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# STUDIES ON THE TRAPS OF SOME INDIAN SPECIES OF UTRICULARIA L.

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#### ABSTRACT

The traps of Utricularia baouleënsis A. Chev., U. bifida L., U. graminifolia Vahl, U. kumaonensis Oliver, U. scandens Benj. and U. squamosa Wt. are studied. The mouth of the trap has a distinct rim and is lateral, terminal or basal. The antennae or appendages on the dorsal side of the mouth are forked and not branched further in U. bifida, U. graminifolia, U. scandens and U. squamosa; in U. baouleënsis they are further branched into two of three branchlets and in U. kumaonensis the appendages ramify further into uniseriate filaments bearing stalked, globose glands at their tips. The wall of the trap is 2-layered. There are bifid digestive glands along the inner layer of the wall in all the species, except U. kumaonensis where only quadrifid glands are seen. The mouth is guarded by a complicated trap mechanism, consisting of the door, velum and threshold.

## INTRODUCTION

Bailey (1949, p. 66) rightly pointed out that "If a truly natural system of classification is to be attained, it must be based upon the analysis and harmonization of evidence from all organs, tissues and parts". The present study which has been taken up with this concept in view, relates to the comparative morphology of the traps of the following terrestrial, semi-marshy species of Utricularia, collected from various parts of India: U. baouleënsis A. Chev., U. bifida L., U. graminifolia Vahl, U. kumaonensis Oliver, U. scandens Benj. and U. squamosa Wt.

Ekambaram (1916, 1918, 1926) described the

structure of the bladder and trap mechanism in U. flexuosa Vahl. The most extensive and authoritative work on the carnivorous plants, in which Utricularia is also treated, is by Lloyd (1942). There is comparatively a dearth of information on the Indian Utricularias and more detailed studies on this genus are very necessary. Recently Taylor (1964) wrote a detailed monograph on the genus Utricularia in Africa and Madagascar; some species mentioned in his treatise occur also in India.

#### MATERIALS AND METHODS

Details about the collection of the materials for studies in the present investigation are presented in a tabular form below:

SI. No.		Plant	Locality	District and State	Date of collection	Collector	No. of voucher specimen
1.	U.	b <b>a</b> ouleënsis	Balukhand Reserve forest	Puri, Orissa	25-4-65	V. Abraham	192
2.	U.	bifida	33	5 9	> 9		187
3.	U.	graminifolia	Mahabaleshwar	Satara, Maharashtra	9-11-64	A. N. Henry	62
4.	U.	kumaonensis	Dechila	Bhutan	22-9-64	V. Abraham	2531
5.	U.	scandens	Thimbu	Bhutan	19-9-64	39	2425
6.	U.	sguamosa	Siruvani	Coimbatore, Madras	9-6-65	A. N. Henry	73

Since the species of *Utricularia* are extremely delicate, great care was taken to collect plants with all the parts; after washing them in water to remove the mud and materials like algae, mosses and roots

of other plants, they were preserved in Formalin-Acetic-Alcohol. The voucher specimens used are deposited in the herbarium of our laboratory. The traps of these plants are minute; hence dissections

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were made and after staining them lightly with safranin, observations were made with the help of a binocular dissection microscope. This method proved most useful for getting a comprehensive three-dimensional picture of these extremely minute structures.

## **O3SERVATIONS**

Plant body: All these plants are small and very slender, usually growing in marshy or semi-marshy soils except U. kumaonensis which is epiphytic on the bases of moist tree-trunks associated with other mosses. In general, the plant consists of an underground, densely branched tangle of colourless stolons, from which arises the scape. Sometimes "rhizoids" are borne on the stolons particularly in the region where the scape originates. Insect catching traps are usually borne on the stolons and sometimes even on the lamina and petiole.

