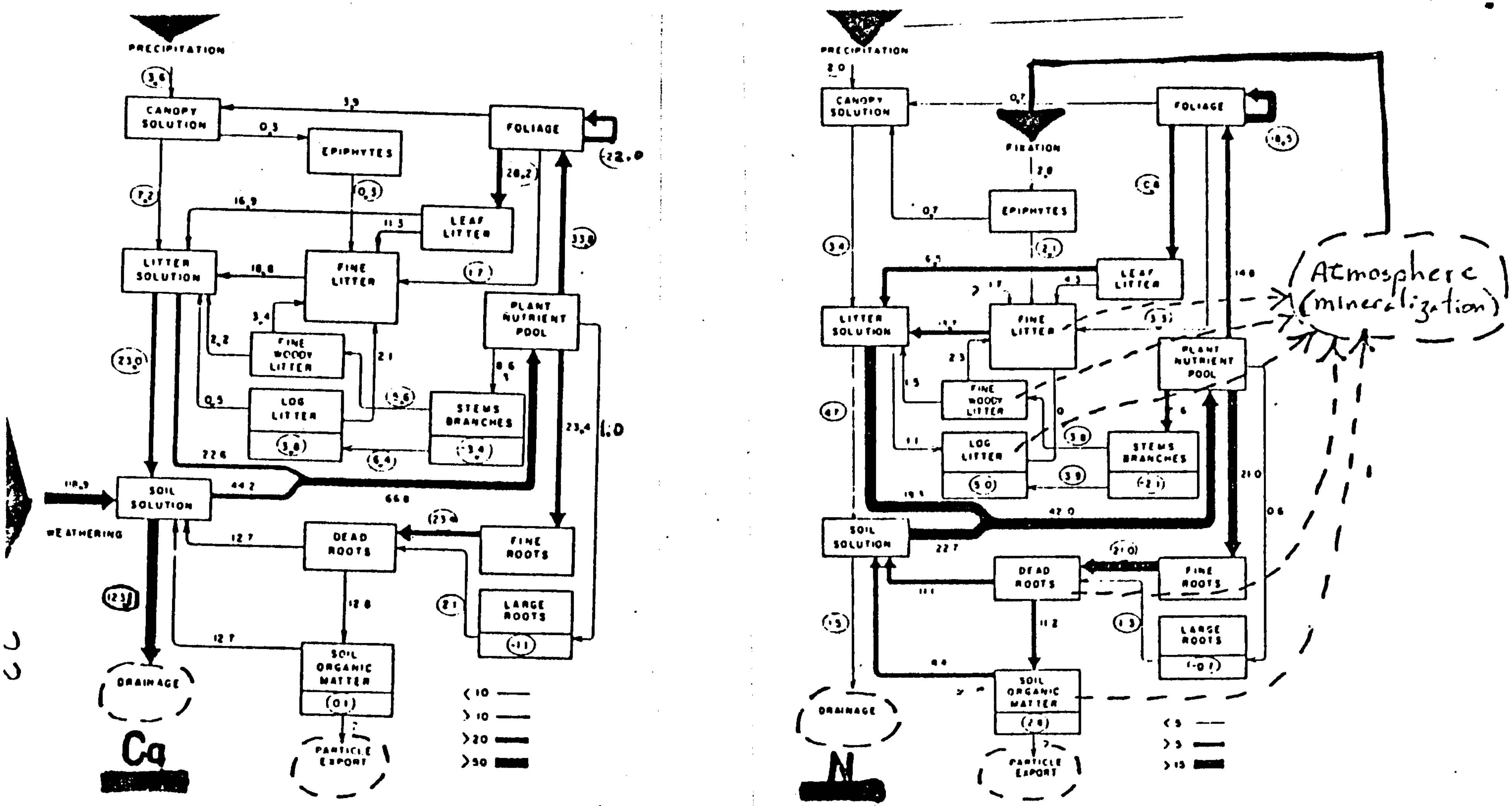


FIG. 3. Element budgets for WS-10. Values are kilograms per hectare per year. Circled values were calculated independently; others were calculated by difference from other fluxes (see text). Values in small rectangles are annual accumulation. Standing amounts are not shown. Thickness of arrow is proportional to flux.

