

THE ECOLOGY OF TURKEY RUN STATE PARK.

PART I—THE FLOOD PLAIN.

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Sugar Creek, one of the large tributaries of the Wabash River, flows in an east to west direction through Turkey Run State Park. It rises well to the east of Parke County and carries an abundance of water. "Sugar Creek seems to be flowing through a post-glacial channel as far as the mouth of Brush Creek. Its immediate valley is usually narrow and often hemmed in by cliffs of Mansfield sandstone. Its principal tributaries from the north are Brush Creek and Sugar Mill Creek. The latter valley is somewhat of the type of Sugar Creek; the former is thought to have been possibly the pre-glacial channel of Sugar Creek, and its banks show little but glacial deposits of sand, clay, and gravel. From the south side the principal tributary is Roaring Creek, which in the lower part of its course, winds through a narrow, rocky ravine. At Turkey Run many of the small tributaries are, over the lower part of their courses, inclosed in rocky gorges with perpendicular or overhanging walls."¹

Sugar Creek and its tributaries, flowing through glacial deposits, carry small boulders, pebbles, and gravel, besides silt and clay. The coarser materials are the tools the streams use in cutting their beds wider and deeper in the massive sandstone. Only a part of the sand and silt is deposited on the lowlands, greater quantities being carried long distances before being deposited. On reaching the Wabash, Sugar Creek carries a great load of sand.

The current of Sugar Creek is swift; eddies and rapids are found in many places. The level of the water varies; the difference between lowest and highest in one year amounting to as much as 20 feet. Seasonal variations have been quite marked during the four year period covered by this study. High water level and the accompanying flooding of the lowlands characterized the springs of 1925, 1926, and 1927; the lowest recorded level for the period between April 27 and May 6 occurred in 1928. At normal rise the gentle slopes along the south bank of Sugar Creek are flooded for a distance of 75 feet or more back from the mean water shore line.

The banks of Sugar Creek are of the depositing-and-eroding type. On both banks are evidences of erosion alternating with deposition. There are also good illustrations of the work that is due to the oscillating movements of the stream. Opposite a gravel bar or levee on one bank is a strip where erosion is going on. East of the Narrows near

¹Harold Orahoad, Soil Survey of Parke County. 38th Ann. Rept. Ind. Dept. of Geol. and Nat. Resources. 1903.

"Proc. Ind. Acad. Sci., vol. 38, 1928 (1929)."

the mouth of Brush Creek, the rocky cliffs disappear and low fertile fields border the creek. Near the mouth of Brush Creek, a xerophytic upland forest of red cedar, and white, black and chestnut oaks adjoins the remnant of a flood plain whose giant sycamores and young elms are being rapidly undermined by the swift current and being toppled into the stream. A small number of *Populus deltoides*¹ are found on both banks of Brush Creek at its mouth. About 100 feet southwest of the mouth of Brush Creek the rock outcrops begin on the right bank of Sugar Creek and continue for some distance beyond the Narrows. On the left bank the rock cliffs start near the covered bridge. Thus the creek is suddenly hemmed in at the Narrows between precipitous and resistant sandstone cliffs. These cliffs continue along both banks but a short distance. So the building up of the flood plain continues.

Three types of flood plains are found in Turkey Run State Park: (1) the gravel bar, the most common type, (2) the sand bar, and (3) the alluvial plain. The climax is the same in all three.

1. **The Gravel Bar.** The gravel bar is made up mostly of gravel, pebbles, and small cobblestones. The cobblestones are rolled or pushed along the stream bed and are deposited when an obstruction such as a fallen tree or a rise in the bed of the stream is met. Anything that serves to check the current causes deposition. The stones and gravel being the heaviest material carried, are dropped farther from shore than the sand or silt. Thus off-shore bars or islands are formed. These form an obstacle in the creek and further deposition results. The islands or bars may become joined to the mainland or they may, by a deflection of the current, be eroded on the side nearest the shore and not make contact with the mainland. In the latter case they may continue as islands or may in time be completely eroded away. In the former case there will be developed on them a vegetation which will begin with the amphibians and xerophytic summer annuals and proceed from the willow stage to the flood plain climax forest.