Traps: The trap is a small, ovoid-globose, laterally compressed body borne on the stolons, petioles and even on the leaf-blades. The stalk side of the trap is the ventral and opposite to it is the dorsal side. The trap opens to the outside by a mouth which has a rigid rim alround. Each trap is traversed by a vascular strand branching from the mid-vein of the lamina or petiole, or from the stolon. According to the terminology of Taylor (l.c.), the mouth of the bladder with reference to the stalk is lateral, terminal or basal. On this basis the mouth is lateral in U. bifida (Figs. 8, 9), terminal in U. kumaonensis (Figs. 35, 36), and basal in U. baouleënsis (Figs. 1, 2), U. graminifolia (Figs. 15, 16), U. scandens (Fig. 23) and U. squamosa (Figs. 28, 29). The upper side of the edge of the mouth which forms the dorsal lip is continued into branched multicellular processes called the antennae or appendages with or without glands.

The antennae or appendages on the dorsal region of the mouth are more or less distinct for each species. They are unbranched in U. bifida (Figs. 8, 9), U. graminifolia (Figs. 15, 16, 17), U. scandens (Fig. 23) and U. squamosa (Figs. 28, 29). In U. baouleënsis they are branched into two or three branchlets (Figs. 1, 2). In U. kumaonensis the appendages ramify further into four or five (Figs. 35-37) as in U. striatula (Taylor, l.c.) where they are numerous. Each branch of the antennae ends in a uni- to multiseriate filamentous hair which in turn bears an ellipsoid stalked gland at its tip as in U. baouleënsis (Figs. 1, 2, 5), U. graminifolia (Figs. 15, 16), U. squamosa (Figs. 28, 29), or spherical stalked glands as in U. scandens (Fig. 23) and U. kumaonensis (Figs. 35. 36, 37, 41). The basal region of the two branches of the antennae in U. kumaonensis is expanded where numerous, 3-celled spherical glands are present all along the inner surface which faces the upper rim of the mouth (Figs. 37, 39). In addition, 3-celled glands are also present on the antennae (Figs. 4, 11, 19, 20, 31). Since all these species occur in wet sandy or marshy habitat the branches of the antennae help in the retention of capillary water, thus aiding an easy entry of the prey into the mouth of the trap.

There are numerous, short stalked, small, globular glands, distributed all along the surface of the traps in all these species (Figs. 3, 10, 18, 24, 30, 38). Since the outer epidermis of the trap is cutinised, the function of these glands or hydropotes appears to be absorption. In addition to such glands, numerous sessile, globose or oval glands are present, particularly around the mouth in the traps of U. kumaonensis and U. squamosa.

The internal structure of the trap is interesting and presents the same plan in the species studied. In a median longitudinal or sagittal section the wall of the trap surrounds a central cavity and consists of two layers of cells of which the inner bears digestive glands which are called the bi- or quadrifids. There are bifid glands in U. baouleënsis (Fig. 6), U. bifida (Fig. 13), U. graminifolia (Fig. 22), U. scandens (Fig. 26) and U. squamosa, and quadrifid glands in U. kumaonensis (Fig. 43). They take their origin from a small basal cell of the inner layer facing the cavity of the trap. Each basal cell has dense cytoplasm and a conspicuous nucleus. The glands are ellipsoid to clavate in outline, uninucleate and enclose granular, vacuolate cytoplasm.

The mouth (Fig. 17, m) of the bladder is associated with a complicated trap-door mechanism whose structure in general is uniform in all the species studied. The mouth is guarded by two valves of which the upper is larger, called the door, and the lower a small, membranous structure called the velum. Attached to the upper rim of the mouth is the door, curved on its outer surface; it hangs down and is continued backwards for some distance where it is free and lies on the threshold. This portion of the door is shallow, slightly grooved, and with margins raised. The outer surface of the door near the mouth bears a number of stalked glands and spherical sessile glands towards the centre (Fig. 33). Each stalked

















Figs. 1-27: See Page 205 for explanations



Figs. 28-44: See Page 205 for explanations

gland consists of an upper ovate gland cell, a lower elongated basal cell with a small rectangular, uninucleate intermediate cell in between (Figs. 12, 21, 25, 32, 40). In U. kumaonensis, however, the glands on the door are different. In addition to the ovate stalked glands, there are few spherical stalked glands between which are seen one or more, stalked, conspicuously obovate, 3-celled glands (Fig. 44). The parenchymatous cells of the door are peculiar in having plicate margins and this feature is conspicuously seen in U. squamosa (Fig. 33). The cells of the door are arranged in the form of semicircular, concentric rings with larger cells towards the region of attachment followed by smaller cells along its periphery.

