THE CLIMATES OF THE LONG-TERM ECOLOGICAL RESEARCH SITES

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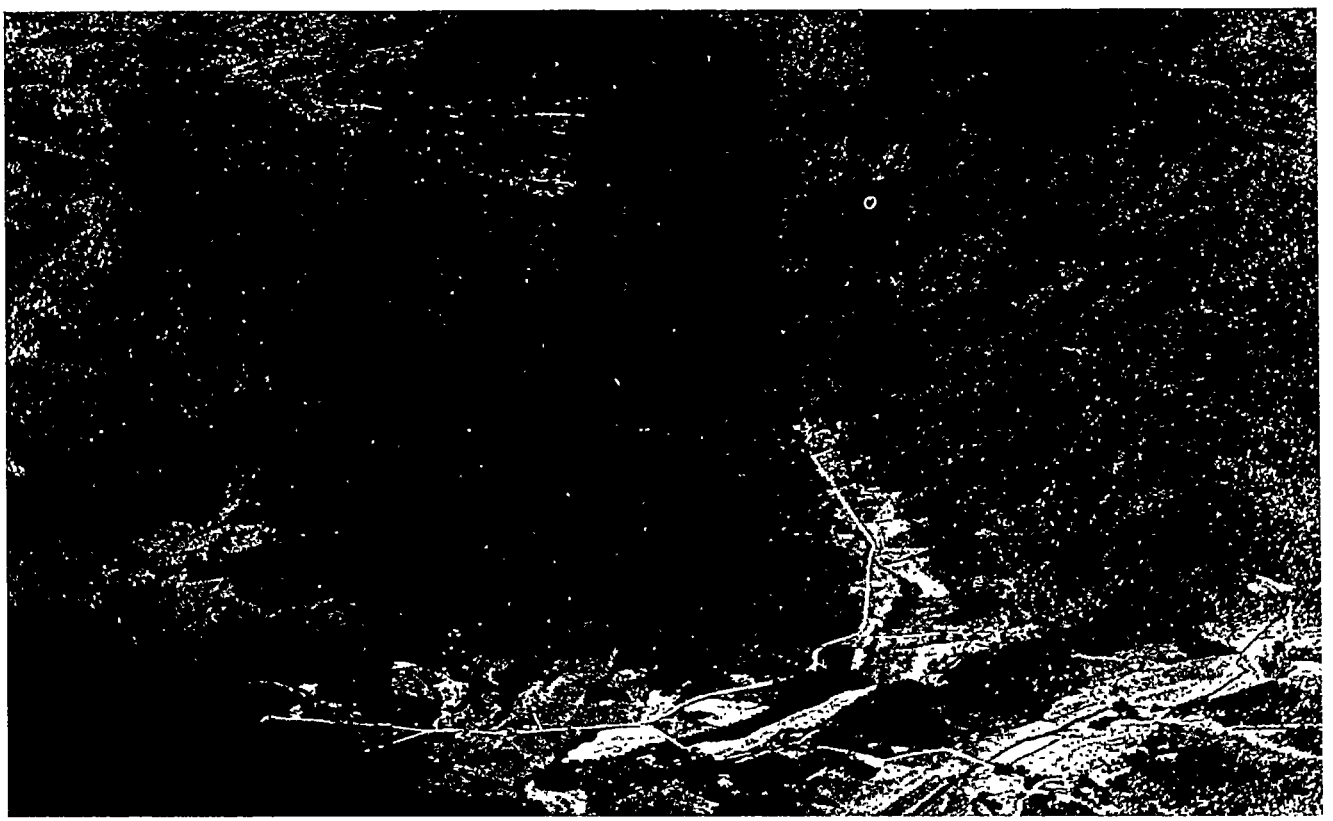

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CHAPTER 3

CEDAR CREEK NATURAL HISTORY AREA, MINNESOTA

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SITE DESCRIPTION

Cedar Creek Natural History Area is a 2185 ha Experimental Ecological Reserve on a large, glacial outwash, sand plain (Fig. 3.1). It includes a large variety of habitat types, ranging from oak savanna to prairie to deciduous hardwood forest (Moore, 1973). The soils, which are mainly derived from glacial outwash sand, include five of the ten major soil orders. The terrain of the area is slightly undulating, and includes rather dry sandy uplands and numerous streams, bogs, lakes, swamps, and marshes. Thus there are many different microclimates within the area.

Climate data (Table 3.1) for the site are taken from the National Weather Service observation station at Cambridge, which is within 15 km of the Natural History Area (Fig. 3.2).

VEGETATION

The principal biomes represented in the Cedar Creek site are hardwood forest and tall grass prairie. The main plant communities are oak savanna, oak forest, conifer bog, Great Lakes pine forest, herbaceous communties on abandoned fields, and wetland marsh and carr. Among the most common species in the tall grass prairie are big bluestem, little bluestem, Indian grass, prairie clover, goldenrod, pasque flower, and shrubs such as roses and wolfberry. In and near the marshes can be found blue-joint grass, sedges, reeds, cattails, bull rushes and wild rice. Burr and Hill's oak dominate the hardwood forest but elm, ash, sugar maple, aspen, basswood and some jack pine are present (Borchert and Gustafson, 1980).