2. **The Sand Bar.** The sand bar is less porous than the gravel bar, is a less xerophytic habitat, and begins nearer to the mainland. Summer annuals and perennials are succeeded in a relatively short time by the willows and sycamores.

3. **The Alluvial Plain.** The alluvial plain is built up at the water's edge. It is formed of deposits of fine silt. In time of flood, the current in the main channel is swift; but as soon as the water spreads beyond its channel, its velocity is checked because its depth becomes less, and it promptly abandons much of its load. During the period of overflow, the edges of the channel current are checked by the slower moving flood-plain water, and this causes further deposition on the banks of the channel. Repeated deposition in this position gives rise to levees. Natural levees have been built up on the north bank of Sugar Creek, southwest of the Ice Box. The alluvial plain is usually moist through the greater part of the spring and summer. A rich hydro-mesophytic and mesophytic vegetation develops. After the spring freshlets have

¹ All names are from Gray's Manual, 7th ed.

gone an algal vegetation is found on these flats. In late summer *Polygonum pennsylvanicum*, *P. lapathifolium*, *Rumex verticillatus*, and *Asclepias incarnata* are abundant, while *Bidens cernua*, *Menthes virginianum*, and *Cicuta maculata* occur in scattering patches.

The flood plains of Turkey Run offer a very diagrammatic study. The zonation is not always well marked nor are the stages always well represented. The following stages in the development of the flood plain are found: (1) Aquatics, (2) Dianthera stage, (3) Willows, (4) Sycamores, (2, 3, 4, constitute the lower flood plain), (5) Elm and Ash (middle flood plain), and (6) Climax Flood Plain Forest (upper flood plain).

1. Aquatics. In the shallow protected places and on the mud flats in late summer are found the algae. This stage is not well represented. Of the emergent aquatics, only one patch of *Sagittaria latifolia* was found in August, 1927 near Goose Rock.

2. Dianthera stage. This zone is submerged during most of the spring and partially or entirely emergent in late summer. *Dianthera americana* (Water willow) is the dominating species in this zone on the gravel and sand bars. *Rumex verticillatus*, *Polygonum pennsylvanicum* and *P. lapathifolium* dominate the alluvial plain. These plants slow up the current and cause deposition of part or all the water's load. They also make difficult the removal of the materials already deposited. The building up of the bar or levee continues and the layer of finer materials becomes deeper until finally the conditions for the next stage to become started prevail. *Ambrosia trifida* and *Xanthium canadense* are the two most common herbs of the late summer.

3. Willow stage. The first tree stage is characterized by *Salix nigra* (black willow), *Acer saccharinum* (white maple) and *Salix longifolia* (sandbar willow). *Acer negundo* is only sparsely represented in this zone along Sugar Creek but it is the dominating species of this zone along Sugar Mill Creek in the new tract to the northwest. Among the herbs these are found: *Radicula palustris* (marsh cress), *Rumex crispus* (yellow dock), *Ranunculus septentrionalis* (early buttercup), *R. abortivus* (aborted buttercup), *Verbena urticaefolia* (white vervain), *Ambrosia trifida* (great ragweed).

4. Sycamore stage. The sycamore (*Platanus occidentalis*) comes in after the willows. It is the tree that gives the characteristic aspect to the scenery along the streams in this region. It is able to endure considerable flooding and partial burying by sand or silt. Its power of sending out adventitious roots is remarkable. The sycamores are among the largest trees found in the park, the largest sycamore measuring over 22 feet in circumference. The many large ones on the south bank of Sugar Creek are the remnants of this stage of the flood plain. The herbaceous vegetation of the preceding stage carry over into this stage. The new species are *Solidago serotina* and *Plantago rugelii*.

