THE *SARRACENIA* PITCHER PLANTS AND BOG GARDENING

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ABSTRACT

The *Sarracenia* pitcher plants are among the world's most beautiful and intriguing plants, and being carnivorous adds an extra dimension of fascination. They are endemic to North America – 10 species are found only in the southeastern United States and one species is widely distributed, from the northeastern US and across Canada. They are easy to cultivate if you understand their basic needs and are grown the world over. Every botanical garden should have them because they are so popular with the public. They go hand-in-hand with other unusual carnivorous plants to make a display that is captivating (puns intended!) to both children and adults. This paper covers types of pitcher plants, their habitats, brief descriptions of the species, a key to identification, cultivation and a short note on conservation.

TYPES OF PITCHER PLANTS

Pitcher plants are carnivorous plants whose leaves are formed into interestingly-shaped hollow tubes for attracting, catching, digesting, and absorbing nutrients from relatively small invertebrate prey (or in a few cases small vertebrates) (Fig. 1). Pitcher plants have no moving parts – the leaves may passively hold rainwater or not (most do not) and the prey falls down inside. Unable to escape due to various preventative measures, such as

Fig. 1 *Sarracenia flava* colour forms, solid green, solid bronze, red blotch, red veins. Photo: T.L. Mellichamp.

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Fig. 2 *Sarracenia leucophylla* with bumblebee licking nectar. Note the downward hairs on the highly decorated hood with translucent tissue and red veins. Photo: T.L. Mellichamp.

Fig. 3 *Darlingtonia californica*. Note the downward orifice, twisted tube and fish-tail appendage analogous to a *Sarracenia* hood. Photo: B. Rice.

Fig. 4 *Heliamphora nutans*. Note the concave nectar spoon analogous to a *Sarracenia* hood. Photo: B. Rice.

Fig. 5 *Nepenthes mixta*. Note the leaves with tendrils for stabilizing pitchers as the stem climbs. Photo: T.L. Mellichamp.

Fig. 6 *Cephalotus follicularis*. Pitchers are about 50mm long, and rest on soil. Photo: B. Rice.

slippery surfaces and downward pointing hairs, they drown or die and are digested by chemicals similar to stomach acids. In many cases other organisms such as bacteria, fungi, slime moulds, mites and insect larvae live unharmed inside the pitchers and contribute to the processing and digestion of the organic fare, and benefit from the milieu of inter-species interactions that go on down in the pit. The pitchers of *Sarracenia* sometimes have colourful markings like flowers and the rim of the orifice, hood and upper tube usually secretes a nectar-like substance to attract insects (Fig. 2).

Before we fall into the depths of detail about sarracenias, let's sample a little of the broader smorgasbord. There are three different kinds of pitcher plants in the world: the sarracenias and their relatives of the Americas (family Sarraceniaceae), *Nepenthes* from Southeast Asian jungles (family Nepenthaceae) and *Cephalotus* from Australia (family Cephalotaceae).

As for the New World: the singular *Darlingtonia californica* (family Sarraceniaceae) (Fig. 3) comes from the Pacific Northwest of the western United States and the 15 or so species of *Heliamphora* (family Sarraceniaceae) (Fig. 4) inhabit the giant inselberg tepuis in the tropical Guyana Highlands of southern Venezuela. The American pitcher plants are terrestrial, and their rosettes of pitchers form clumps. *Darlingtonia* (Cobra-lily) is very difficult to grow outside its native range because it likes lots of sun and very cool root

Fig. 7 Flowers of *Sarracenia leucophylla* (red) and *S. alata* (yellow) are nodding at the time of pollination; petals are pendulous requiring the bee to enter properly for cross pollination. Photo: T.L. Mellichamp.

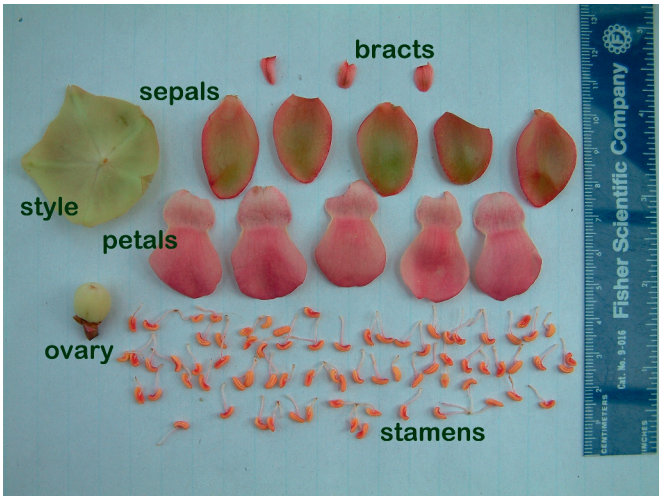

Fig. 8 Flower dissection of *Sarracenia rosea*, showing all parts. Photo: P.M. Gross.

temperatures, generally below 20°C (70°F). *Heliamphora* (Marsh or Sun pitchers) are a challenge to grow because they also like a lot of sun and cool root temperatures – just like *Darlingtonia*. They may be tropical but they grow at high elevations with enormous rainfall. For an excellent book too beautiful to be true in describing these plants, see McPherson (2007). For pictures and information on any of these plants, consult the International Carnivorous Plant Society at http://www.carnivorousplants.org.