SYNOPTIC CLIMATOLOGY

The mid-latitude continental location of Cedar Creek leads it to experience influences of both polar and tropical air masses and, especially in the cooler part of the year, the presence of the polar front, its associated jet stream, and frequent passages of mid-latitude cyclonic storms. In summer the site comes under the influence of the southerly airflow from the extreme edge of the subtropical high pressure zone in the southern part of the North Atlantic ocean. This airflow provides moisture for summer convectional storms. As a result of this overall situation, the climate is characterized by four distinct seasons and changing weather both within and between seasons.

The last spring frost occurs on the average between 2 and 11 May and the first fall frost occurs between 26 September and 5 October giving a frost free season of between 140 and 160 days. The location receives about two thirds of its annual precipitation during the five month growing season when the source of moisture is the tropical part of the Atlantic Ocean and the Gulf of Mexico. During the winter months moisture comes more frequently, but in smaller quantities from the Pacific Ocean (Borchert and Gustafson, 1980). Climate data are presented in Tables 3.1 and Figs. 3.3 and 3.4.

WATER BALANCE

The water balance at Cedar Creek shows typical features for a mid-latitude continental site (Table 3.2, Fig. 3.5). These include the minimal evapotranspiration loss during winter and the summer maximum of precipitation. The current water balance calculations suggest the possibility of a short period in the summer when actual evapotranspiration exceeds potential evapotranspiration.

CLIMATIC FACTORS AFFECTING FLORA AND FAUNA

Precipitation is most critical in the growing season from May through September, and year to year changes in rainfall values during this period may have marked effects on the primary productivity levels. This effect can be accentuated by the high variability of the soil moisture across the Cedar Creek site from the marshland to the drier, sandy soils of higher elevations. The proximity of the site to the boundary between forest and prairie makes growing season precipitation even more critical. Longer term climatic changes together with the effects of fires, windstorms, insect infestations, plant diseases, and successional events in wetlands have meant that the details of vegetational mosaics have been continually shifting (Borchert and Gustafson, 1980). There are about 110 days per year with more than 2.5 mm of snow on the ground.

Literature Cited

Borchert, J.R. and Gustafson, N.C., 1980. *Atlas of Minnesota: Resources and Settlement.* Center for Urban and Regional Affairs, University of Minnesota, Minneapolis, and the Minnesota State Planning Agency. 3rd Ed. 308 pp.

Moore, J.W. 1973 *A Catalog of the Flora of Cedar Creek Natural History Area, Anoka and Isanti Counties, Minnesota. Bell Museum of Natural History, University of Minnesota, Occasional Paper,* 12:1-28.

Fig 3.1. Old field succession on the oak-savanna outwash sand plain.

Fig.3.2. The observing site at the Cedar Creek Natural History Area laboratory.

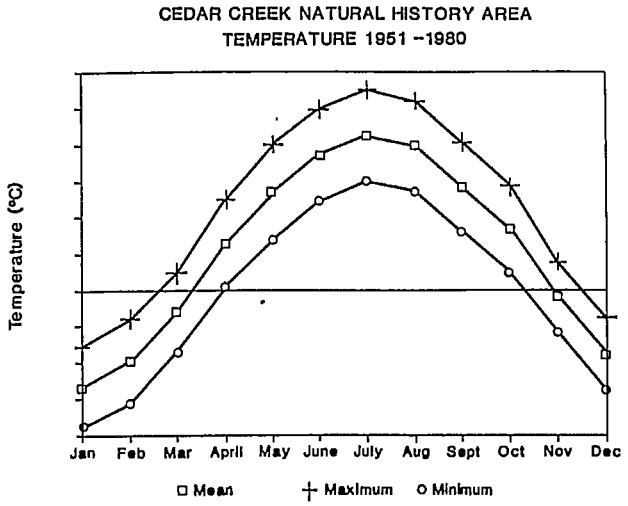

Fig. 3.3. Average annual temperature values at Cedar Creek Natural History Area.

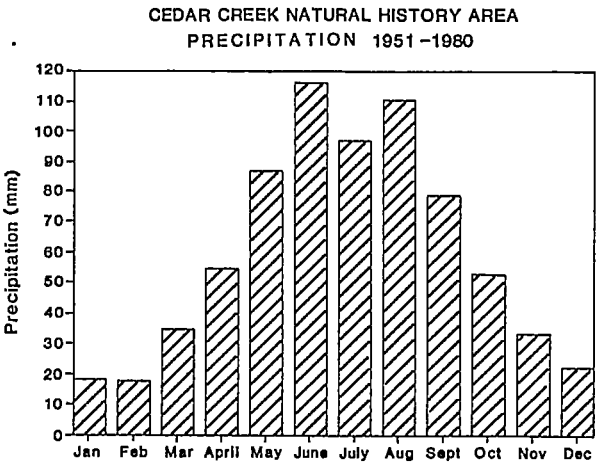

Fig. 3.4. Average annual precipitation totals at Cedar Creek Natural History Area.

