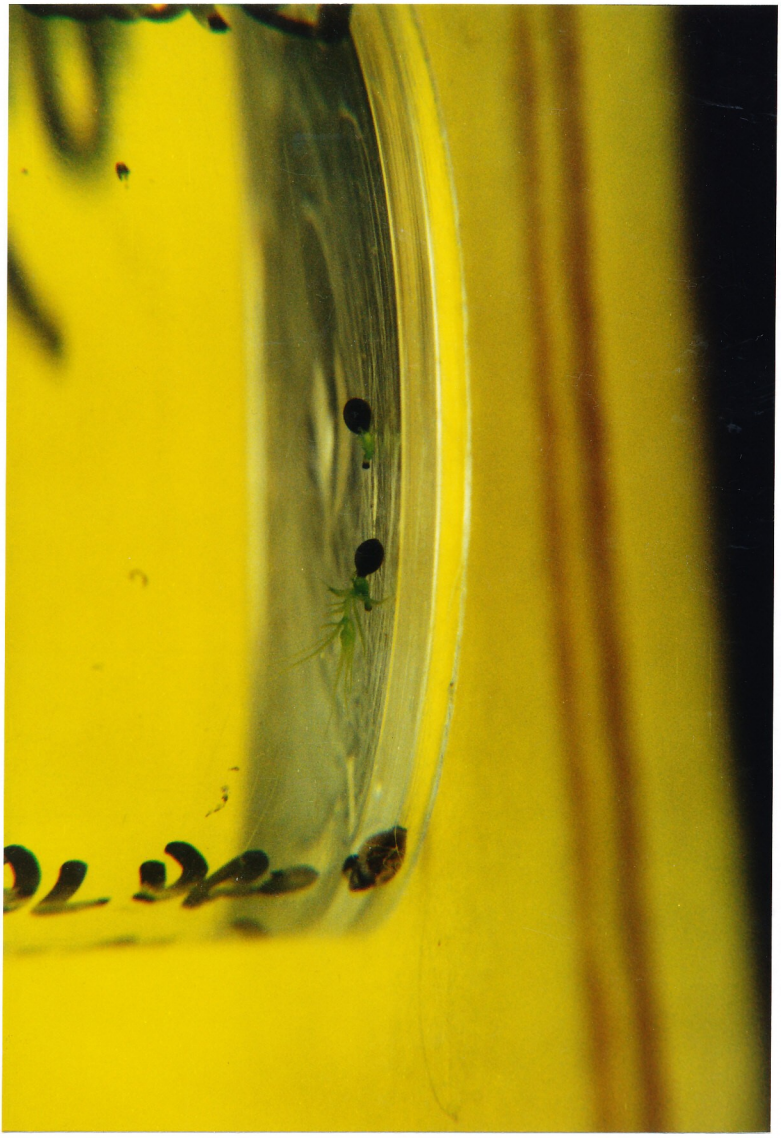
FLYTRAP NEWS

NEWSLETTER OF THE CARNIVOROUS PLANT SOCIETY OF New South Wales (Sydney, AUSTRALIA)

Volume 11 Number 3
January/February/March 1998

ISSN 1323 - 8159
PRICE $3. 00
Free with membership



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Special functions such as the Annual Social and Christmas Swap meet are held on the second Saturday and Sunday of the month respectively. Field Trips are as advertised from time to time.
Meetings are regularly held on the second Friday of the month as shown below.
TIME: 7.30 - 10.00pm
VENUE: Woodstock Community Centre, Church St, Burwood.

Meeting Dates for 1998				
			10th July	
13th February	***Nepenthes*** by Peter Biddlecombe		14th August	Tuberous ***Drosera*** by Ken Harper
13th March	***Sarracenia*** by Richard Riles		11th September	Potting ***Sarracenia*** by Jessica Biddlecombe
17th April	***B. reducta*** by Ken Harper		9th October	***Aldrovanda*** by Denis Daly
8th May	Tepus video night		13th November	
12th June AGM	Video Night after AGM		13rd December	Christmas ***Swap Meet***.

CURRENT MEMBERSHIP RATES

Single Membership within Australia	$A17
Family membership within Australia	$A17
Overseas Membership	$A17

Please make cheques/money orders payable to the Carnivorous Plant Society of NSW

Chat Corner

Jessica Biddlecombe

Hi fellow CPer's,

The Christmas break is over and you should all have been busy with your plants. Doesn't it excite you to see how good they all look now!!!

I did not get any feedback on anyone else's Sarras falling over so I must be the only one with this problem. What am I doing wrong!!!

I have heard a few say their Sarra tops are burning. With the intense heat and sun we have had lately, even Peter's head has burnt and without his hat on so maybe a 50% shade cover is needed at the moment.

In February Peter B. gave his talk on ***Nepenthes***. Peter was obviously nervous and for those unfortunate (or fortunate) people who were not there missed out on a good laugh and interesting information. Thanks to Ken Harper who added his considerable knowledge to the discussion a lot of questions were answered.

Peter took in some nice plants to show how well his grow in straight sphagnum (the ***N. ventricosta*** x ***N. rafflesiana*** had stunning pictures). Peter grows everything in sphagnum still with great success. (P.S. We also have live sphagnum for sale in 180 litre bags for $38.)

