

be achieved through full-scale and/or selective burning and involves cutting back shrubs and trees in the winter or summer and scorching the resprouting stems with a simple, clean and highly effective propane-fuelled flame-thrower. However, years of anti-fire/anti-smoke propaganda, symbolized by 'Smokey the Bear', has produced a fear and intolerance of fire, and smoke easements are now hard to secure in many states.

Historically, these habitats would have been maintained through beaver activity. Many bogs, especially low-lying sites suitable for conversion to agriculture, have had drainage ditches or drainage tiles installed to lower the water table. ABG recreates beaver activity to restore and maintain the site's hydrology and soil structure. This is carried out with the minimum of soil disturbance so as not to create ruderal sites where weedy species can take hold. A simple, but effective restoration technique is to dam up ditches using the organic debris accumulated from clearing the site. This slows the entry of water into the bog, reducing erosion, and limiting the amount of silt deposited over the bog.

ABG carries out a number of restoration projects with the Georgia Plant Conservation Alliance (GPCA) which is a network of state, federal and private agencies and public gardens working to conserve endangered plant species and ecosystems in Georgia. ABG's tissue culture laboratory propagates rare and endangered native and non-native species. It also raises funds for the Conservation Program through the development and propagation of unusual and horticulturally interesting plant forms and cultivars. These include an all red form of the Venus flytrap 'Akai Ryu' (developed by ABG staff member, Ron Gagliardo) and an all green form of the Gulf Coast purple pitcher plant (*Sarracenia purpurea* subsp. *venosa* var. *burkii*).

Recent View on the Biology and Protection of *Aldrovanda vesiculosa*

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The free-floating aquatic *Aldrovanda vesiculosa* is unique within Droseraceae. It features active traps the structure and mechanism of which are comparable to those of *Dionaea*. The physiology of the rapid trap movement has not yet been fully understood. *Aldrovanda* is a thermophilous species spread from temperate to tropical zones in Europe, Asia, Africa, and Australia. Yet, its occurrence has always been sparse and irregular. In temperate countries, apical winter buds (turions) are formed in autumn. They overwinter on the bottom, float up to the water surface in spring, and resume the growth. Populations in Africa, tropical Asia and Australia richly flower and set seeds but they do not form turions and grow throughout the year. Temperate populations flower rarely in warmer seasons but flowering results mostly in production of abortive seeds.

Recent data on its distribution in Africa and Asia are not available (except for Japan - last site) and only a few recent sites are known from Australia. In Europe, it occurred more frequently and was recorded at about 150 sites in the last two centuries. It has declined dramatically in the last 30 years, vanishing from Germany, France, Italy, and Slovakia, and the number of its sites has decreased to about one-tenth. Two artificial sites are in Switzerland where it was successfully introduced in 1908. In all European countries, it has had a status of "critically endangered species" and has been under strict state protection. Yet, this has not helped much!

Aldrovanda is highly sensitive to competition with filamentous algae and higher aquatic plants that form denser stands. Fast apical growth and vegetative propagation by branching shoots are the only way to overcome the competition. The most important ecological requirements of *Aldrovanda* include: a) free-CO₂ concentration >0.1 mM as the plant is a strict CO₂ user; pH may be within 5.0-7.6; b) a medium humic acid concentration (2-30 mg.l⁻¹); c) high biomass of plant litter from reeds or sedges; d) water surface free of a dense biomass of submersed or floating macrophytes; e) transparent water free of suspended matter or phytoplankton; f) relative irradiance >20% of full sun; g) relatively warm water in summer (optimum 25-28 °C); h) shallow water (0.15-0.6 m, but summer minimum 5-10 cm); i) abundant

zooplankton as prey; j) oligo-mesotrophic water. *Aldrovanda* grows in shallow standing dystrophic waters, but only in loose stands of emergent vegetation (*Phragmites*, *Typha*, *Carex*) or in little bays among tussocks of denser vegetation. Generally, small habitat changes may result in the decline of *Aldrovanda*. Its decline has been caused mainly by water eutrophication, drainage, and filling in of water bodies.

Its outdoor culture mimics habitat conditions at natural sites. In a culture, about a 3 cm layer of litter of robust *Carex* species, placed over 5-8 cm of sand, is used as the bottom substrate. The container is loosely planted with sedges or common reed. Water depth is 20-30 cm. As *Aldrovanda* is susceptible to boron deficiency, boric acid must be added. Turions overwinter well in the refrigerator. As outdoor cultivation can be still problematic in-vitro culture offers hopeful perspectives to be used for scientific and nature conservation projects dealing with ecophysiological studies, keeping of gene-pool stock, and (re)introduction activities. Very recently, growing *Aldrovanda* in-vitro has been managed successfully.

Great effort has been made to select new suitable sites in the Czech Republic. The plants placed in nylon enclosures in three shallow dystrophic wetlands in N. and S. Bohemia grew rapidly and reproduced 8-34 times over the 1994 season. Approximately 10-50 % of the turions overwintered. When 30 *Aldrovanda* plants were introduced to the suitable sites in S. Bohemia (Trebou region) in 1995, the plants grew rapidly only in a *Carex rostrata*-dominated pool. Turions overwintered perfectly and in the 1996-1997 seasons, the plants propagated richly, forming an abundant population. Its total size was about 6,000 shoot apices in 1996 while 11,000 ones in 1997. Water level at the sites in summer has been found to be the crucial factor for rapid growth and propagation of *Aldrovanda*. The water level was very low in 1995, but high in 1996 and 1997. Thus, a new prolific site arose in S. Bohemia, where *Aldrovanda* had never grown.

Ecology and Distribution of *Utricularia* Species in India

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The genus *Utricularia* is known to occur in almost every country of the world, but the majority of the species are mostly distributed in seasonally wet and high rainfall receiving tropical and subtropical regions (Taylor 1989). India is known for its varied habitats and climate which is responsible for the high diversity in species of *Utricularia*. About 35 species are recognised under the genus for the Indian political boundary (Janarthanam & Henry, 1992). These belong to eight sections with high diversity seen in section *Oligocista* with 18 species for the region followed by section *Phyllaria* and *Utricularia* with five species each. Remaining sections are represented by either one or two species each.

Based on their habitats, the species can be broadly classified into one of the following categories: i) floating / suspended aquatics, ii) rooted marshy terrestrials and iii) partial epiphytes. The floating or suspended aquatics are distributed almost throughout the country, at least sporadically. Their habitat is usually stagnant or slow flowing fresh water. Rooted marshy terrestrials show high diversity in their habitats varying from wet lateritic rocks to moss covered water dripping rocks and fast flowing streams in which black boulders form the substrate. The whole of section *Oligocista* belong to this type. Most of these are distributed along the Western Ghats and West Coast of Southern India. There is lot of variation in microhabitats which is also reflected in inter and intraspecific variation. A high amount of intraspecific variation is seen in the species which are distributed widely and in several microhabitats. However, it is noticed that the marshy terrestrial species which are recorded across the continents are very rare and that two are recorded from lower to medium elevations from the inland. Based on the distribution and diversity, the following two centres of species diversity is recognised for the genus *Utricularia* in India: 1) Eastern Himalayas, where the partial epiphytes with appendaged seeds (sect. *Phyllaria*) are mostly distributed and 2) the Western Ghats and West Coast, where the species of section *Oligocista* with several endemic species are distributed. It is observed that the world's highest rainfall receiving station situated in the state of Meghalaya in North East is very poor in species diversity, suggesting that high rainfall alone