Now on to the other plants. One of the pitfalls of writing about carnivorous plants is that the reader will make too many generalities about all the plants in question. In this case, pitcher plants have many traits in common. They all have hollow modified leaves, live in sunny areas with low-nutrient, acidic soils and like lots of water. They mostly all have hoods over the orifices of their pitchers which can help divert rainwater, keep out

Fig. 9 *Sarracenia alabamensis*. Note the decumbent S-curved spring pitchers and much larger erect summer pitchers. Photo: T.L. Mellichamp.

Fig. 10 *Sarracenia flava* in pine flatwoods growing in an open meadow bog in southern Alabama, later August, with red blotch in throat. Photo: T.L. Mellichamp.

Fig. 11 *Sarracenia leucophylla* in an open meadow in southern Alabama near Perdido, late August. Photo: T.L. Mellichamp.

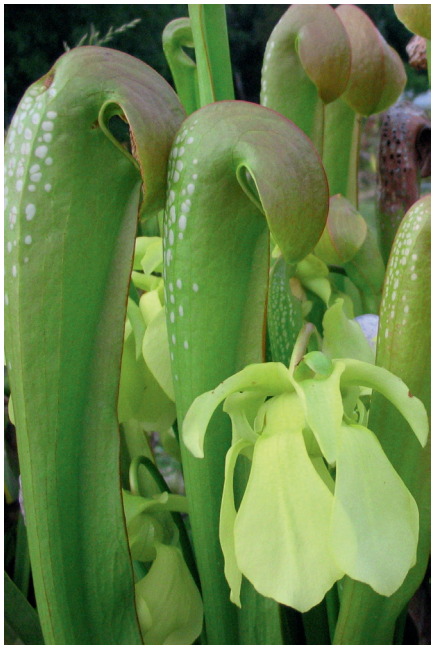

Fig. 12 *Sarracenia minor*. Note the discrete white spots on the tube and hood held closely over the orifice, May. Photo: T.L. Mellichamp.

indigestible debris, and help prevent victims from fleeing by flying. No carnivorous plant uses its flowers to trap prey – it is always the leaves.

In the tropical jungles and open wetlands of Southeast Asia we find the *Nepenthes* pitcher plants (Fig. 5). These are climbing or sprawling plants with leaves scattered along the length of their semi-woody stems, constantly adding new lengthening growth, where each leaf produces an elongate tendril at its tip that can wrap around a twig to help carry the vine up into the sunlight. A pitcher then forms from the growing tendril tip

and is held at just the proper angle to catch rainwater and become an attraction for prey. In all cases a sweet sap is secreted around the mouths of the pitchers to attract certain types of nectar-loving prey. Then, as dead bodies accumulate in the basin, the smell of decaying meat attracts carrion feeders who also become fatalities. In many cases ambush insects or small birds or mammals seeking a meal or a drink fall victim, adding to the pot. It seems like you can't get out of this life alive, so you might as well contribute to the complexity one way or another. When I was in Borneo in 1984 I drank some of the fluid from a large *Nepenthes rajah* (it held a pint or so). The pitcher was freshly open and the rainwater was clean, though it could have held a small drowned rat. I did not feel bad, though it is believed that all pitchers produce a narcotic that stupefies the victims to help them fall in better (or get out worse). The word 'nepenthe' comes from the Greek, meaning an elixir that makes one forget his troubles.

Nepenthes have been trouble-free conservatory subjects for well over a century at many European and American botanical gardens. One or another of the 100 or so species and countless hybrids can be easily grown in a cool or warm temperature regime. Some have spectacular freely-produced pitchers. That brings up the generality that, as a rule, hybrids do better in cultivation than species. There are at least two explanations: hybrid vigour, a genetic phenomenon where the whole is more than the sum of the parts (or perhaps certain traits are released from genetic suppression when they are in a new and different developing environment); and the fact that created hybrids have to be grown from seed, and that gardeners typically select the best surviving seedlings that have the genetic combinations that work under their growing conditions.

Fig. 13 *Sarracenia psittacina*, with pitchers sprawling in a rosette. The orifice is lateral and hood globose. Photo: T.L. Mellichamp.

Fig. 14 *Sarracenia purpurea* subsp. *venosa* in South Carolina. Note the erect hood, long hairs, and water-filled tubes. Photo: P.M. Gross.

Fig. 15 *Sarracenia rubra* complex. From left to right: *S. rubra*, *S. r.* subsp. *gulfensis*, *S. jonesii*, *S. alabamensis* subsp. *wherryi*, *S. alabamensis*, *S. alata*. Photo: T.L. Mellichamp.

Number three of the pitcher plants is the diminutive *Cephalotus follicularis*, a unique little charmer from the region of Perth, in southwestern Australia (Fig. 6). This is another species that likes it cool, wet and sunny at the same time. Its ribbed pitchers are rarely more than 50mm long, and they form a tight clump with flat green leaves. The small flowers are reminiscent of members of the saxifrage family, though it is in a family by itself. None of the three groups (families) of pitcher plants are related to the other, nor closely to other carnivorous plants.