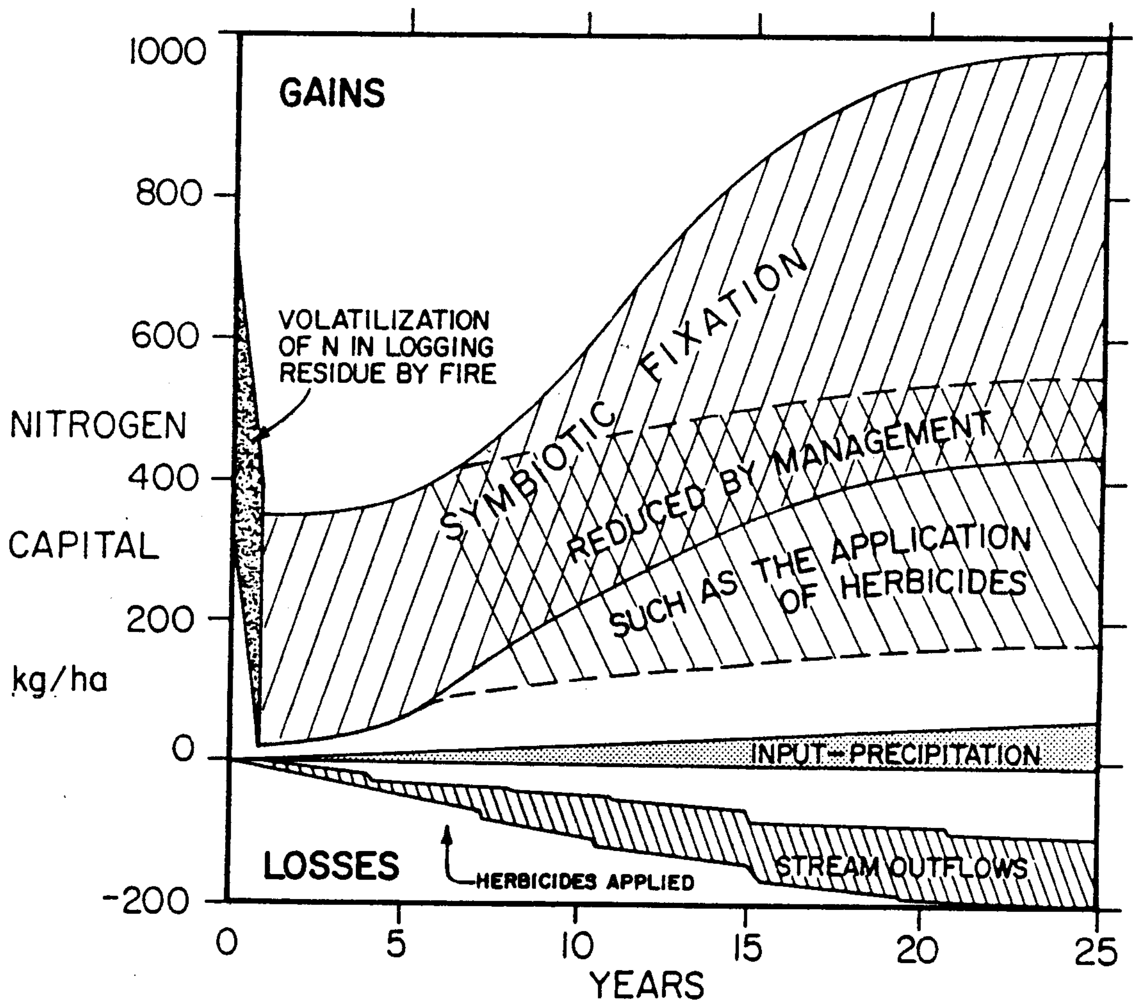


Figure 20. Idealized nitrogen balance for Douglas-fir clearcuts showing N volatilization losses caused by burning of logging residue and replacement by symbiotic fixation of volatilized N by snowbrush ceanothus or red alder. Fixation is capable of replacing both volatilization and stream outflows caused by leaching and soil erosion. N fixation will be reduced by practices such as application of herbicides which reduce the biomass of N fixers.

