Tuberous organs in *Utricularia*, and new observations of sub-tuberous stolons on *Utricularia radiata* Small

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The genus *Utricularia* is confounding and bizarre. You are simply wrong if you think that the genus can be dismissed as a set of free-floating lake weeds, or stringy terrestrial species with tiny leaves. Many of its species produce mysterious, strange structures; the diversity of peculiar things exhibited by *Utricularia* species astonishes.

The production of tubers is such an example—nearly twenty species of *Utricularia* are known to generate them. (Plant physiologists might argue whether all these structures are truly tubers in the technical sense.) The species that produce tubers are not particularly closely related to each other; Taylor (1989) notes that they occur in six separate sections (*Aranella*, *Chelidon*, *Orchidioides*, *Phyllaria*, *Pleiochasia*, *Utricularia*).

Despite this diversity, *Utricularia* tubers can probably be divided into two main types. Tubers of the first type function as water storage reservoirs. Consider species in the section *Orchidioides*—many of these plants are epiphytes that live on trees, and rely upon the small amount of moisture that unreliably trickles down the branches. Dehydration is a significant risk, so water-storing tubers are a good insurance policy for survival. Storing carbohydrates (*i.e.*, food) is probably only a secondary function for these tubers.

Section *Orchidioides* is known for its horticulturally finicky members. But it is equally well known that, if cajoled into survival, these plants reward the grower with spectacular flowers. *Utricularia alpina* is the species most likely to be cultivated (Wyman 2008), but other species such as *U. jamesoniana* are fairly easy to grow. In horticulture, *Orchidioides* tubers are not useful in propagation, although exploring this further might be an enlightening and productive field of research.

The second type of *Utricularia* tuber consists of those that function as a carbohydrate reserve. The best-known example of this is *Utricularia menziesii*, which is dormant during the long, hot, dry summers of its native southwestern Australia. Each fall it emerges from dormancy, powered by the energy resources stored in its cluster of carbohydrate-rich tubers at the inflorescence base. For the horticulturist, these tubers provide a convenient way to ship plants during dormancy. Furthermore, by judiciously separating the tubers, plants can readily be propagated.

These two types of *Utricularia* tubers occur in many forms. Frequently, as in the epiphytic *Utricularia*, they are loosely clustered near the bases of inflorescences. But this is certainly not the only model for tubers in the genus! In *U. brachiata*, only a single tuber is produced by the plant, and it is located directly under the flower stalk. *Utricularia christopheri* also produces a single tuber, but it is located a little deeper in the soil—it is attached to the rosette by a little shoot. This is similar to the *Genlisea pygmaea* tubers observed by Rivadavia (2007). *Utricularia mannii* has a single basal tuber, but it also produces smaller ones on its stolons. Probably my favorite of the group, the peculiar *U. moniliformis*, has multiple tubers strung together on the stolons like sausages on a string!

Figure 1: *Utricularia inflata* tubers on long, strand-like shoots. The tuber at far left has extruded a new growth.

The familiar *Utricularia inflata* also produces carbohydrate-rich tubers, although they are only a few mm in diameter (see Figure 1). *Utricularia inflata* is in the genus section *Utricularia*, which includes the most common aquatic or semi-aquatic species such as *U. australis*, *U. gibba*, *U. macrorhiza*, and *U. vulgaris*. (The related *U. platensis* also generates tubers.) Tubers can usually be found on large *U. inflata* plants, and their presence is a useful way to distinguish it from similar species (such as *U. macrorhiza*). Supposedly, being stranded on mud is particularly conducive to encouraging *U. inflata* plants to produce tubers (Taylor 1989). But why the plant produces its tubers on whip-like shoots, several cm long, defies easy explanation!

In April 2006, I visited eastern Texas and was led on fascinating trips to several carnivorous plant sites by Mike Howlett and Michael Pagoulatos (Rice 2006). Our trips were focusing on *Sarracenia alata*, *Pinguicula pumila*, and *Utricularia purpurea*, but there were many other things of interest to see. One Harris County site that Mike promised to show me boasted a plant that he claimed was *Utricularia radiata*. This was surprising to me, since Taylor (1989) did not record the species in Texas.