5. Elm and Ash stage. As the flood plain builds up and becomes dry enough to permit the germination and development of a mesophytic vegetation, the willows and sycamores are replaced by elms and ash. *Ulmus americana*, *U. racemosa*, and *Fraxinus americana* are the domi-

nating trees. *Ulmus fulva* and *Sambucus canadensis* are common. The herbaceous plants include: *Steironema ciliatum* (fringed loosestrife), *Ranunculus septentrionalis* (early buttercup), *R. abortivus* (aborted buttercup), *Rudbeckia laciniata* (wild goldenglow), *Lysimachia Nummularia* (moneywort), *Bidens vulgata* (begger-ticks), *Helianthus tuberosa* (Jerusalem artichoke), *Rumex crispus* (yellow dock), *Oenothera biennis* (evening primrose), *oxalis corniculata* (lady's sorrel).

6. Climax Flood Plain Forest. A rich mesophytic flood plain forest succeeds the elms and ash. There is no flooding of this forest except at periods of high water level, the period of flooding being relatively short. Walnut and butternut (*Juglans nigra* and *J. cinerea*), Ohio buckeye (*Aesculus glabra*), water or blue beech (*Carpinus caroliniana*), black sugar maple (*Acer saccharum* var. *nigrum*), hackberry (*Celtis occidentalis*), tulip (*Liriodendron tulipifera*), redbud (*Cercis canadensis*), Kentucky coffee tree (*Gymnocladus canadensis*), mulberry (*Morus rubra*), pawpaw (*Asimina triloba*), *Fraxinus americana*, basswood (*Tilia americana*), slippery and cork elms (*Ulmus fulva* and *U. racemosa*) are the tree members of this association. The members whose chief range is mainly southward are: the coffee tree, pawpaw, hackberry, redbud, mulberry, and tulip or yellow poplar.

Lianas are conspicuous in this rich flood plain forest. Virginia creeper (*Psedera quinquefolia*), greenbrier (*Smilax hispida*), frost and river-bank grape (*Vitis cordifolia* and *V. vulpina*), moonseed (*Menispermum canadense*), and poison ivy (*Rhus Toxicodendron*) climb over the trees and hang in festoons from the branches.

The undergrowth is particularly beautiful and luxuriant due to the fertility of the soil and conditions of shade and moisture. Among the shrubs are: *Benzoin aestivale* (spicebush), *Evonymus atropurpureus* (Wahoo or burning bush), *Cornus alternifolia* (alternate leaved dogwood), *Cornus Amomum* (silky dogwood), *Dirca palustris* (leatherwood), *Staphylea trifolia* (American bladdernut), *Viburnum Lantago* (nanny berry), *V. prunifolium* (black haw), *Xanthoxylum americanum* (prickly ash), *Cartaegus punctata* (punctate haw), *Ribes Cynosbati* (prickly gooseberry), *Clematis virginiana* (virgin's-bower).

The herbaceous vegetation is dominantly vernal, the shade being too dense for a typically aestival flora. The list of herbs includes many that are also found in the climax forest of the region. The following spring herbs are prominent in this association: ¹*Mertensia virginica* (Virginia cowslip or bluebells), **Claytonia virginica* (spring beauty), **Erythronium americanum* (yellow adder's tongue), **E. algidum* (white adder's tongue), **Phlox divaricata* (blue phlox), **Trillium recurvatum* (wake-robin), **Polemonium reptans* (Jacob's ladder), **Hydrophyllum appendiculatum* (water leaf), **Viola cucullata* (blue violet), **Arisaema triphyllum* (Jack-in-the-pulpit), *A. Dracontium* (green dragon), *Isopyrum biternatum* (false rue anemone), *Caltha palustris* (marsh marigold), *Dicentra cucullaria* (Dutchman's breeches), *D. canadensis* (squirrel corn), *Polygonatum biflorum* (small Solomon's seal), *P. commutatum* (great Solomon's seal), **Cardamine Douglasii* (spring cress), *C. bulbosa*

¹ Indicates dominant species.