In March, Richard Riles gave a talk on Sarracenias. His talk was well prepared and caused much loud discussion. With a map and overlays showing the different areas the species grow in gave greater insight into these plants. Could we agree on whether hybrids were a good thing!!! Of course not, but it sure lead to everyone giving their opinion. The yeys beat the nays and as I am a hybrid person I am one of the yeas. Thank you Richard for an interesting talk.

From the mouths of those who were lucky enough to go to Richard Sullivan's barbecue, it seems they all had a good time -- wish we were there. Richard and Philippe Reyter had plants for sale so you should have been there and not missed out. It is a nice run to Bathurst. Richard and Janelle always make you feel welcome and at home. Why not give Richard a call and pop up there?

A friend (Phillip Hayes) popped around to show me his Venus Flytrap. An ordinary plant except for the one leaf with two heads. This happens occasionally I know, but his plant was joined at the base of the traps giving two distinct and identical traps. When one of the traps was triggered with a live fly the other trap closed simultaneously. As each mechanism could have worked individually I am eagerly awaiting further observations. Is this a case of getting two for the price of one!!!

May I say at this time thanks and congratulations to Jose and Sarah De Costa for the new edition in a few months to the Society and wish to ease their minds that he or she will be included in their annual fees. Rest assured from Aunty Jessica!!! ..... Jose, Breath in, Breath out, Sarah will get you through this time.

We all wish to thank Wesley and Joan Fairhall for our supper each month. They continue to feed us and slake our thirst.

News from Justin (who was very dubious about ***Nepenthes***) is that his are going very well and he is adding to his collection bit by bit. Good on you.

Nepenthes were, at one stage, likened to orchids. Everyone thought they needed hot houses. Well like orchids we found that most, with care, can be grown outside. Peter B has grown his Nepenthes under 50% shade ***(even lowlands)*** all year round. Admittedly last year was a severe winter for us (down to 0ºC .... first time in over 17 years). This low temperature did knock a few lowlands around and gave us a bit of a scare, but they rallied in spring better than ever. I would suggest a bit of protection in sustained lower temperatures. Last winter Richard Sullivan accidentally left a Nepenthes outside one night in -6ºC temperatures after showing it to friends. Next morning it was black and "dead" ..... shock ..... horror. Richard took it back inside his glass house where I believe it has revived. These plants are hardier than you think.

Kirstie has moved to Warrimoo (Blue mountains) and still travels to our meetings!!! Will we still see her in winter? Hope so, Kirstie always has something to add to the meeting.

Peter B and I have a variety of imported Tassel ferns and a few Australian ones. For all those interested in these rare and ancient ferns contact us on 02 9554 3678. We also have ***Nepenthes*** for sale. Don't miss out.

Come to the next meeting and add your bit of news.

Your friendly CP'er
Jessica

Utricularia longifolia Ken Harper

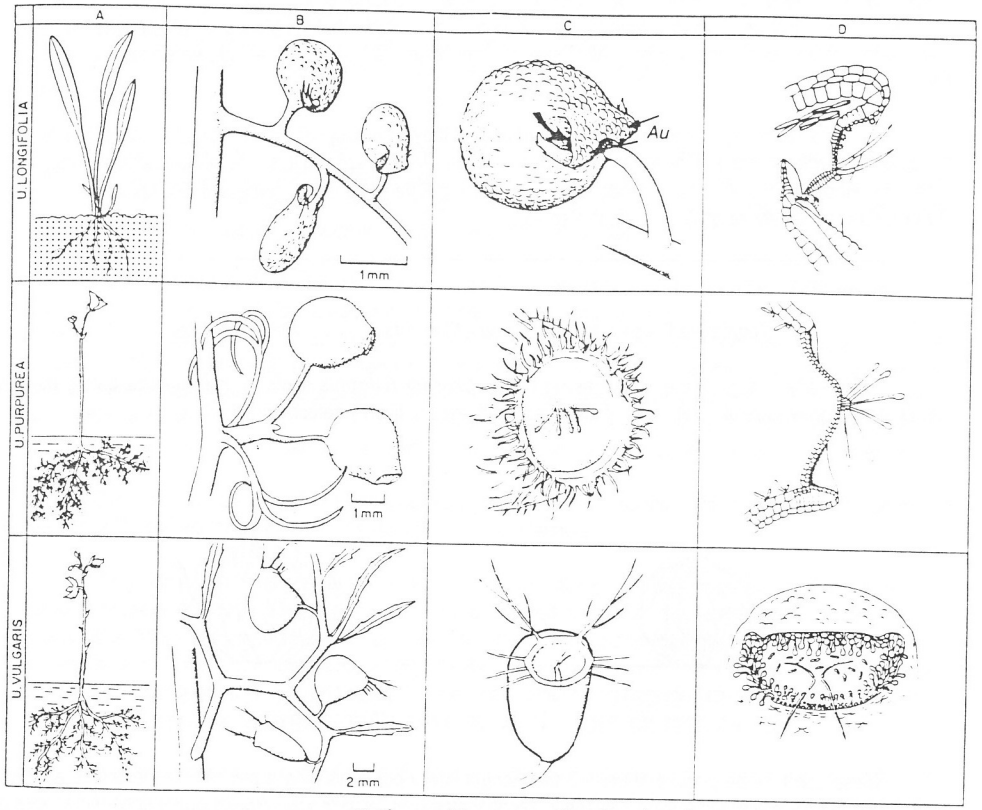
In my early years growing carnivorous plants, ***Utricularia*** did not feature highly on my "wanted" list. After discussions with a number of other growers and swapping some of my plants, I now grow about twenty ***Utricularia*** species. This short article will only discuss one of my favourite bladderworts, ***Utricularia longifolia***, an epiphytic ***Utricularia***.