OTHER CARNIVOROUS PLANTS

In addition to the pitcher plants of the world, there are a number of other famous carnivorous plants that are widely grown. To enumerate but not elaborate: the Venus'-Flytrap (*Dionaea muscipula*), one species found only in southeastern North Carolina and adjacent South Carolina, USA, with a snap-trap; over a hundred species of Sundews (*Drosera* species) from all over the world but especially from the eastern US and Canada, South Africa and Australia, with long hairs tipped by sticky glands that ensnare prey; Butterworts (*Pinguicula* species) from the northern hemisphere and Central and South America, with sticky fly-paper-like leaves; and Bladderworts (*Utricularia* species), aquatic species from around the world that have tiny underwater 'suction bubbles' on their leaves that suck in tiny prey when triggered. These are the most well-known carnivorous plants, but there are others.

All these diverse plants have in common the need for goodly amounts of sunlight, plenty of fresh water, and generally acidic substrates. They are able to grow in these low-nutrient habitats because they supplement their nutritional needs with insect prey, and this allows them to survive by growing where normal plants cannot easily overgrow them. As we have seen, carnivorous plants grow the world over in similar habitats. The

Fig. 16 *Sarracenia leucophylla*, left and right ends; *S. rosea*, middle; hybrid between them, right-centre; in the wild in southern Alabama near Perdido, late August. Photo: T.L. Mellichamp.

Fig. 17 Samples showing intermediates from hybrid swarm between *Sarracenia jonesii* (left) and *S. purpurea* (right), from mountains of North Carolina near Brevard. Photo: T.L. Mellichamp.

one place that has more different kinds than anywhere else is eastern North Carolina–South Carolina, USA, where five different genera (18 species in total) grow in the vicinity of an extensive natural area called the Green Swamp Preserve.

The remainder of this article will deal with *Sarracenia* pitcher plants, one of the most colourful and easily grown of the carnivorous plants.

PITCHER PLANT HABITATS

I saw my first *Sarracenia* in 1968 in the coastal pine flatwoods of southeastern North Carolina. These habitats are, or once were, quite common throughout the southeastern

US. They are open meadows with few to many scattered longleaf pines (*Pinus palustris*), apparently dominated by grasses (Fig. 10). We call them pitcher plant bogs, though they are more like moist meadows than mucky wetlands. The soil is sandy with a good admixture of partly decomposed organic matter, something like peat. They are quite acid (pH 4–5), which makes the nutrients somewhat unavailable. There is plenty of rainfall, usually in the range of 2,000mm per year, that leaches the soil of nutrients. This torrential rainfall often comes in the form of afternoon thunderstorms in the summer. Rainfall can be locally heavy during the hurricane season, which is June through November, peaking in September and October. This is precisely the period during which sarracenias, and many other plants of the pitcher plant bogs, ripen their seeds and count on water (and high winds) for dispersal over the relatively flat mosaic of wetlands. Virtually all such seeds float! Pitcher plants can also grow in seepage areas, along small streams and around the edges of ponds, but they are at their best in open flatwoods and on roadsides.

An important factor in maintaining these habitats is fire. Usually it is caused by lightning and while a burn can start with any summer thunderstorm, fires are especially effective in late winter (February and March) when the undecayed leaves and stems of last year's growth are at their driest and burn hot and fast, killing undesirable woody vegetation and releasing nutrients that promote better spring growth. When fire is suppressed, as by humans, the vegetation grows over and the pitcher plants are shaded out. When a fire does come after 10–20 years, sometimes bog plants that have managed to survive are rejuvenated and they spring back into massive growth. The landscape of the Southeast is a mosaic of wetlands and drylands where fire and water, along with soil type, play major roles in producing the dominant vegetation. Carnivorous plants and other bog plants need open, sunny sites and constantly moist, acidic soil. Ground water can keep the soil moist in some places when rainfall is not plentiful. The longleaf pine does not produce dense shade when grown in scattered stands in the wetlands and they are adapted to the periodic fires by having long needles that protect the young tip growth from fast-moving fire.

Fig. 18 *Sarracenia* cultivar 'Mardi Gras': a selection from the cross (*leuco* × *purp*) × (*leuco* × *psitt*). Photo: T.L. Mellichamp.

Fig. 19 A bog garden made of landscape wall-blocks stacked 3 or 4 high. The clumps of sarracenias are 2–3 years old. Photo: T.L. Mellichamp.