Unfortunately, it had been a dry year and upon our arrival we saw that the water levels at the *Utricularia radiata* site were lower than optimal. Standing on the edge of the muddy wetland we could not see any carnivorous plants at all—it certainly was not choked with *Utricularia*. Still, we were there, so we carefully explored the muck and after much poking around, we found a few shoots embedded in the mud. The specimens were pathetic—short stolon fragments a decimeter or so long. Most did not even have leaves, but the few leaves that were present showed the very regular dichotomous branching that is characteristic of *U. radiata*. Clearly, Mike's dubious claims were vindicated. (I have since seen herbarium specimens of *U. radiata* from other Texan sites.)

In my experience, *U. radiata* usually grows as an annual, so I surmised that the plants we were seeing were in their death throes. However, as I extricated lengths of stolon from the mud, I was

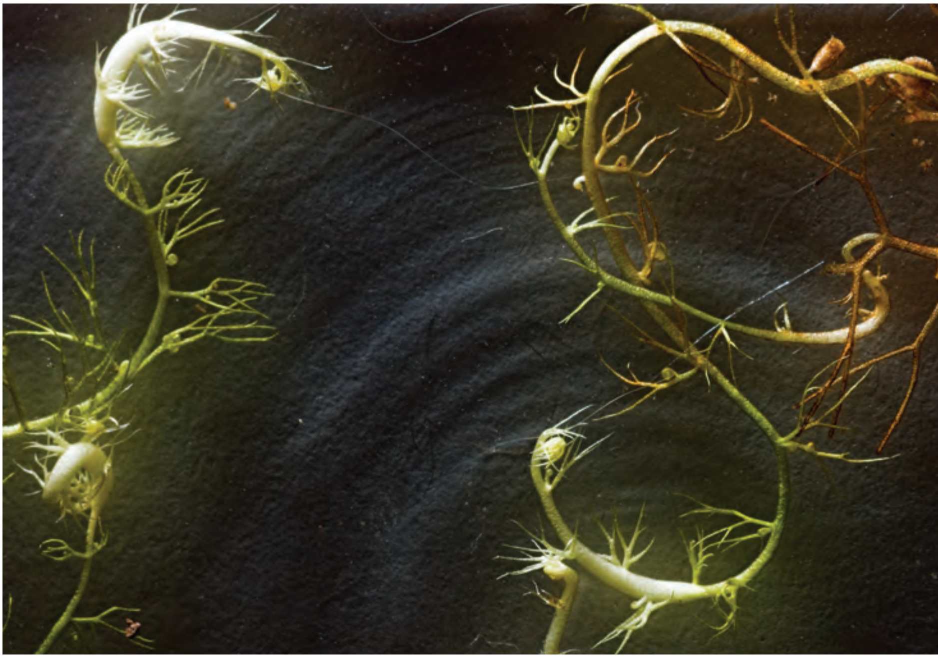

Figure 2: *Utricularia radiata* shoots with swollen, sub-tuberous, chlorophyll-free segments.

surprised to see that intermittent lengths of the shoot were swollen, and lacking in chlorophyll (see Figure 2). Unlike the flexible, green parts of the shoots, these swollen lengths were stiff and, when broken, were clearly supplemented by starchy tissues. Quite frequently, the swollen stolons were twisted around in small loops, almost knot-like in character (see Figure 3).

I do not know of these structures having been observed before. I can only surmise that they were produced by the *Utricularia radiata* plants in response to the temporarily inhospitable conditions of the season. So not only was I surprised to learn that *U. radiata* occurred in Texas, we were both surprised to discover that it probably grows as a perennial, and a sub-tuberous one at that!

As there were not many plants at the site, I took only a few small fragments with me to photograph. Remarkably, after only 48 hours at room conditions, the knot-like loops straightened, the tuberous shoots lengthened and developed chlorophyll, and leaves started to form. Truly, these sub-tuberous shoots were powerful energy sources! Unfortunately, I was unable to provide suitable growing conditions rapidly enough and the plants perished. However, strains of *U. radiata* such as at these Texas sites have potential for the specialist horticulturists who might find the usual, annual nature of the species to be frustrating.

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Figure 3: *Utricularia radiata* shoots with swollen sub-tuberous organs, twisted into short loops. The loops at top right and middle-left are starting to uncurl.

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