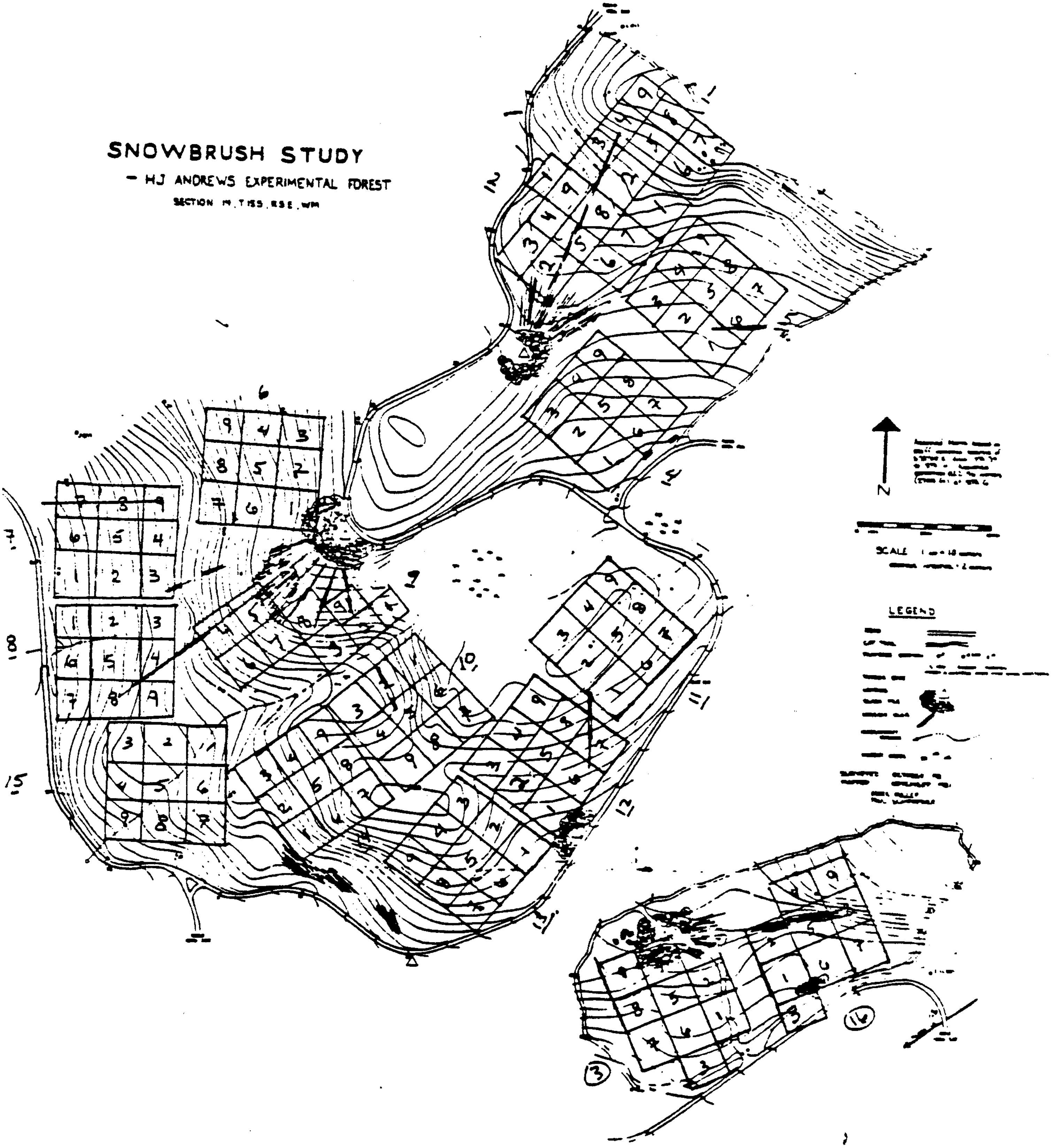
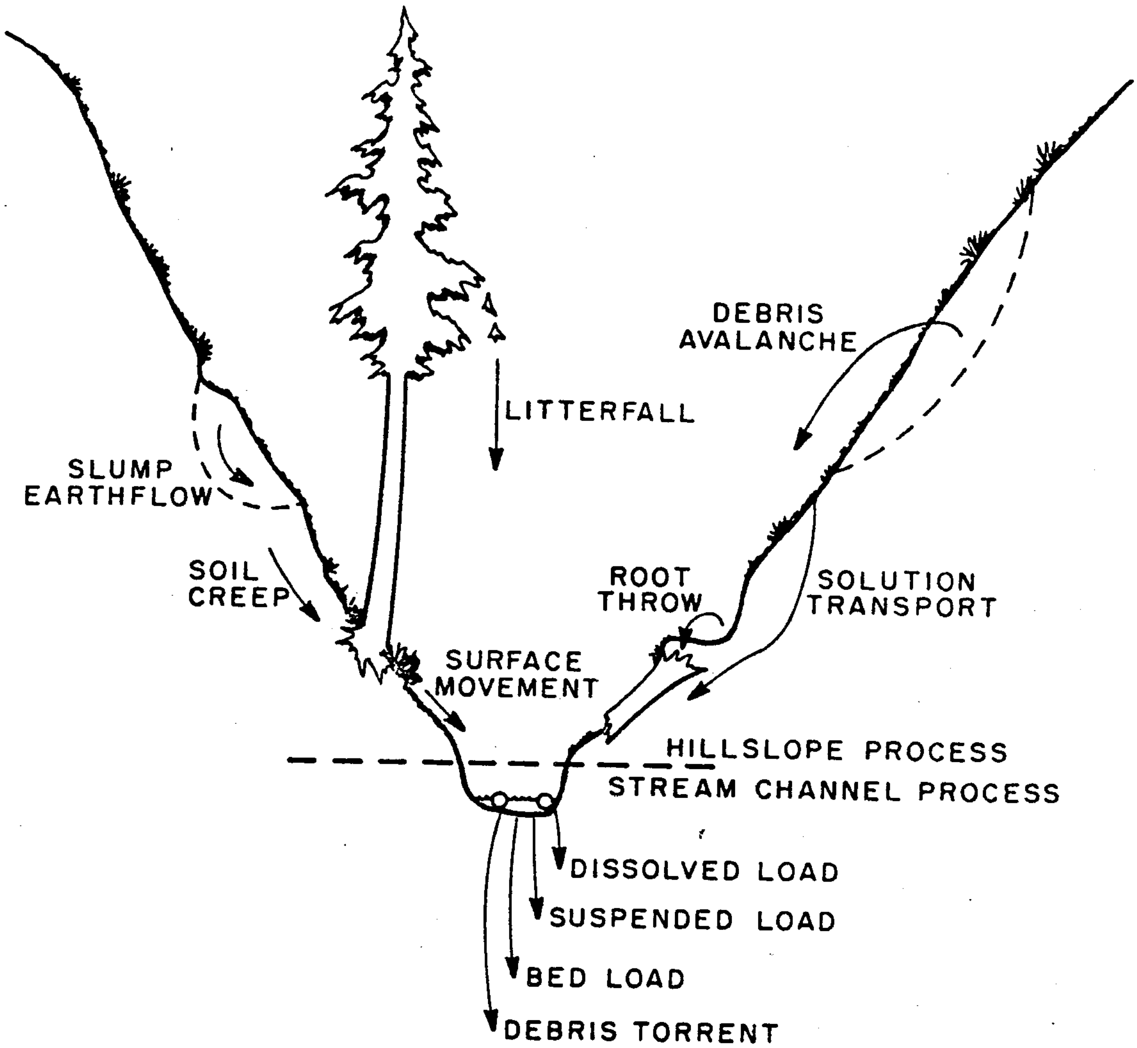
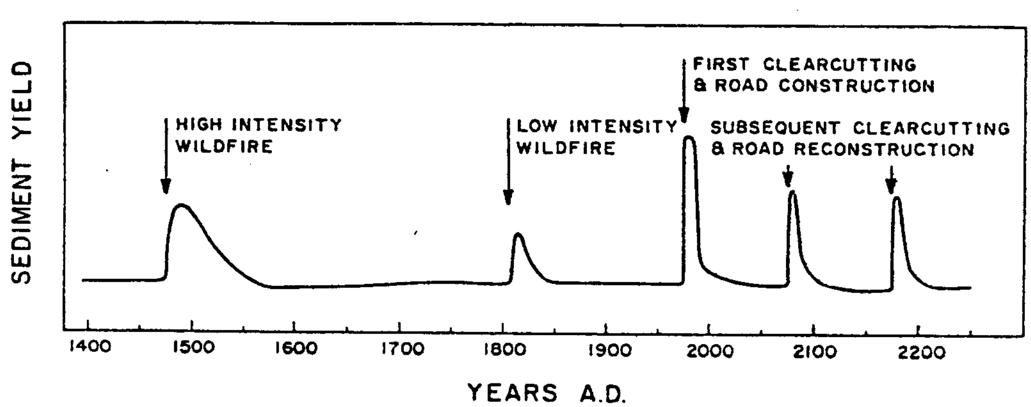


Figure 1. Arrangement of treatment plots at the LTER Snowbrush study site. Measurement plots do not actually occupy entire treatment area.


DEBRIS AVALANCHE
LITTERFALL
SLUMP EARTHFLOW
SOIL CREEP
ROOT THROW
SOLUTION TRANSPORT
SURFACE MOVEMENT
HILLSLOPE PROCESS
STREAM CHANNEL PROCESS
DISSOLVED LOAD
SUSPENDED LOAD
BED LOAD
DEBRIS TORRENT


SEDIMENT YIELD
HIGH INTENSITY WILDFIRE
LOW INTENSITY WILDFIRE
FIRST CLEARCUTTING & ROAD CONSTRUCTION
SUBSEQUENT CLEARCUTTING & ROAD RECONSTRUCTION
1400
1500
1600
1700
1800
1900
2000
2100
2200
YEARS A.D.