(spring cress), *Hydrophyllum virginianum* (waterleaf), *H. macrophyllum* (waterleaf), *Osmorhiza Claytoni* (sweet cicely), *O. longistylis* (sweet cicely), *Silene virginica* (fire pink), *S. stellata* (starry campion), *Viola pedata* (blue bird's foot violet), *V. sooria* (blue violet), *V. striata* (pale blue violet), *Asarum canadense* (wild ginger), *Scutellaria lateriflora* (skullcap), *Allium tricoccum* (wild leek), *A. canadense* (wild onion), *Sanguinaria canadensis* (bloodroot), *Oxalis corniculata* (yellow wood sorrel).

Other characteristic herbs are: **Urtica gracilis* (nettle), *Pilea pumila* (clearweed), *Laportea canadensis* (wood nettle), *Elymus striatus* (slender wild rye), *Sisyrinchium albidum* (blue-eyed grass), *Smilacina stellata* (false Solomon's seal), *Acalyphy virginica* (mercury weed), *Achillea millefolium* (yarrow), *Actimeris alternifolia* (yellow iron weed), *Agastache nepetoides* (giant hyssop), *Agrimonia gryposepala* (agrimony), *Boehemeria cylindrica* (false nettle), *Cacalia atriplicifolia* (Indian plantain), *Camasia esculenta* (wild hyacinth), *Camoanula americana* (tall bellflower), *Carex grisea* (gray sedge), *Cryptotaenia canadensis* (honestwort), *Daucus carota* (wild carrot), *Erigeron annuus* (white top), *Eupatorium purpureum* (Joe Pye weed), *Evonymus obovatus* (trailing strawberry), *Galium Aparine*, *Geranium maculatum* (wild geranium), *Geum canadense* (white avens), **Lobelia syphilitica* (great lobelia), *Impatiens pallida* (pale jewel weed), *I. biflora* (spotted Jewel weed), *Lysimachi Nummularia* (moneywort), *Mitchella repens* (partridge berry), *Phyostegia virginiana* (false dragon head), *Polygonum virginianum* (Virginia knotweed), *Sisyrinchium albidum* (blue-eyed grass), *Verbena urticaefolia* (white vervain).

A luxurious and extensive patch of *Monarda fistulosa* was found not far from the Swinging Bridge on the mature flood plain. It is more typical of dry soils.

In many places along both banks of Sugar Creek are evidences of retrogression in connection with the flood plain climax forest. The creek after building up for a considerable time begins to destroy what it has built. This may begin at any stage in the flood plain development; more frequently it destroys the climax forest. On the left bank west of Goose Rock the huge sycamores are being undermined by the stream and gradually, after a severe struggle, they are toppled into the water. Here they form an obstruction in the path of the current and in some instances have been the means of saving some of the other trees from a similar fate by causing deposition to be re-initiated.

On the north bank the climax forest is being rapidly destroyed in a few places.

SUMMARY.

1. Sugar Creek seems to be flowing through a post-glacial channel. It carries much glacial drift consisting of small boulders and pebbles. These are deposited, forming gravel bars.

2. Only a small portion of the load of sand is deposited on the banks.

3. The banks of Sugar Creek are of the eroding-and-depositing type.

4. Three types of flood plain are developed; the climax is the same in all three.

5. Six stages or associations are shown, aquatic, dianthera, willow, sycamore, elm and ash, and climax flood plain forest.

6. The majority of the trees of the flood plain climax are southern as to range.

7. The climax flood plain forest is in many instances a temporary climax due to retrogression caused by a change from depositional to erosional phase.

This study was begun in the spring of 1925 when I visited Turkey Run State Park for the first time with a class conducted by Dr. Henry C. Cowles of the University of Chicago. Since then I spent part of each spring and summer up to and including 1928. On a special week-end trip in November, 1925, a study of the mosses was begun under Dr. Cowles' direction.

The results of the study are divided as follows: I. The Flood Plain. II. The Canyons. III. The Upland Forests. Parts II and III will appear in later issues of the Proceedings of the Indiana Academy. A list of the mosses and liverworts is to be published soon in the Bryologist.

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