We do not really know when and where pitcher plants evolved as there is no fossil record but we believe they came from the uplands of the Southern Appalachian Mountains in the general region where the Carolinas meet northern Georgia. Here existed abundant wetlands, mountain bogs and seeps, kept open by very cold winters, acidic soils and periodic glaciation. The most primitive *Sarracenia* we have today could be *S. jonesii*, found in such habitats. During the Tertiary Period when many changes were taking place geologically, these plants migrated southward along river corridors to spread into the lowlands and conditions became especially suitable after Pleistocene glaciation as the South warmed. Speciation ensued, and the coastal plain was populated with a number of species. Today we see a depauperate mixture of species because the wetlands have been so impacted by human activities during the past 100 years. It has been estimated that we have lost well over 50% of pitcher plant habitats since 1900. Even so, pitcher plant bogs have been shown to have the highest diversity of species of vascular plants outside the tropics, with as many as 40 species per square metre. This number includes carnivorous plants, orchids (e.g. *Calopogon*, *Cleistes*, *Platanthera*, *Pogonia*, *Spiranthes*), *Gentiana* and *Sabatia*, members of the lily family (e.g. *Aletris*, *Lilium*, *Pleea*, *Tofieldia*, *Zygadenia*), bog-buttons (*Eriocaulon*), milkworts (*Polygala*), milkweeds (*Asclepias*), grasses and sedges, members of the aster family too numerous to mention, but especially the beautiful *Liatris* and *Marshallia*, and many other wonderful herbaceous plants. Many of the species found in these wetland meadows can be grown as associates with carnivorous plants in cultivated settings; however, one must be wary of plants that spread vegetatively. In the wild they grow more slowly and are kept in check by fire, low nutrients and competition. When brought into cultivation they become garden thugs and can take over a wetland planting. A well-known example is the striking white-topped sedge, *Dichromena*. Never plant it in a bog garden! Other pretty-but-predatory types are *Hypericum*, *Rhexia*, *Xyris*, *Viola* and most bog ferns except *Osmunda*.

SARRACENIA SPECIES

There are 11 species of *Sarracenia*, and three subspecies. I will itemize them here and give brief notes, and a simple key to identification. More detailed information can be found in the references, especially Schnell (2002). They are simply in alphabetical order.

Some basic facts about their structure are that the pitchers may be erect or decumbent, up to 1m tall (Table 1 gives typical mature heights for comparison), evergreen (E) or marcescent (M) (withering in winter), smooth or hairy, with the orifice rim red or green, with red veins or not, with translucent white tissue or not, and with characteristic phyllodia or not. Phyllodia are flat, non-pitchered, tapering, over-wintering leaves characteristically produced in mid-summer on three species. The flowers are borne singly on tall, leafless scapes; the petals are either yellow or red (Fig. 7); and they may have the sweet fragrance of roses or the feline fragrance of cat urine.

The flowers are all basically alike with five sepals, five petals, up to 100 stamens and the unique umbrella-shaped style disk that holds pollen when it is shed because the flowers are held upside down for pollination (Figs. 7, 8). They become erect as the seed pod matures. As mentioned, phyllodia are produced in mid-summer and overwinter in some species. The combinations of these characters may be used to tell the species apart. All are easy to grow well, except perhaps *S. jonesii*. Table 1 summarizes the main characteristics.

Scientific name	Flower size (mm); colour; odour	Pitcher height (mm); form; persistence	Texture; smooth or fuzzy; rim	White tissue; veins	Pitcher season (spring, summer)	Phyllodia
S. alabamensis	30 Red Sweet	500 Erect M	Soft Fuzzy Green	None Few red veins	Spring-weak Summer-robust	None
S. alata	50 Yellow Feline	900 Erect M	Firm Smooth, rarely fuzzy Green	None Few red veins	Spring-weak Summer-robust	None
S. flava	60 Yellow Feline	900 Erect M	Firm Smooth Yellow	None Red veins or blotch	Spring-early summer only	Yes, erect 300mm
S. jonesii	30 Red Sweet	600 Erect E	Firm Smooth Red	None Red veins	All summer	None
S. leucophylla	60 Red Sweet	900 Erect M	Firm Smooth White	White hood, tube Red veins	Spring-weak Summer-robust	Yes, erect 400mm
S. minor	40 Yellow None	300 Erect E	Firm Smooth Red	Spots on hood No veins	All summer	None
S. oreophila	50 Yellow Feline	400 Erect M	Firm Smooth Green	None Red veins	Spring only	Yes, curved 150mm
S. psittacina	40 Red Sweet	150 Decumbent E	Firm Smooth No rim	White blotches on hood, tube Red veins	All summer	None
S. purpurea	50 Red Sweet	150 Decumbent E	Firm Smooth to fuzzy Red	None Red veins	All summer	None
S. rosea	50 Pink Sweet	150 Decumbent E	Firm Fuzzy Red, thick	None Red veins	All summer	None
S. rubra	30 Red Sweet	300 Erect E	Firm Smooth Red	None Red veins	All summer	None

Table 1. Main characteristics of the 11 species of *Sarracenia*.

1. ***Sarracenia alabamensis*** Alabama Canebreak Pitcher Plant. This is one of the rarest and most unusual species. It is a member of the *S. rubra* complex and as such has small dark maroon flowers about 25mm wide. Its pitchers come in two forms, slender spring pitchers that bend over in an S-curve and may touch the ground, followed by gradually larger pitchers, then the late summer ones flush in August and can be 600mm high. The pitchers themselves are unique in being soft textured and quite fuzzy to the touch. The orifice rim and hood are usually yellow-green with minimal red veins. It occurs in only a dozen localities in three counties in south central Alabama near Montgomery (Fig. 9).