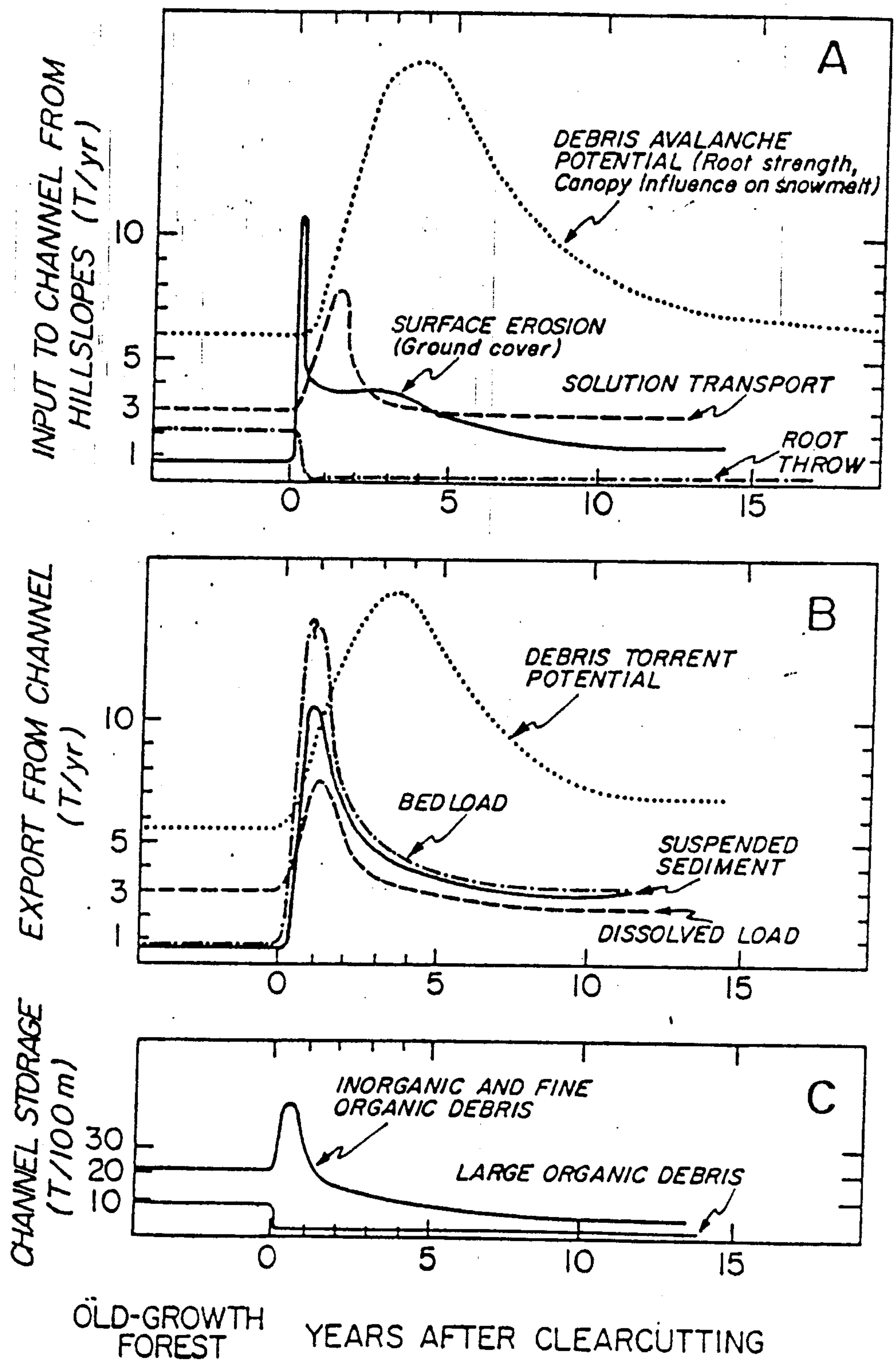
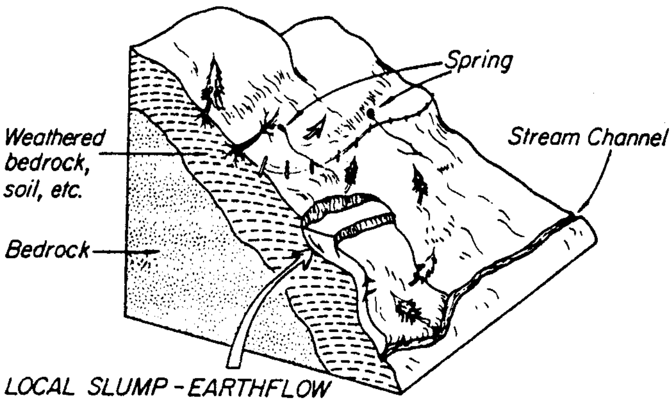


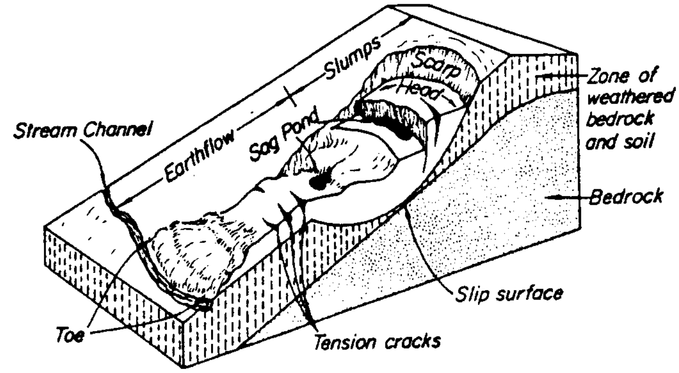
Figure 3. Hypothetical trajectories of potential rates of selected erosion processes and channel storage after clearcutting in Watershed 10. Shown in parentheses in A are vegetation factors which influence process rate.

SOIL CREEP



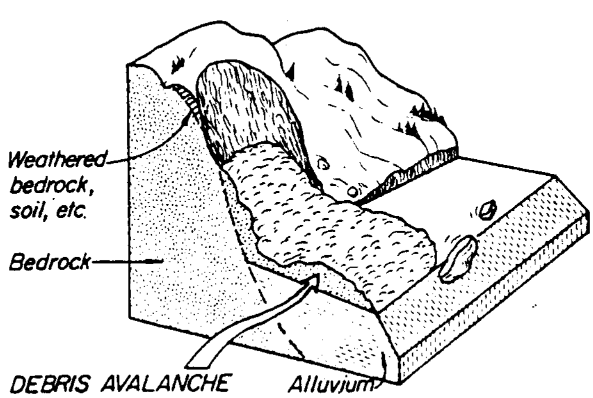
Creep is the slow downslope movement of clayey material.

SLUMP - EARTH FLOW



Slump-earthflow involves two distinct but related features; 1) shear failure of a slump block which deposits earth on the slope below, and 2) flowage of the earth downslope to stream channels.

DEBRIS AVALANCHE - DEBRIS FLOW



Debris avalanches are the rapid and shallow mass movements of coarse textured material downslope.