Most epiphytic bladderworts grow upon trees, in rainforests where their stolons get a foothold in moss, decayed bark and detritus, but two live in bromeliaeds. They are not parasites and do not harm their hosts. Amongst these species are found those with the most magnificent flowers of all carnivorous plants, comparable in beauty with the finest orchids.

Utricularia longifolia is native to Brazil and has light green, irregular lance-shaped leaves up to 20 cm long. The leaves narrow to almost a stalk at the base and die away in winter. The foliage of ***U.longifolia*** can be quite easily burnt by the strong summer sun and some protection from direct sunlight is recommended.

I have been growing ***U.longifolia*** for seven years and it has only flowered for me five times from the four large pots of it I grow. Despite the difficulty experienced in encouraging ***U.longifolia*** to flower, it is definitely well worth waiting for. The scape is up to 50 cm long and can bear up to 12 flowers. Each flower is approximately 3 cm across and a beautiful mauve colour with a golden-yellow palate. There is reportedly in cultivation a violet-blue flowered variety of ***U.longifolia*** with an orange palate (var. *forgetiana*) which unfortunately I do not have.

My ***U.longifolia*** grow in a variety of media, ranging from straight sphagnum moss, mixes of peat and sphagnum moss, right through to a peat and sand mix. The only plants that have flowered for me grow in mixes containing straight or mostly sphagnum moss and this is now my preferred potting mix for this ***Utricularia***.



© FROM JUNIPER ET AL, "THE CARNIVOROUS PLANTS", 1989.

Fig. 4.12(*B*) Above. Showing something of the range of general habits, trap sizes and details of three different species of *Utricularia*.

U. longifolia. A mud or 'muck' living, sometimes semi-epiphytic species from Brazil. The striking blue-purple flowers on very tall scapes often, as Lloyd points out, rival the orchids in beauty. The traps, however, are minute and the submerged leaves, unlike *U. purpurea* and *U. vulgaris* are non-existent, whereas the aerial leaves are well developed. The globose traps are markedly tuberculate, and the 'antennae' short and blunt-tipped. Two well-developed 'auricles' (Au) almost occlude the trap entrance and only very small, free-swimming or crawling prey could enter such a trap, perhaps under the auricles (curved arrow). The door is conventional except for having only two trigger hairs and a steeply-sloping vestibule.

U. purpurea ranges from North to South America including the larger Caribbean islands. The flowers are similar to those of *U. longifolia*, unlike *U. vulgaris* which are yellow, but there are no aerial leaves. The submerged leaves of this New World group are markedly curved (B) and grouped in whorls. The traps are larger than *U. longifolia* with short antennae, particularly round the trap (C). The trigger hairs are very striking, with globose, mucilaginous tips.

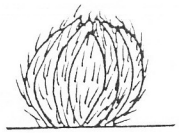
U. vulgaris is broadly distributed across the northern hemisphere, reaching northern Africa and temperate Asia. However, closely related species, e.g. *U. australis*, range from Japan to Australasia. The traps are large, up to 4 mm across, with very long antennae (B–C) around the trap. The submerged leaves (A–B) are well-developed and often almost obscure the traps. Air shoots with 'mussel-shaped leaves with stomata' (Lloyd, 1942) may arise in some forms of this large group. The trap mouth is large (C–D) with well-developed 'antennae' 'guiding' the prey to a mouth which is surrounded by mucilaginous stalked glands. (Fig. 4.15C). There are four trigger hairs tapering to a point.

U.longifolia can be easily divided and repotted in late spring or early summer but will not flower for me until at least two seasons after repotting. I therefore prefer to grow my ***U.longifolia*** in large pots of at least 20 cm in diameter, filled mainly with sphagnum moss. This large pot size ensures that the plant does not need to be disturbed for at least three or four years. All of my pots containing this bladderwort are grown standing in water trays.

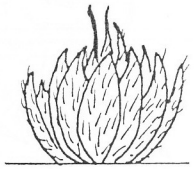
Australia has many native species of ***Utricularia*** but they never appear overly popular in collections here. ***Utricularia longifolia*** is one of the larger bladderworts species from Brazil and it is a delightful addition to my collection. Hopefully I'll successfully divide some more ***U.longifolia*** in months to come and distribute this ***Utricularia*** more widely for other growers to also enjoy.

Vegetative Propagation of *Drosera filiformis* — Philippe Reyter

In the early spring, as the winter resting bud of ***Drosera filiformis*** starts to open up and before the new leaves start to grow, carefully pull some of the primordial leaves until they detach from the bud.



TIGHTLY CLOSED
WINTER RESTING BUD



PICK LEAVES AT THIS STAGE
BEFORE NEW GROWTH

These can now be planted 1/3 to 1/2 their length into a pot containing a mix of 50% peatmoss and 50% sand. Stand the pot in a shallow water tray and in bright filtered light. While some growers prefer sphagnum moss as a potting mix for the parent plants, it might, as it grows, smother the primordial leaf before it has a chance to form roots and send up new leaves.

This method has worked for me with both ***D. filiformis*** var filiformis and ***D. filiformis*** var tracii with a strike rate of approximately 60%.