   There is also *S. alabamensis* subspecies *wherryi*, Wherry's Pitcher Plant. It may reach 300mm tall, producing only one type of pitcher that is dull green flushed with strawberry-red. This attractive small species occurs in southern Alabama just north of Mobile Bay and just west into Mississippi and just east into Florida.
2. ***Sarracenia alata*** Pale or Winged Pitcher Plant. This is a tall species up to 700mm tall. It produces nice spring pitchers but the summer ones are much more robust. The colour is usually green but they can have red veins and be blush red. They are usually smooth but can be fuzzy. Its flowers are the most beautiful, large, pale cream-yellow and come just before the leaves (Fig. 7). It occurs from Alabama to east Texas.
3. ***Sarracenia flava*** Yellow Pitcher Plant. This is a magnificent tall species with pitchers up to 900mm, striking yellow-green almost always with red veins or a red blotch in the throat or totally copper to bright red flushed (Figs. 1, 10). It is quite variable and has had many colour forms named. See Schnell (2002) for a listing of the named forms. The erect summer phyllodia are characteristic. The large flowers are yellow and come just before the leaves. It grows from North Carolina to eastern Alabama, along the coast.
4. ***Sarracenia jonesii*** Mountain Sweet Pitcher Plant. This is one of the rarest species, occurring in the mountains of extreme northwestern South Carolina and adjacent North Carolina. It occurs in mountain bogs and seeps and can form large clumps. It has tall, firm pitchers that can be red flushed with many red veins. One characteristic that is hard to tell is that well-grown pitchers have a bulge just below the orifice (Figs. 15, 17). This species is one of the most difficult to grow well.
5. ***Sarracenia leucophylla*** White-topped Pitcher Plant. This is a striking, large plant with pitchers up to 1m (Figs. 2, 7, 11). The tops of the pitchers and the hoods are mostly white due to much translucent tissue being present. These areoles, as they are called, are surrounded by green or red veins. The most robust pitchers are produced in late summer. They are commercially collected and sold as fresh or dried 'cut flowers' in some places. These white pitchers seem to be particularly attractive to moths, so much so that the pitchers can fill up with prey and become discoloured. Careful growers may stuff a bit of cotton in the tubes to prevent this.

The flowers are produced just before, and with, the spring leaves. It grows along the Gulf Coast from the western Florida panhandle to just into Mississippi.

6. ***Sarracenia minor*** Hooded or Spotted Pitcher Plant. This is the most easily recognized pitcher plant, where the hood arches over and practically covers the orifice (Fig. 12). The back of the hood and upper tube have distinct rounded white spots. This species 'eats' mostly ants, who crawl up the tube and dive into the tube, apparently attracted by nectar and the dazzle of the translucent white spots. This species grows from southeastern North Carolina to central Florida but not far westward. There is a giant form named *S. minor* var. *okefenokeensis* found only in the famous Okefenokee Swamp in southeast Georgia. It may reach 1m. No one knows why this giant form is found only there, growing in the swamp and in wet ditches on floating mats of sphagnum moss.
7. ***Sarracenia oreophila*** Green Pitcher Plant. This was the first pitcher plant to be declared endangered, some 30 years ago. It is not much better off now. It occurs in widely scattered populations in northern Alabama, with one location in north Georgia and one in western North Carolina. It may also be a somewhat ancestral type, living in the non-coastal uplands along rivers, streams, seepage slopes and in wet woods. It can take a bit of shade and has been found on the stable sandy banks of large rivers. It is the least satisfying horticulturally because the pitchers die down by mid-summer, leaving only the curved phyllodia to overwinter.
8. ***Sarracenia psittacina*** Parrot Pitcher Plant. This species is most distinctive because the pitchers sprawl flat on the ground; the hood forms a globose beaked head hiding the orifice which faces laterally (Fig. 13). The mass of white blotches, spots and red veins make for a colourful pitcher. Down inside the tube are long (to 4mm) brown hairs, thickly arrayed to create a one way trap for prey who enter and can only go deeper. It grows along the coast from eastern Georgia, across Florida into Mississippi. The mat-forming leaves are often hidden under dense grasses, often in very wet places, and only the flowering scapes can be seen.
9. ***Sarracenia purpurea*** Purple Pitcher Plant. This is most people's idea of

Fig. 20 Severe ditching (3m deep) for drainage in the heart of a vast Green Swamp *Sarracenia* bog in 1976, with a total loss of hundreds of acres of plants. Photo: T.L. Mellichamp.