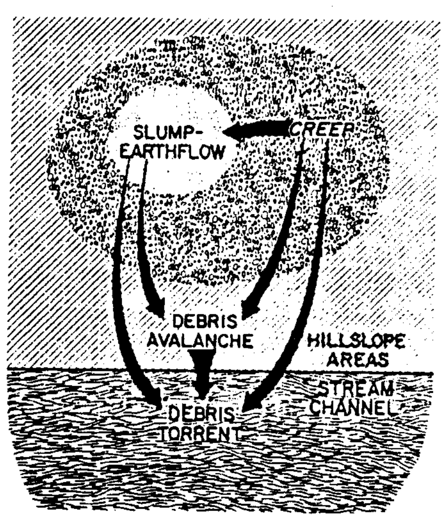


FIGURE 3 *Relationships among mass erosion processes. Arrows point from a process that sets up instability leading to failure by the process at head of the arrow. Width of arrows is a rough indication of degree of influence based on studies in the H. J. Andrews Experimental Forest.*

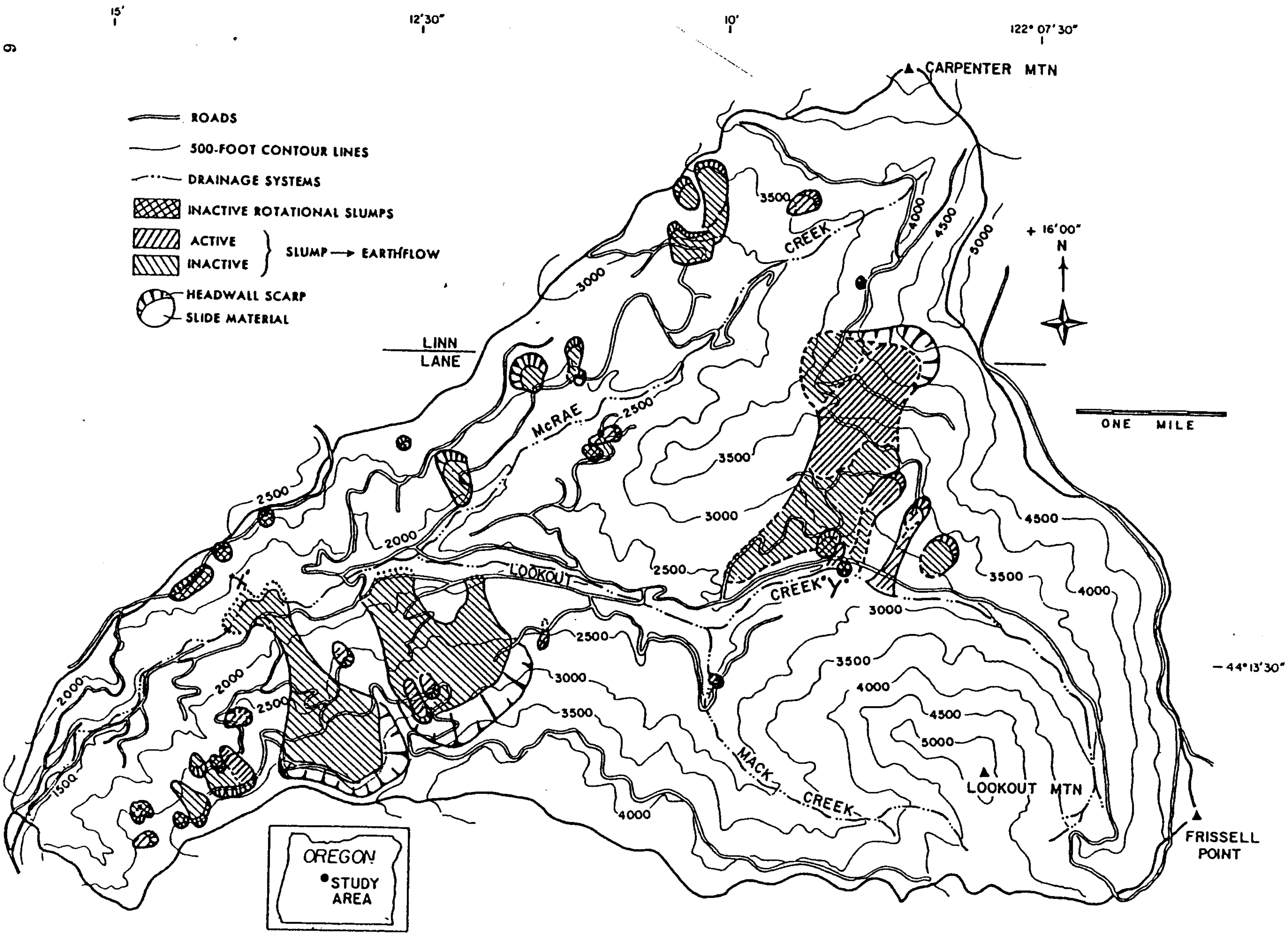


Figure 2.--Deep-seated mass movements, H. J. Andrews Experimental Forest. Location "X" shows toe of large earthflow and location "Y" marks the earthflow sketched in figure 4; both features are discussed in the text.