Quantifying Mineral Nutrition of Carnivorous Plants — Denis Daly

In January 1998 I received a copy of an article "Mineral Nutrition of Carnivorous Plants: A Review"[1] from the author, Lubomír Adamec, who had become aware of my interest in this topic. Lubomír's research activities have shifted to conservation of ***Aldrovanda vesiculosa*** and while it is unlikely that he will be publishing additional "Mineral Nutrition" articles in the future, he has written an article of tremendous value to amateur CPer's. It has summarised the work of many researchers and provided guidelines to the quantification of nutrient concentrations.

It will take some time to "digest" Lubomír's article, to collect and "digest" as many of the references that I can locate so that I might gain the maximum benefit possible. In the meantime here is my humble interpretation of some of the many aspects covered.

Quoting directly from the abstract of reference [1]:- *"Plant Carnivory is one of many possible adaptation strategies to unfavourable conditions, mostly low nutrient availability in wet, acid soils."* This reference reviews issues concerning the mineral nutrition of carnivorous plants: *"the relative importance of carnivory and root nutrition", "which elements from prey are of principal importance for growth; the relationship between mineral and organic nutrition based on carnivory; the interactions between carnivory and root mineral nutrition; and the importance of carnivory under natural conditions."*[1]

In the introduction of reference [1] we read:- *"As carnivorous plants (CP's) grow together with non-carnivorous plants in their natural habitats, both plant groups are subjected to the same ecological conditions. Carnivory, which developed several times during plant evolution, is only one of many possible adaptation strategies to unfavourable conditions (for a discussion of this, see Juniper et al., 1989: 3 - 11)"* [1].

Paragraph two of the introduction to reference [1] makes for informative reading:- *"Charles Darwin (1875) was the first to reveal that CPs showed enhanced growth if fed on insects and/or animal proteins. His successors showed that* **Drosera** *plants fed on insects had a higher rate of plant reproduction than vegetative growth (see Oosterhuis, 1927; Lloyd, 1942). It has been also demonstrated in* **Drosera** *that, alone, foliar uptake of nutrients from prey was not sufficient for normal growth of CPs. However, root mineral nutrition, alone, without feeding on insects was sufficient for normal growth. On the basis of laboratory growth experiments, German physiologist K. Goebel summarized the importance of carnivory as early as 1893: "Carnivory is useful for plants but is not indispensable.""*

Over the last 120 years biologists examined the *"relative importance of foliar and root nutrition of CPs"*[1]. Reference [1] reviews these questions "in the light of recent literature".

Many non carnivorous plants grow in very infertile soil alongside carnivorous plants. There must be some nutrients **present and available**, either permanently, or washed over, or otherwise made available at, the site from time to time. *"there is a tremendous difference between the* ***available*** *and* ***total*** *macronutrient content in most bog and fen soils. For example, Roberts and Oosting (1958) reported very low available nutrient content in bog soils with* ***Dionaea*** *in North Carolina ..... However, the available nutrient content in fen soils can be one or two orders of magnitude higher (e.g. Schwintzer, 1978; Aldenius et al, 1983)....."*[1, p275, Sect. III par 2].

Ever since obtaining a copy of the 1958 article on ***Dionaea muscipula*** by Roberts and Oosting[9 page 199] I, from an Engineering point of view, was disturbed by the fact that there was no indication of the accuracy or, in particular, the sensitivity of the chemical analysis, conducted on the behalf of Roberts and Oosting by Mr. Robert Schramm, other than "standard calorimetric methods" (of 1958), and yet it was reported that some nutrients were undetectable.

In point 6 of the summary of the 1958 article ***Dionaea muscipula*** by Roberts and Oosting[9 page 216] the soil is described as infertile .... BUT .... there is a "thin surface layer of black incorporating organic matter"[9 page 216]. There is no mystery to me as to where "modest fertilisation" for this nutrient modest species[1] could have come from? It would seem that amateurs are inclined to seize upon one aspect, the infertile soil, and ignore other important aspects, such as, in this instance, the reported presence of surface organic matter. So what if the soil is infertile if nutrients wash in and out from time to time, or are liberated from the surface litter by miro organisms, there are nutrients present and they provide a modest fertilisation for ***Dionaea muscipula*** and all the other non carnivorous plants present. Natural hydroponics.

Roberts and Oosting's nutrient feeding experiment[9 page 212] concludes with the sentence *"It is probable that poor growth of the experimental plants resulted from using too high a concentration or the wrong proportion of nutrients"*. Roberts and Oosting are pointing out the fact that the result of their nutrient trial is inconclusive and yet it appears that this test has been influencing amateurs for years. In answer to the obvious question as to why Roberts and Oosting published I would reply:- Approaching the end of time/money allocated to the project they needed to complete the research project and that includes publishing the research paper. There is nothing wrong in publishing, "warts and all", after all they did not hide the fact that the results of the fertiliser trial were inconclusive.

It is for these and, undoubtedly many other reasons, beyond the normal understanding of amateurs, that we can be grateful that Lubomír Adamec, a professional in the field of botany, took the time and effort to conduct his review[1]. It is a scientific paper. It does not "spoon feed us". It needs to be studied in some detail to be of benefit.

Lubomír, being familiar with much, if not all, of the past research, knowing, instinctively, what to critically question, having access to library resources, and botanical journals virtually "at his finger tips", was able to summarise and correlate the relevant conclusions from many researchers.

Lubomír advises[3] "In any case, slight fertilisation or none is much better than a great one" [3].