Fig. 21 Display raised bed of carnivorous plants including *Sarracenia*, *Drosera*, *Dionaea*, and *Calopogon* (orchid) at the North Carolina Botanical Garden. Photo: T.L. Mellichamp.

the typical pitcher plant. It is widely grown and easy to care for. The pitchers may be green with red veins or solid purple. It is the only species of *Sarracenia* that normally holds rainwater in the pitchers (Fig. 14). This can work because they sit flat on the ground and cannot tip over (and break) as a taller pitcher would if filled with rainwater. This also explains why this species is the only one with an erect hood, not covering the orifice. Unfortunately, it allows the perpetuation of the myth that all pitcher plants hold water. This species ranges the widest, from the northeastern United States all across Canada, where it grows in sphagnum bogs surrounding small glacial lakes. It may also be found in wet boggy swales and seeps along the Atlantic Coast as far south as southeastern Virginia. There is a *S. purpurea* subspecies *venosa* that can be recognized occurring in the eastern part of the two Carolinas. It is distinguished by its shorter, fatter pitchers that are usually more fuzzy. There is also a form *S. purpurea* forma *heterophylla* with all bright yellow leaves and flowers that occurs very rarely in the northeastern part of its range. This form is a genetic mutation that breeds fairly true from seeds. Virtually all species of *Sarracenia* have been found in nature in forms without red pigment (anthocyanin-free), either in the leaves or the flowers. Even species with normally yellow flowers will have red coloured veins and tissues in their leaves. The very rare ‘albinos’ are often weaker plants and they do not always come true from seed.

10. ***Sarracenia rosea*** Pink Pitcher Plant. This was recently (2002) named as a separate species. It is the Gulf Coast counterpart of the northern Purple Pitcher Plant. It is very distinctive, however, with shorter flowering scapes, 150–200mm rather than 300–700mm, and pink to whitish flowers rather than maroon to red. This species always has very fat leaves and the rim of the orifice is very thick and red. It is a most beautiful species, easy to grow and flower (Figs. 8, 16).

Fig. 22 An idea for a poster to call attention to the plight of carnivorous plants and other wetland species. Photo: T.L. Mellichamp.

Fig. 23 Larry Mellichamp with giant hybrid *Sarracenia flava* × *S. rosea* in western Florida. Photo: S. Ploszak.

11. ***Sarracenia rubra*** Red or Sweet Pitcher Plant. This is a slender species, ranging from diminutive plants to 150mm up to more than 400mm tall, usually with quite red pitchers and distinct red veins on the tubes and hood. The flowers are small with petals that are deep maroon and sweet smelling. It grows from eastern North Carolina down to eastern Georgia. It is the typical species in the *S. rubra* complex, which consists of five entities that do not grow together in the wild (they are considered disjunct or allopatric). They are *S. rubra*, its slightly larger counterpart in western Florida, *S. rubra* subspecies *gulfensis*, *S. jonesii* in the Carolina mountains, and *S. alabamensis* and *S. alabamensis* subspecies *wherryi* in central and southern Alabama, respectively. These five different entities may be named as I have presented them here with three species and two subspecies, or they may be recognized by some authors as five subspecies under *S. rubra* (Figs. 9, 15, 17). Either way, they are sometimes difficult to tell apart but they do have distinctive traits that can be seen in well-grown specimens. Knowing where your plants come from will be a big help to identification in the case of the *S. rubra* complex.

    The different ways of naming and recognizing these units (called taxa) is something professional and amateur botanists have argued over for years and never seem to come to an agreement. That is because there is no right or wrong way – the plants are populations in nature that have not differentiated from each other as much as some other species have and therefore their characters overlap

more, making identification more problematic. In fact, some authors have lumped them all into the one 'originally named' species, *S. rubra*, with lots of variations. I think this misses the point of recognizing differences in nature. The different opinions are honest efforts of each person to portray what they think is the best view of their relationships. As horticulturists, you have to pick a naming scheme and stick with it, being consistent in following one whole view or another. I think that by giving these very rare plants species names, it helps bring attention to them and their plight and makes it simpler to present them to the public by not having to explain why something is NOT a species.

SIMPLE KEY TO IDENTIFICATION OF *SARRACENIA* SPECIES

1. Pitchers with white translucent areas on hoods and tubes
    2. Pitchers decumbent, orifices lateral.....*S. psittacina*
    2. Pitchers erect, orifices vertical
        3. Pitchers with hoods held well above orifice; hoods completely white-areolate with red or green veins separating the white areas; petals red.....*S. leucophylla*
        3. Pitchers with hoods arched close over orifice, with discrete round spots on back of the hood and tube; petals yellow.....*S. minor*

1. Pitchers without white translucent areas
    4. Pitchers erect
        5. Petals yellow
            6. Hoods almost round; phyllodia present
                7. Hood bases reflexed back behind neck and practically touching; phyllodia erect.....*S. flava*
                7. Hood bases reflexed back behind neck, but edges not nearly touching; phyllodia curved.....*S. oreophila*
            6. Hood wide oval; phyllodia absent.....*S. alata*
        5. Petals red, maroon or pink
            8. Pitcher texture firm, smooth; orifice rims red; red veins present on both surfaces of hoods and outside surface of tubes
                9. Pitcher tube solid for lowest ⅓ of length; distinct bulge in the upper ¼ of tube; flower scapes about equal the pitchers.....*S. jonesii*
                9. Pitcher tube solid for lowest ¼ of length; no bulge in upper tube; flower scapes 1.5–3 times the height of the pitchers.....*S. rubra*
            8. Pitcher texture soft, fuzzy; orifice rims green; red veins absent under hoods and outside surface of tubes.....*S. alabamensis*
    4. Pitchers decumbent
        10. Petals maroon to red; pitcher length 3 times or more their width; orifice rim c. 2mm thick; flower scapes c. 30–80cm long.....*S. purpurea*