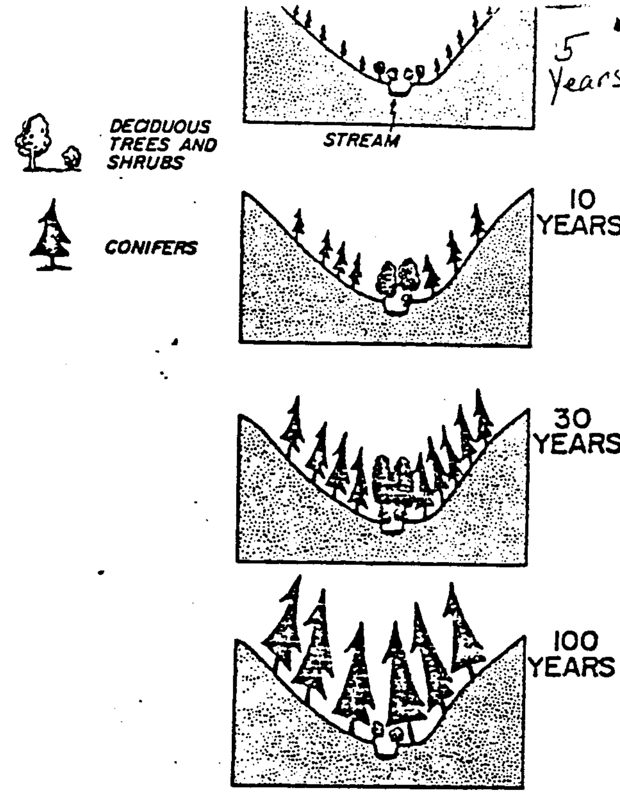
15

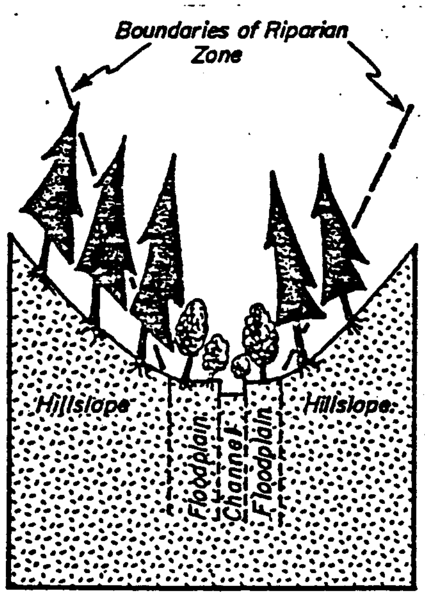
in USDA Forest Service Gen. Tech. Rep. RM-43

Influences of Riparian Vegetation on Aquatic Ecosystems with Particular Reference to Salmonid Fishes and Their Food Supply[1,2]

lliam R. Meehan, Frederick J. Swanson, and James R. Sedell[3]

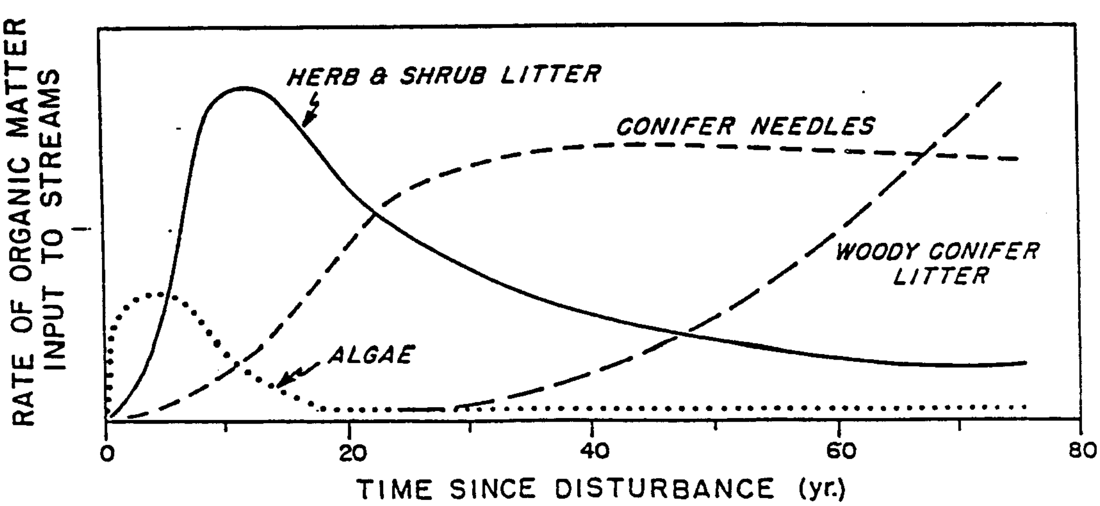
Abstract.--The riparian zone has important influences ι the total stream ecosystem including the habitat of lmonids. Shade and organic detritus from the riparian ne control the food base of the stream and large woody bris influences channel morphology. Temporal and spatial anges in the riparian zone, the indirect influences of parian vegetation on salmonids, and the effects of man's tivities are discussed.