Carnivorous Plants need mineral nutrients. That fact would seem undeniable. What is debatable is now much and how should it be applied. But note what a slight or no fertiliser is better than ..... a great fertilisation. The concept does not extend to no fertiliser being better than a slight fertilisation.

Even those carnivorous plant species that do grow in very infertile soils do get some nutrients from the soil in their natural environment. However when grown in captivity, usually in pots, the leaching of the pots ultimately denies the plant access to those minute quantities of nutrients that it could acquire in the natural state. Could we expect it to survive, let alone thrive.

Everybody who uses an organic or peat based mix provides a "slight fertilisation" for their plants as soil micro organisms recycle the nutrients from organic form to nutrients that are available to the plants roots.

Repotting every year using a fresh, good quality peat could, depending upon the growth rate of their plants, provide sufficient mineral nutrients. The growth rate of any plant will be directly influenced by environmental conditions of temperature, light, atmospheric carbon dioxide concentration, water and nutrient availability. The least abundant factor becomes the deficient factor and predominates to limit the growth rate.

Recently I connected to the internet and joined various digests including the CP-Digest at cp@opus.hpl.hp.com. As well as joining this digest I down loaded copies of all the back issues that I could find.

There are many CP'ers who maintain that one should not use any fertilisers on carnivorous plants. However on closer examination of the correspondence it appears that while many CP'ers are aware of the fact that carnivorous plants require mineral nutrients from other sources other than insects they are wary of using too much fertiliser lest they kill their plants and prefer to rely upon the mineral nutrients obtainable from the peat in the potting mix.

Those brands of peat that gain the reputation for being "the better ones" are simply those with an appropriate range and concentration of nutrients. Incidentally the manufacturer of any particular brand of peat may have added a tiny amount of fertiliser.[6] **BUT for how long will peat be available at all let alone at reasonable cost?**

There are some CPer's posting to that digest and reporting success with a slight application of dilute fertiliser to foliage and traps as well as roots. The application of nutrients to the foliage can be beneficial to carnivorous plants as detailed in reference [1].

The key issue is how concentrated and how much fertiliser is beneficial and safe.

The danger of "a great fertilisation".

The danger in fertilising is in applying it excessively (a great fertilisation). When the concentration of "salts", in contact with the plant cells becomes too high the cell walls burst. The cells are killed, water is lost from the plant, opportunistic micro organisms invade the plant and consume it. You might as well crush the plant under foot. .... you get the same result.

Unfortunately most persons think "I want this plant to grow quick .... just a bit more fertiliser will help .... a bit more ..... Oh what the hell! ..... I just put some more fertiliser on to really get it going. ...

The recommended rate of "general fertiliser" application is excessive for normal plants

If you took any plant straight from the wild and fertilised it as if it was an "ordinary garden plant", such as a rose, its chances of survival would be very low indeed.

The "normal garden plants" that everyone puts heaps of fertiliser on, have, during their breeding over the years (sometimes over several centuries) developed a tolerance to high nutrient concentrations and indeed have become dependent upon it. They had to be in order to increase the crop yield. What we think of as "normal garden plants" are not "normal plants".

It is all a matter of realising that while plants must have mineral nutrients to survive and thrive, most plants, including carnivorous plants, don't need much fertiliser. While you won't know for a long time that you have starved a plant to death, you soon know if you have killed it with too much fertiliser.

Applying dilute fertiliser too frequently can also cause the nutrient concentration to build up to an excessive concentration in the potting mix. So simply using a very dilute fertiliser is not the total answer.

The popular press books and media gardening personalities do not want to be blamed if you kill your plant with too much fertiliser after you misinterpret their instructions. It's easier to advise "no fertiliser". If your plant dies much later you won't know to blame them. Anyhow they are relying upon the likelihood that the plant will survive on the nutrients in the soil until the next repotting.

Fertilisation with Special Cultivation techniques

The hydroponic and "in vitro" grower, must ensure that the plant has access to all the nutrients. Due to the very nature of these cultivation/propagation processes these nutrients are supplied by adding mineral nutrients. However as the nutrients are accurately controlled and usually completely replaced as fresh nutrient solution or fresh media the problem becomes simply one of using a sufficiently dilute nutrient solution as the unused nutrients are removed from the plant and discarded and thus cannot "build up" to excessive concentrations.

Aquatic *Utricularia* and *Aldrovanda* must always be grown "hydroponically" and thus by completely changing the nutrient solution the nutrients can be controlled more precisely than we can for pot cultivated plants.

The inadvertent "lazy hydroponic grower experiment"

This growing season (1997/1998 ... southern hemisphere), up to early January 1998 I had not applied fertiliser to my plants since the previous summer. All my plants in 100% sphagnum were all doing rather poorly. In hindsight I now realise that the nutrients had leached from the sphagnum. (Growing in 100% sphagnum is virtually hydroponic growing.) The sphagnum itself was telling me something was wrong. It was not actively growing. It was also lacking nutrients. But I was not taking any notice.

After receiving the copy of Lubomír's paper[1] I got to the second paragraph in the introduction and I knew the reason for the poor performance of my plants .... lack of mineral nutrients. My plants got a feed of dilute fertiliser immediately. I recommenced my fertilisation program. The ***Sarracenia's*** started to "recover" (produce functional trap leaves) within two weeks.