The lower semicircular rim of the mouth which consists of three to four layers of parenchymatous cells, is continued into the cavity of the bladder in the form of a cylindrical, horse-shoe shaped, 2layered structure called the threshold (Fig. 34) by Lloyd (l. c.). The two layers of the threshold are closely appressed and fit into each other. They are united with the lower or ventral semicircular rim of the mouth and free on the opposite side where their free ends project into the cavity of the trap. The door closely fits into the threshold. Of the two layers of the threshold, the outer is parenchymatous (Fig. 34, ol) and all along its surface most of the cells bear variously shaped stalked unicellular glands which project into the cavity of the trap in this region (Figs. 7, 14, 27, 42). In structure these glands resemble the bifids or quadrifids. The inner layer (Fig. 34, il) of the threshold consists of transversely arranged, compact, uniformly thickened cells with small nuclei and dense vacuolate cytoplasm.

Along the lower, or ventral basal region of the mouth and projecting inwards freely is a tiny structure (Fig. 34, v) called the velum (Lloyd, *l. c.*). It consists of a central core of thick-walled cells surrounded by a thin-walled parenchymatous layer. Lloyd (*l. c.* p. 234) describes that "Along the outer edge of this pavement there is attached a thin but transparent membrane the velum, which lies against the lower edge of the door, filling in the chink between this and the threshold". In between the velum and the threshold most of the cells bear stalked glands similar to those on the door.

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# EXPLANATION TO THE FIGS. ON PAGES 203 & 204

Figs. 1-27: Utricularia baouleënsis (Figs. 1-7). 1-2. Side views of traps, ×30. 3. Short stalked globular gland on wall of trap, ×300. 4. Stalked gland on antenna, ×300. 5. Multicellular oval stalked gland terminating an antenna branch, ×135. 6. Bifd glands on inner wall of trap, ×300. 7. Stalked glands from inner layer of threshold facing cavity of trap, ×300. U: bifida (Figs. 8-14). 8-9. Side views of traps, ×25. 10. Short stalked globular gland on wall of trap, ×100. 11. Stalked gland on antenna, ×100. 12. Stalked gland on door, ×100. 13. Bifd glands on inner wall of trap, ×100. 14. Stalked glands from inner layer of threshold, ×300. U: graminifolia (Figs. 15-22). 15-16. Side views of traps, ×25. 17. Front view of trap in apical region showing mouth (m, mouth), ×25. 18. Short stalked globular gland on wall of trap, ×100. 21. Stalked glands on antennae and mouth of trap, ×100. 21. Stalked gland on odor, ×100. 22. Bifd glands on inner wall of trap, ×25. 24. Short stalked gland on wall of trap, ×100. 25. Stalked gland on door, ×100. 26. Bifd glands on inner wall of trap, ×100. 27. Stalked glands from inner layer of threshold, ×300.

Figs. 28-44 : Utricularia squamosa (Figs. 28-34). 28-29. Side views of traps,  $\times 25$ . 30. Short stalked globular gland on wall of trap,  $\times 100$ . 31. Stalked gland on antenna,  $\times 100$ . 32. Stalked gland on door,  $\times 100$ . 33. Dissection of outer surface of door flattened,  $\times 135$ . 34. Dissection of an entire mount of threshold (*il*, inner layer; *ol*, outer layer; *v*, velum),  $\times 125$ . *U. kumaonensis* (Figs. 35-44). 35. Side view of trap,  $\times 25$ . 36. Dorsal view of trap,  $\times 25$ . 37. Ventral view of expanded antennae bearing long stalked glands marginally and short stalked glands near the mouth,  $\times 25$ . 38. Short stalked gland on wall of trap,  $\times 100$ . 39. Short stalked gland on antenna,  $\times 100$ . 40. Stalked gland on door,  $\times 100$ . 41. Long stalked multicellular gland along margin of antenna,  $\times 100$ . 42. Stalked glands from inner wall of threshold facing cavity of trap,  $\times 300$ . Fig. 43. Quadrifid glands on inner wall of trap,  $\times 100$ . 44. Obovate, 3-cefled gland on door,  $\times 300$ .