

CONDITIONS  
FOR  
THE FLOWERING OF « *UTRICULARIA RESUPINATA* » <sup>(1)</sup>

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RESUMEN

**Condiciones para la floración de « *Utricularia resupinata* ».** — *Utricularia resupinata*, planta de las costas arenosas del norte de Michigan, requiere para florecer, una combinación de dos factores: altas temperaturas en Julio (verano) y un nivel bajo de agua. En ausencia del uno o del otro de estos factores, no tiene lugar la floración.

INTRODUCTION

For many years the reaction of various factors upon plants has been studied. In most studies conditions have been as nearly alike as possible except for the variation of the single factor under consideration, e. g., heat, water relations, soil conditions or constitutions, and light, mentioning but a few.

When it appeared that the flowering of *Utricularia resupinata* B. D. Greene was dependent upon interaction of two factors in the Douglas Lake, Michigan, region, a special study was commenced and maintained for several years <sup>(2)</sup>.

<sup>(1)</sup> Contribution N<sup>o</sup> 397, Department of Botany and Plant Pathology, Kansas State College of Agriculture and Applied Science, Manhattan, Kansas, U. S. A.

<sup>(2)</sup> A preliminary note calling attention to this observation was published in *Ecology* 10 : 353. 1929.

## LOCATION

Douglas Lake is located in the northern tip of the lower peninsula of Michigan in the United States of North America (about Long.  $84^{\circ}45'$  W. and about Lat.  $45^{\circ}35'$  N.). It is one of the lakes left after the retreat of glaciers. The part that interests us most is the habitat of *Utricularia resupinata*. The plants grow on sandy, marly shores emerging just above the water in protected coves. In three such places *U. resupinata* has been studied; in Marl Bay and Deer Bay of Douglas Lake and at the boat landing on the east side of Little Lake Sixteen, another lake of glacial origin.

## THE PLANT

*Utricularia resupinata* itself is a rather small plant with a white, almost mycelium-like root system in thuroly saturated marls. Late in July or early in August a short stem is sent up into the air 5-7 cm bearing 1-2 small 3-parted leaves and a single, small, purplish lentibulariaceous flower at the summit. Plants of *U. resupinata* are so numerous that they make a purple layer near the ground.

Flowering here does not occur every year as many observations testify, but when in 1923, upon comparing certain meteorological data with occurrences of flowering, it was noticed that flowering had taken place only in years of high July temperatures and low lake levels which exposed the habitat of *U. resupinata*, further investigation into this apparent relationship was undertaken. The following questions suggest themselves immediately. Will this *Utricularia* flower every year the July temperature is high above normal, above  $21.1^{\circ}$  C. ( $70^{\circ}$  F.), irrespective of water levels, or will it flower every time the water level is low, irrespective of the temperature of July?

Continued observation disclosed that each time the combined factors (high July average temperature and low water level) obtained, flowers were found, but in the absence of the ap-

pearance of both factors, no flowers were to be found. Extremes of one without the concomitant other extreme were not attended by flowering. During the exceptionally low water of 1926 during a season of subnormal temperatures, no flowering took place. The high waters of Douglas Lake during 1935, 1936 and 1937, which were maintained by a dam, prevented flowering, altho the July temperatures were decidedly above normal. The discovery of *U. resupinata* at Little Lake Sixteen in 1936 gave further proof of the relationship, for during the hot summers in which the level of Douglas Lake was held high by a dam, at Little Lake Sixteen with low stages, *Utricularia* flowered abundantly.

TABLE I

*Water level of Douglas Lake, Michigan, and average July temperatures in relation to flowering of « Utricularia resupinata »*

Year (¹)	July average temperature °C	Douglas Lake	
		Water level	<i>U. resupinata</i>
1916.....	23.4	Very low	Flowered
1917.....	21.6	High	—
1921.....	24.0	Exceedingly low	Flowered
1926.....	18.9	»	—
1931.....	22.0	»	Flowered
1933.....	21.7	Held high by dam	—
1935.....	22.7	»	—
1936.....	22.2	»	—
1937.....	21.3	»	—
1939.....	21.1	Low	Flowered

Average July temperature..... 20.0

(¹) Only the years pertinent to this study are given here. In the years omitted temperatures were normal or below and water levels were normal or high, and in no case did *Utricularia resupinata* flower.

## DISCUSSION

Since the establishment of the Biological Station nine years have been characterized by July temperatures of 21.1° C. or higher distinctly above the average of 20.0° C. Of these, five years have been accompanied by low water levels in Douglas Lake and have been attended by flowering of *Utricularia resupinata*. During four of these nine years, low water in Douglas Lake was prevented by a dam at the outlet of Douglas Lake and flowering was inhibited in spite of high temperatures. However, flowering of *Utricularia* accompanied the low levels at Little Lake Sixteen in the only two of these years in which observations were made.

In 1926, a year of abnormally low water but attended by distinctly subnormal temperatures, there was no flowering of *Utricularia resupinata*.