My tap water is not a dilute fertiliser

The tap water in Sydney, Australia, is quite good. I measured the conductivity of my tap water at around 180 micro siemens per centimetre (µS/cm) placing it mid range of the following data. Sydney water contains some nutrient ions as shown in the following Table 22.1 from reference [8]:-

Australian capital city water supply	Sodium mg/L (ppm)	Calcium mg/L (ppm)	Magnesium mg/L (ppm)	Chlorine mg/L (ppm)	Bicarbonate mg/L (ppm)	Sulphate mg/L (ppm)	Total alkalinity as calcium carbonate mg/L (ppm)	Conductivity dS/m
Melbourne	4	3	1	6	——	1	——	0.04
Sydney	10 - 39	2 - 12	2 - 7	16 - 27	——	2 - 14	——	0.1 - 0.3
Brisbane	21 - 46	43 - 78	39 - 88	32 - 111	72 - 101	1 - 85	51 - 72	0.3 - 0.6
Adelaide	78 - 106	23 - 36	14 - 27	142 - 195	70 - 164	8 - 40	50 - 117	0.5 - 0.8
Perth	36 - 140	3 - 30	4 - 12	57 - 240	10 - 140	8 - 70	7 - 100	0.2 - 0.9

If there is no carbonate in water its alkalinity is approximately 0.71 x bicarbonate concentration.[8]
dS/m = 0.001*µS/cm

Reference [8] is full of good practical advice. Whether you have a scientific background or not it is not hard to read. I recommend that you obtain a copy and read it cover to cover several times.

Total Dissolved Solids (TDS) = Electrical conductivity (EC) in dS/m multiplied by 640 [8]

In Sydney water's case this corresponds to a TDS of between 64 - 192 mg/L (ppm). But when the total ions above for Sydney are tallied they give a range of 32 to 99 mg/L. .... less than what would be expected from the conductivity readings. Why? .....The table above does not list the ions that are not relevant to plant growth/health. Note that the ranges overlap (64 to 99). I would question the data if they did not overlap.

Sydney water is definitely not a slight fertiliser even though it has some of the minor and trace essential plant nutrients present. This is in agreement with the results of the lazy hydroponic grower experiment.

It is also a "soft water". Sodium based soaps are quite effective, there is no need to use potassium soaps or water softening chemicals to get a lather. This is obvious from the lack of bicarbonate and alkalinity shown in the table above[8].

The lazy hydroponic grower's conclusions.

In reference [1] ***Sarracenia flava*** is classified as a "nutrient requiring species". Given the observations that I made during my "lazy hydroponic grower" experiment, I would suggest that all ***Sarracenia*** are "nutrient requiring species".

Without nutrient uptake from the roots the traps do not form and thus the plant cannot trap insects. My tentative observations indicate that ***S. psittacina*** and to a lesser extent ***S. purpurea*** are the most susceptible. The greater susceptibility of these species to lack of mineral nutrients could be a direct consequence of the reduced volume of rhizome (reduced food reserves), compared to the other ***Sarracenia*** species, that is a characteristic of both of these species. (Note that while I believe that this theory is likely I have not conclusively proved it at this time.)

Observations on some CP species not cited in reference [1]

During the 1997/98 spring/summer some ***Darlingtonia's*** I had been growing in 100% sphagnum died. They had grown very well the year before when I was actively fertilising with very dilute fertiliser every week.

I obtained replacement plants from Philippe Reyter from stock he had naturalised at Lithgow[4]. Where they had been "naturalised" they undoubtedly had built up a reserve of nutrients.

Fortunately, as I got these replacements in December 1997, they did not have to wait long, for me to realise what I was doing (not doing) wrong. However since I recommenced applying dilute fertiliser both plants commenced to send up a flower scape. Growth slowed in the record hot weather over January and February 1998 but has improved now that the weather has moderated somewhat.

Most, if not all, ***Darlingtonia's***, in cultivation, are grown in 100% sphagnum (or serpentine or gravel). Many people report that they are hard to grow. At this time I suggest this could be because they are also "nutrient requiring species". (Note that while I believe that this theory is likely I have not conclusively proved it at this time.) I am assuming that they are at this point in time. Mine certainly grow better with a "slight fertilisation".

My experience of the death of unfertilised ***Heliamphora*** seedlings that were growing in 100% sphagnum and a lone fertilised ***H. minor*** seedling survivor also leads me to suspect that ***Heliamphora's*** are also a "nutrient requiring species".

The reaction of *Cephalotus* to fertiliser.

Cephalotus is definitely able to absorb nutrients through the roots. Indeed a ***Cephalotus*** is able to absorb sufficient nutrients through its roots that the plant reverts to the non carnivorous winter leaves if given around the same small amount of root fertilisation that when applied to ***Sarracenia's*** encourages trap formation.[5]

Cephalotus is able to grow big, but without traps, by absorbing mineral nutrients via the roots and non carnivorous foliage, without insects. It abandons its carnivorous habit. This is immediately obvious as ***Cephalotus*** has a different carnivorous leaf from its non carnivorous leaf.

That *Cephalotus* does not produce traps when not stressed for nutrients suggests to me that the mechanism that triggers trap formation in spring may indeed be the result of the depletion of stored nutrients due to the accelerated growth resulting from increased photosynthesis that accompanies the longer days and brighter light of the approaching spring/summer.

Cephalotus could be evolving towards or away from Carnivory at this point in geological time. Letting *Cephalotus* flower should result in an increase in trap formation as essential nutrients are diverted to seed production.