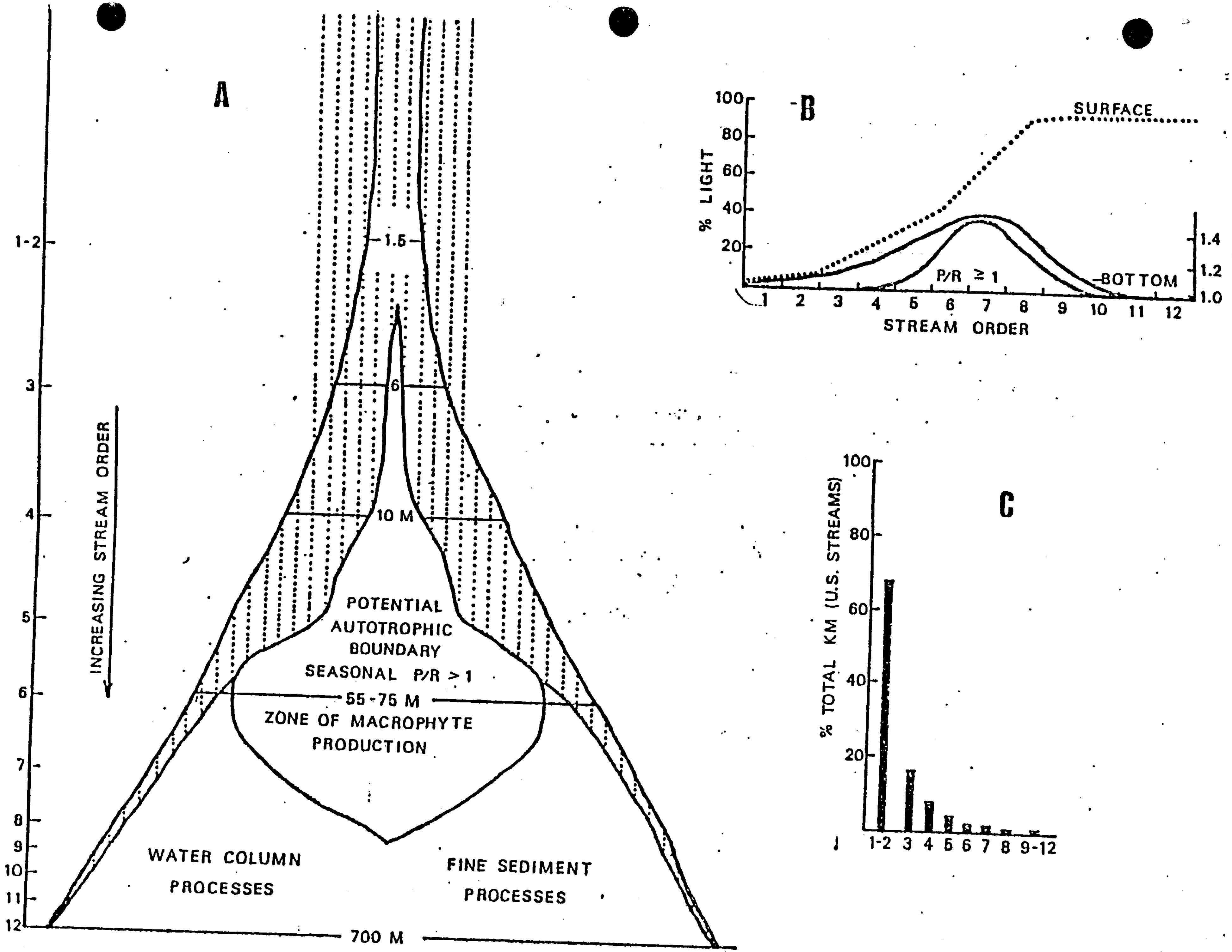


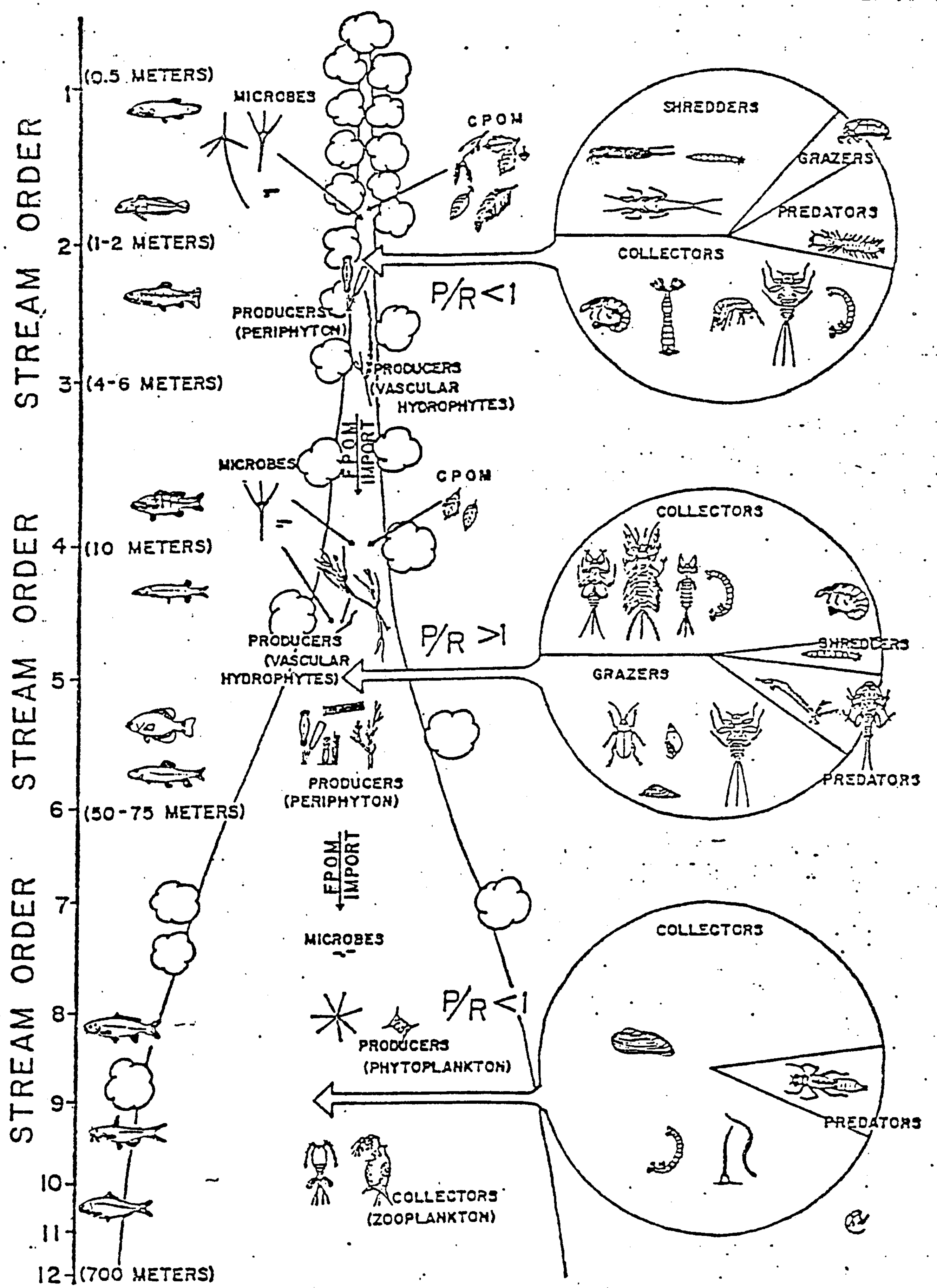


RIPARIAN VEGETATION

SITE	COMPONENT	FUNCTION
above ground-above channel	canopy & stems	1. Shade-controls temperature & in stream primary production 2. Source of large and fine plant detritus 3. Source of terrestrial insects
in channel	large debris derived from riparian veg.	1. Control routing of water and sediment 2. Shape habitat-pools, riffles, cover 3. Substrate for biological activity
streambanks	roots	1. Increase bank stability 2. Create overhanging banks-cover
floodplain	stems & low lying canopy	1. Retard movement of sediment, water and floated organic debris in flood flows




A
1-2
3
4
5
6
7
8
9
10
11
12
INCREASING STREAM ORDER
1.5
6
10 M
POTENTIAL
AUTOTROPHIC
BOUNDARY
SEASONAL P/R > 1
55-75 M
ZONE OF MACROPHYTE
PRODUCTION
WATER COLUMN
PROCESSES
FINE SEDIMENT
PROCESSES
700 M
B
% LIGHT
100
80
60
40
20
SURFACE
P/R ≥ 1
BOTTOM
1.4
1.2
1.0
1 2 3 4 5 6 7 8 9 10 11 12
STREAM ORDER
C
% TOTAL KM (U.S. STREAMS)
100
80
60
40
20
1-2 3 4 5 6 7 8 9-12