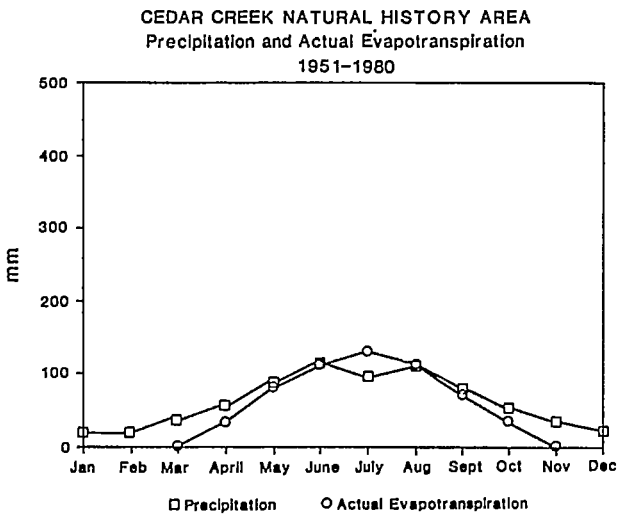

Fig. 3.5. Monthly water budget values at Cedar Creek Natural History Area.

Table 3.1

SUMMARY STATISTICS CEDAR CREEK NATURAL HISTORY AREA

TEMPERATURE
Deg. C.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon Mean	-13.45	-9.81	-3.00	6.39	13.43	18.54	21.19	19.78	14.19	8.42	-0.87	-8.84
An Mean	5.50	St Dev	0.66									
Mean Mx T	-7.93	-3.95	2.47	12.42	19.94	24 82	27.50	26.06	20.27	14.31	3.90	-3.92
Mean Mi T	-18.97	-15.67	-8.48	0.35	6.92	12.26	14.87	13.51	8.10	2.53	-5.64	-13.75

Mean Temp Warmest Month	21.19	St Dev	1.40
Mean Temp Coldest Month	-13.45	St Dev	2.81
Annual Range of Monthly Mean Temps		34.64	
Num months with mean temp >0		7	
Num months with mean temp >15		3	
Highest monthly mean		24.20	
Lowest monthly mean		-19.50	

PRECIPITATION
mm

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon mean	18.2	17.6	34.6	55.1	87.1	116.2	97.2	110.7	79.1	53.6	33.9	22.6

Mean annual total	726.0	
Wettest year in period	1037	
Driest year in period	327	

Monthly totals during wettest year in period — Year 1975

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
76	11	43	135	60	235	63	179	84	27	116	8

Monthly totals during driest year in period — Year 1976

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
24	28	53	24	59	59	25	21	9	6	9	10

Total precip in months with temp >0	599

Table 3.2.

WATER BALANCE DATA FOR CEDAR CREEK NATURAL HISTORY AREA

Water budget for Latitude 45.4 N, Longitude 93.2 W
Field capacity 100.0 mm Resistance curve C

MON	TEMP	UPE	APE	PREC	DIFF	ST	DST	AE	DEF	SURP	SMT	SST
Jan	-13.5	0	0	18	0	100	0	0	0	0	0	41
Feb	-9.8	0	0	18	0	100	0	0	0	0	0	58
Mar	-3.0	0	0	35	0	100	0	0	0	0	0	93
Apr	6.4	29	33	55	23	100	0	33	0	116	93	0
May	13.4	64	82	87	5	100	0	82	0	5	0	0
Jun	18.4	91	118	116	-2	98	-2	118	0	0	0	0
Jul	21.2	106	139	97	-42	64	-34	131	8	0	0	0
Aug	19.8	98	119	111	-8	59	-5	116	3	0	0	0
Sep	14.2	68	71	79	8	68	8	71	0	0	0	0
Oct	8.4	39	36	54	18	85	18	36	0	0	0	0
Nov	-0.9	0	0	34	34	100	15	0	0	19	0	0
Dec	-8.8	0	0	23	0	100	0	0	0	0	0	23
	Yearly Totals:		597	726				586	11	140		

Explanation for Water Balance Columns. (All units are millimeters depth of water unless otherwise specified.)

MON	Month of the year
TEMP	Mean monthly air temperature in deg. C.
UPE	Unadjusted potential evapotranspiration
APE	Adjusted potential evapotranspiration
PREC	Precipitation
DIFF	PREC minus APE
ST	Soil moisture storage
DST	Change in storage from preceeding month
AE	Actual evapotranspiration
DEF	Soil moisture deficit
SURP	Soil moisture surplus
SMT	Snowmelt
SST	Water equivalent held in snowpack.