Further experiments with *Cephalotus*

At the end of the last paragraph of section IV of reference [1] the mineral content in typical insects, as determined by several researchers, is detailed. There are apparently ample amounts of nitrogen, phosphorous, potassium and calcium together with some magnesium.

I will attempt experiments with fertilisers with a very low level of nitrogen, phosphorous, potassium and calcium in order to hopefully encourage ***Cephalotus*** to produce the trap leaves. I will also experiment with applying dilute "liquid insect" directly into the traps.

Pinguicula's

Some species of ***Pinguicula's*** that discard the carnivorous habit over winter, when insects are scarce, may also use a similar process of detecting the approach of summer as ***Cephalotus*** and thus will be likely exhibit a "loss of Carnivory" if too well fed. My ***Pinguicula's*** go very well with a "slight fertilisation".

Observations of CP species addressed in reference [1]

I have grown and applied a "slight fertilisation" to many of the plants that Lubomír refers to as "root leaf nutrient competitors". Their growth has always been much faster than if I did not fertilise them. However as my method of fertiliser application has been by spray I have been applying fertiliser to the leaves as well as to the soil so I cannot evaluate which, leaf or root, fertilisation method was best.

The revelation that ***Drosera's*** need to get nutrients from the soil and indeed can survive without Carnivory (page 274 reference [1]) is very interesting. Do they actually abandon Carnivory, as ***Cephalotus*** does, so that they no longer trap or digest trapped insects? How would we know that a ***Drosera*** has abandoned Carnivory? Unlike ***Cephalotus***, ***Drosera's*** have only one type of leaf.

My experience with fertilising pygmy ***Drosera*** has been limited as I have not had much success with pygmy ***Drosera*** (I did try to grow them when I was not fertilising without success). I have a few newly acquired pygmy ***Drosera*** plants (from Richard Sullivan) and they seem to like being sprayed with dilute fertiliser. So do my ***Dionaea muscipula*** plants. The health of ***Dionaea muscipula*** plants growing in 100% sphagnum did not deteriorate as far as the ***Sarracenia's*** during the "lazy hydroponic grower" trial. This tends to confirm the inclusion of ***Dionaea muscipula*** in the "nutrient modest species". However my observations of "nutrient modest species" are rather limited as yet.

My tentative observations indicate that ***Drosophyllum*** and ***Byblis*** react favourably to dilute fertiliser applied to both soil and foliage.

How much fertiliser to add

Lubomír also recommended[3] the article: "Adamec et al. 1992. CPN 20/21:18-24 (reference [2])" to me.

On page 20 of reference [2] information as to the concentration of macro and minor nutrients applied to pots containing carnivorous plants with beneficial effect is presented. To us amateur cultivators such information is very valuable.

I take the liberty of reformatting and elaborating on these details. The nutrients added to the substrate in the "NS-S" variant are as follows.

Description of Compound	Formula Weight	mili Moles per kg of Substrate of "NS-S"[2]	Amount per kg of substrate in "NS-S"[2]	Amount per Litre in "x5" Stock i.e. applied 200 mL to 1 kg of soil
$CaCl_2$	110.99	0.198 mM	22 mg	110 mg
NH_4NO_3	80.05	0.50 mM	40 mg	200 mg
KH_2PO_4	136.09	0.15 mM	20.14 mg	100.7 mg
$FeCl_3$	162.224	0.0032 mM	0.52 mg	2.6 mg
$MgSO_4 \bullet 7H_20$	246.50	0.082 mM	20.22 mg	101.1 mg
Total salts			102.88 mg	514.4 mg

Examining the nutrient details added to a kilogram (dry weight) of soil using the chemical concept of moles may be somewhat complicated. My main reason for doing so was to "recalculate" the calculations of reference [2] in order to "cross check" so that I could be certain that I was interpreting the data in reference [2] correctly. As it was I discovered a minor discrepancy in the quantity of chlorine. These "calculations" are presented in the following table:-

Fertiliser Component	Qty of component per kg of Soil (mM)	Quantity of the nutrient ions per kg of soil								
		Nitrogen from ammonium	Nitrogen from nitrate	Potassium	Phosphorous	Calcium	Magnesium	Sulphur	Chlorine	Iron
$CaCl_2$	0.198 mM					0.198 mM			0.396 mM	
NH_4NO_3	0.50 mM	0.50 mM	0.50 mM							
KH_2PO_4	0.15 mM			0.15 mM	0.15 mM					
$FeCl_3$	0.0032 mM								0.0096 mM	0.0032 mM
$MgSO_4 \bullet 7H_20$	0.082 mM						0.082 mM	0.082 mM		
Totals		0.50 mM	0.50 mM	0.15 mM	0.15 mM	0.198 mM	0.082 mM	0.082 mM	0.4056 mM	0.0032 mM
Atomic weight		14.01	14.01	39.1	30.97	40.08	24.31	32.06	35.45	55.85
milli grams	37.13 mg	7.0 mg	7.0 mg	5.86 mg	4.65 mg	7.936 mg	1.993 mg	2.629 mg	0.3403*mg	0.1787 mg

* there appears to be an arithmetic error in reference [2] with regard to the quantity of chlorine present.

Note that there is only around 37 mg of nutrient elements in 103 mg of fertiliser salts. mM is a mili mole or 0.001 mole; I mole = Formula weight (Atomic weight) in grams. i.e. 1 mole of nitrogen is 14.01 grams of nitrogen

The trace nutrients were not considered in the experiment presented in reference [2]. They would be present in both the peat and in the plants used in the experiment. Trace nutrients will be present in any good fertiliser used and in total they would be of the order of 1% of the total of the macro and minor nutrients ... 1 mg in the 100 mg of fertiliser added to each kg of soil.