STREAM ORDER
STREAM ORDER
STREAM ORDER
1 (0.5 METERS)
2 (1-2 METERS)
3 (4-6 METERS)
4 (10 METERS)
5
6 (50-75 METERS)
7
8
9
10
11
12 (700 METERS)
MICROBES
CPOM
SHREDDERS
GRAZERS
PREDATORS
COLLECTORS
P/R<1
PRODUCERS (PERIPHYTON)
PRODUCERS (VASCULAR HYDROPHYTES)
FPOM IMPORT
MICROBES
CPOM
COLLECTORS
P/R >1
SHREDDERS
GRAZERS
PREDATORS
PRODUCERS (VASCULAR HYDROPHYTES)
PRODUCERS (PERIPHYTON)
FPOM IMPORT
MICROBES
COLLECTORS
P/R<1
PRODUCERS (PHYTOPLANKTON)
PREDATORS
COLLECTORS (ZOOPLANKTON)

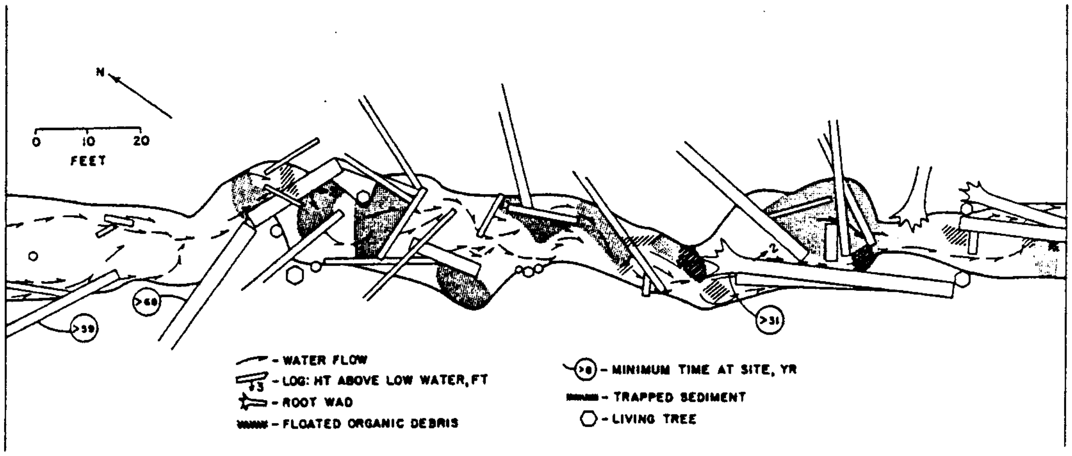


Figure 2.--Map of large organic debris and other material in a 200-ft forested section of Zog Creek.

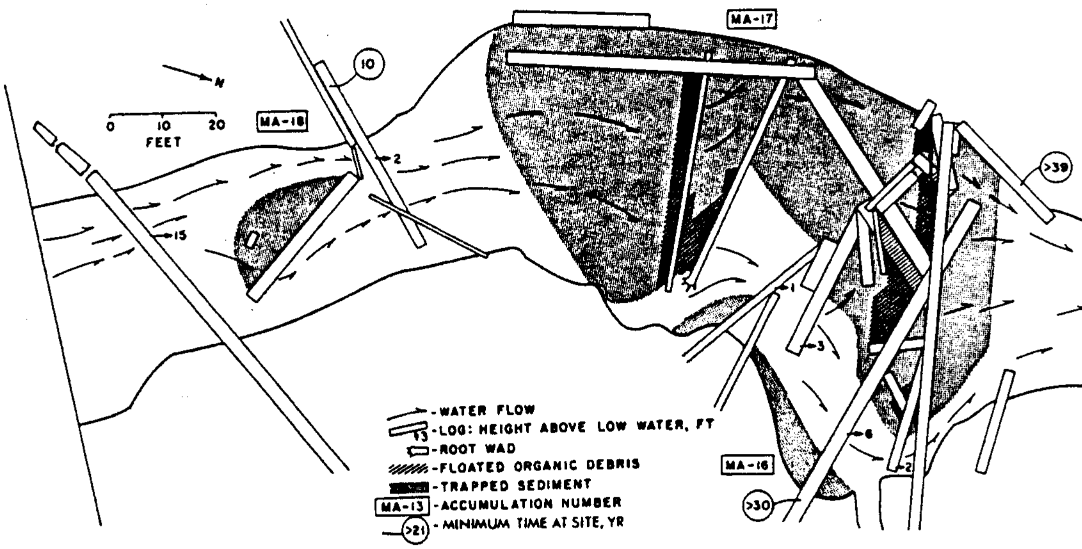


Figure 3.--Map of large organic debris and other material in a 200-ft forested section of Mack Creek

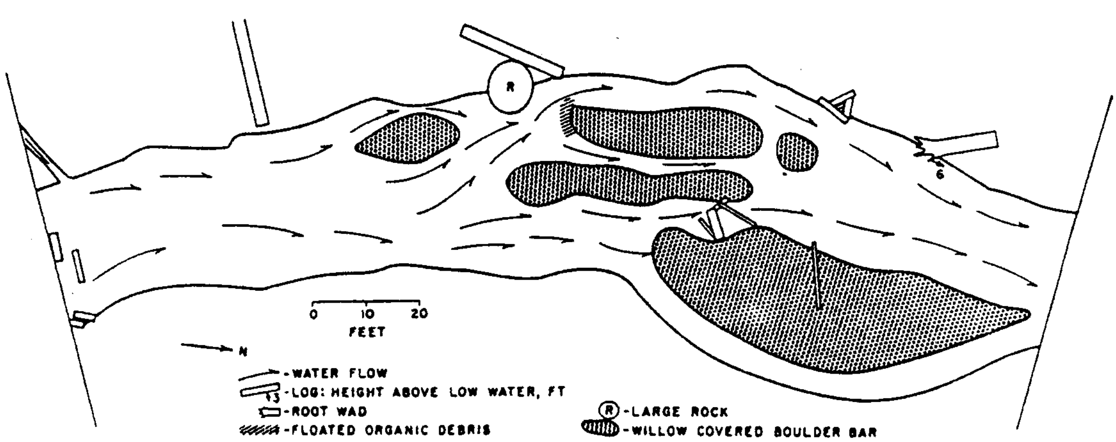


Figure 5.--Map of large organic debris and other material in a 200-ft clearcut section of Mack Creek downstream from sections shown in figure 3 and 4.