10. Petals pink; pitcher length less than 3 times the width; orifice rim c. 4mm thick; flower scapes c. 5–30cm tall.....*S. rosea*

HYBRIDS

All species of *Sarracenia* are inter-fertile and they hybridize readily in the wild whenever two species occur together (Fig. 16). See Schnell (2002) for a list of wild and man-made hybrids and their scientific names. In some cases, hybrid swarms occur because the hybrids are fertile and can back-cross with the parents and other hybrids, giving a range of intermediate forms between the parents (Fig. 17). There are famous locations in the Southeast where this occurs after disturbance and it is difficult to find a pure species in some cases. This distinctive trait of sarracenias (not unique, because the same can happen with oaks, many orchids, and some other plant groups) allows for the production of spectacular man-made hybrids of great ornamental value, often involving more than two species. The practice of making man-made hybrids began in the late 19th century when these plants became very popular ornamentals in England, and were made available commercially by the famous Veitch Nursery. The earliest hybrids were made at the National Botanical Gardens, Glasnevin, Dublin, Ireland (for example, *Sarracenia* × *moorei* = *S. leucophylla* × *S. flava*).

In modern times, new complex hybrids have been produced in Great Britain, Europe, Australia and America. See McPherson (2007) for some examples. It has also become common practice to name selections of hybrids (and species) as cultivars. These selections are of singular unique plants of outstanding merit. They must be propagated asexually (by division of the clump) or by tissue culture. I began making hybrids and selecting cultivars in 1985, along with the late Rob Gardner of the North Carolina Botanical Garden. We used the species *S. purpurea*, *S. minor*, *S. psittacina*, and *S. rubra* so that the hybrids would be smaller, grow continuously and tend towards being evergreen. But we also utilized *S. alabamensis* (with *S. psittacina* to make 'Doodlebug') and some other species mixed in. We wanted to make selections that were outstanding and that would grow well in cultivation, partly to remove pressure from wild collected plants and partly, because there was so much habitat destruction going on at that time, to call attention to these remarkable plants and encourage efforts to preserve them. We named a dozen or so cultivars, some of which have found their way into commercial production. Our hybrids include 'Ladies-in-Waiting', 'Dixie Lace', 'Mardi Gras' (Fig. 18), 'Flies Demise', and the Little Bugs™ series: 'Doodlebug', 'Ladybug', 'Lovebug', and 'Redbug'.

SEED CULTURE

To create *Sarracenia* hybrids, you have to cross pollinate two parents (that's traditional and the practice hasn't changed in years!). This is done shortly after the flowers fully

open, as they are female-receptive first. Take pollen from one parent flower (from the umbrella-style where it accumulates after two days) as the male donor (use a cotton swab or your little finger – just practise), and place it on the stigmas of the female parent on the first day after opening. Label your cross with the names of both parents, female first. You may save pollen – keep it dry and refrigerated, or frozen, to use when needed. If you wait too long after the flower opens to place pollen on the stigma, the female parent will not be receptive and no seed will form. The seed pods will swell if the cross takes, and ripen in September. There could be more than 500 seeds in a pod. Germination requires a cold treatment of the seeds: 40 days at 5°C of stratification; that is, the seeds must be moist-chilled. Either sow on a wet peat:sand mix and refrigerate (in a plastic bag covering to keep from drying out); or place seeds in a vial of water while chilling, then pour out onto mix. Seeds will germinate after 2 weeks at 21°C. The longer you chill (up to 3 months) the greater percentage of germination. I found 4 weeks to be sufficiently optimal. Unused seeds may be kept dry and refrigerated for several years. Young seedlings need moisture (but not too wet) and plenty of light to grow. They prefer long days but will grow at anytime throughout the year. Adults go dormant under short days. I found that fertilizing the seedlings will hasten their maturity and I was able to flower seedlings in as little as the third year; but 4–6 years is more typical. Fertilize seedlings with 7.5ml/4.5litres (½ tablespoon/gallon) of balanced acid fertilizer. I used several rates and several formulations and they all worked. Flush with fresh water regularly, and fertilize as often as every 10 days. Fertilizer is absolutely necessary if you want your seedlings to make progress, otherwise they could take up to 9 years to flower.

CULTIVATION

Sarracenias are easy to grow if you understand their needs and follow a few guidelines. Here are the environmental factors to consider: soil, sunlight, water, temperature. These comments apply to virtually all bog plants that you might grow together from the southeastern United States.

Soil: Use 60–70% brown peat (Canadian peat in North America) to 20–30% sharp quartz sand (such as pool filter sand). Up to 10% of this mixture can be other materials such as compost or leaf mould. Sarracenias like it low nutrient but not completely sterile. The peat provides the acidic environment and water-holding capacity but the plants are not aquatic; they do not like anaerobic conditions. Hence, sand or perlite helps keep it open. I dislike perlite on top because it floats. But it makes a perfectly good under-the-surface soil amendment. You could apply an acid fertilizer at the rate of 5–10ml/4.5litres (1–2 teaspoons per gallon) once or twice a month to help improve growth. Always use a well-drained container so water will not collect. Pitcher plants can take flooding, but not for long. In short, I like a wet-but-well-drained mix. Paradoxical, perhaps. Do some tests yourself and see what works best.

Sun: Sarracenias, and all bog plants, like full sun. Anything less may result in weak growth and unnatural pitchers. It is best to grow them outdoors or in unshaded, well-ventilated glasshouses. They can take heat better than shade. Do not use terrariums as has been the recommendation – they cannot get full sun and, being closed up in a tank, they will roast.

Water: They like plenty of fresh water. They do not like hard water with a lot of soluble salts. Anything over 200 parts per million may be unsuitable. Test your water and try it on a few plants, or use rainwater or create clean water with a reverse-osmosis apparatus. For years we have used city water on all our bog plants with no ill effects. The pH of the water is 8 which is not ideal, but not bad. But low salts. Perfect. Never let the plants dry out as they cannot wilt and recover. It is better to keep them too wet than to let them dry out.

Temperature: In the wild it is very hot and humid, with temperatures up to 38°C for short periods and above 21°C at night. So, these plants love heat. In the winter, bog plants are mostly hardy down to very cold temperatures. Ours have survived –20°C, and I know that folks up north have grown them much colder. Keep them from drying out and they can take the cold. It is not clear whether they actually *require* a cold dormancy. I think they benefit from it in the long run as it helps rejuvenate them, but letting them go down below 5°C might be sufficient for a given year. The short days of winter will also encourage dormancy, even if the plants do not freeze. I have seen sarracenias grown indoors at various botanical gardens and they seem to become weaker without a periodic good, cold dormancy.

PROPAGATION

Sarracenias form large clumps from rhizome growth. Each creeping rhizome grows 25–50mm a year and the clump enlarges. It is easy to divide the clump into individual rhizomes, each with a growing tip. Roots grow all summer and division can be done at any time. Newly divided and re-potted plants should not be kept too wet until they heal or they will rot where the tissue was torn. Re-pot into a peat:sand mixture. A good time is October or November, after pitcher formation has ceased but while roots are still very active. This is a much better strategy than waiting until spring. I have lost virtually all the sarracenias I have divided in March. Plants re-potted in the autumn will send up flowers and make new pitchers the following spring if grown at 5°C all winter.

DISPLAY

Sarracenia, and other bog plants, can be displayed effectively in various venues. While they can be grown in individual pots, there is the risk of being too wet, too dry or too hot. Combining into a larger ‘bog dish garden’ is worth some effort – the community pot ameliorates the effect of some of the environmental extremes. A round 400mm bowl

can be large enough for a collection of several *Sarracenia* and associates. Re-potting every 2–4 years as the plants grow works well. For a larger display, an in-ground bed is desirable (Fig. 19). We have constructed a 3m × 1.5m oval bed with concrete landscape wall-blocks, each 100mm × 200mm. The bed is 400mm deep, lined with a rubber pool liner. The liner actually comes to the third block from the bottom, the edge laid over and held in place by the fourth, or top, block. We first add a 50mm layer of pine needles, then some sand, then the bed is filled with the peat:sand mixture, allowed to settle, then planted. Pitcher plants love the 250–300mm depth for their roots and they have formed large clumps. Keep the beds wet; punch holes in the liner for drainage.

CONSERVATION

Finally, a word about preserving sarracenias in the wild. Because they are wetland plants, they are highly susceptible to habitat destruction throughout their range. Timbering does not seem to hurt them as long as the soil hydrology is kept intact. Some of the best plants I have seen were ones that had invaded disturbed land after pine tree harvest. It had the same effect as a fire – it rejuvenated the land. Drainage and ditching are their worst enemy, and thousands of acres are lost every year (Fig. 20).

Several species are on the Federal Endangered Species List, namely *S. alabamensis*, *S. jonesii* and *S. oreophila.* Others are rare, local, and may be protected in certain states. The Nature Conservancy owns several pitcher plant bogs throughout the Southeast and there are some state and regional efforts to save habitats. Some bogs are held in private hands. One family in southern Alabama manages a tract for judicious seasonal harvesting of pitchers as fresh cut flowers. The Green Swamp Preserve is a 6,073ha preserve in southeastern North Carolina, harbouring many carnivorous plants and other rare wetland species. Some of the best preserves are on military bases throughout the Southeast. *Sarracenia* do not mind disturbances as long as fire comes through periodically, the sun shines brightly, and the soil stays moist. Keeping out poachers is a useful engagement. Short of acquiring a few acres of pitcher plant wetland in the South, the best thing you can do to help is to avoid buying plants that have been collected from the wild.

CONCLUSION

Sarracenias are a wonderful group of beautiful species of carnivorous pitcher plants that helps attract attention to the wide world of plants, especially among children. They are colourful, easy to grow, and interesting. They evoke questions from the public. Growing them makes a great hobby because there are enough species, forms and hybrids to challenge the collector but not so many as to make it impossible to have a representative collection. They are expected to be seen at botanical gardens and they can be part of inviting displays of form and colour (Fig. 21). Every effort should be made to learn to grow them well and to display them with pride. Why can't one become the 'panda-substitute' poster-child of the endangered plant movement (Figs. 22, 23)?

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