It should also be noted that there is calcium and magnesium present in the formulation. In Australia, for the purpose of manufacturing supplemental fertiliser, it is assumed that calcium and magnesium are in the potting mix, or in the water. Most supplemental purpose fertilisers sold (e.g. Zest, Thrive, Aquasol etc.) will be unsuitable unless you have enough calcium and magnesium in your water. A fertiliser sold for hydroponic use would be more appropriate even if you have to mix two parts, A and B.

Thus the addition of 100 mg of fertiliser per kg of dry weight of soil is a starting point. This can be applied after potting in the manner employed in reference [2]:- Dissolve 0.5 grams (half of one gram) of fertiliser per litre of water and apply 50 mL of the resultant fertiliser solution for each 250 g of "soil" in the pot.

One or two drops of this nutrient solution can be applied to one or two leaves or added into one or two traps each per week in the manner detailed in reference [2].

Note the minimum quantities used! ..... a slight fertilisation.

Ivan Snyder, from the USA, reported using Miracle Grow [7], making a stock solution of 7.5 grams to 3.785 litres (US gallon) . Ivan's stock solution contains around 2 grams of dissolved salts per litre or 4 times the strength of the solution used by Lubomír [2]. But Ivan does "dilute as needed for each plant"[7]. The phosphorous is rather high and there is no calcium and magnesium (probably in Ivan's water). "Miracle Grow" is a supplemental rather than a complete fertiliser.

My "home brand" fertiliser Carni Thrive (mark 3) is a two part concentrated solution and is normally diluted 400:1 with water, at which time, both parts are mixed together. It is a complete fertiliser rather than a supplement and indeed may be used as a hydroponic fertiliser. While it contains calcium and magnesium its pH is less than 7.0.

The 400:1 diluted Carni Thrive fertiliser contains around three times the dissolved salts as does the solution used by Lubomír [2]. Thus it is only necessary to apply 60 mL of the 400:1 diluted fertiliser to one kg of soil. For a 250 gram pot this is easily effected by watering the plant, letting it drain, and applying 15 mL of diluted fertiliser (two teaspoons) to the pot surface. The trace elements in Carni Thrive account for approximately 1% of the total dissolved salts.

The "no fertiliser" recommendation occurred with Australian native plants

In the 1960's when cultivation of Australian native plants was becoming popular there were problems of putting too much fertiliser on and killing the plants. Then it was said "don't use fertiliser" on Australian native plants. Australian native plants were virtually "straight from the wild" due to the fact that they became very popular within a short period of time. The desirability of the Australian native plants created a market demand that resulted in research to "solve the problem". Now appropriate fertiliser is sold for use with Australian native plants.

Conclusion

There is information available that provides information about providing a "slight fertilisation" for carnivorous plants. It does need the use of some basic arithmetic and chemistry and it does need care, for one does not know how close the experimenter was to the maximum quantity that the plant could take.

It is likely that sacrifice plants will be needed as one searches for the upper limit in order to define a safe area within which plants can be grown. However, occasionally data will be available with a wide separation of concentrations of nutrients, which will provide guidelines which we can start with and, hopefully, limit the numbers of plants sacrificed. To find this data it is highly probable that a "literature search" would be necessary.

References:

[1] ADAMEC Lubomír, **Mineral Nutrition of Carnivorous Plants: A Review,**
The Botanical Review Vol 63 No 3, July - September 1997, The New York Botanical Garden.
[2] ADAMEC Lubomír, DUSÁKOVÁ Karla, JONÁCKOVÁ Marcela,
Growth Effects of Mineral Nutrients Applied to the Substrate or onto the Leaves in Four Carnivorous Plant Species,
Carnivorous Plant News Letter Vol 20 Nos 1 & 2, March - June 1992, International Carnivorous Plant Society, ISSN 0190 9215, p18 to 24.
[3] Correspondences with Lubomír ADAMEC of January 1998.
[4] REYTER Philippe, **Establishing *Darlingtonia californica* in the wild near Lithgow,** FlyTrap News Vol 10 No 3,
January/February/March, 1997, The Carnivorous Plant society of NSW, ISSN 1323-8159, pages 9 to 11.
[5] Personal observations.
[6] DALY Denis, **The salesperson with flecks in their hair,** FlyTrap News Vol 11 No 1, July/August/September, 1997,
The Carnivorous Plant society of NSW, ISSN 1323-8159, page 27 paragraphs 1 & 2.
[7] SNYDER Ivan, **What type of fertiliser some of us Yanks use,** FlyTrap News Vol 10 No 1, July/August/September, 1996,
The Carnivorous Plant society of NSW, ISSN 1323-8159, page 19.
[8] HANDRECK Kevin A. & BLACK Neil D. **Growing Media for Ornamental Plants & Turf,** 1994, University of NSW Press.
ISBN 0-86840-333-4 page 259.
[9] ROBERTS Patrica R., Oosting H. J., **Responses of Venus Fly Trap (*Dionaea muscipula*) to Factors involved in its Endemism,**
Ecological Monographs, Vol. 28, No 2, April 1958.

Update on growing *Aldrovanda vesiculosa*

Denis Daly

I now grow ***Aldrovanda*** outside in small bottles[6] [7] and am just attempting to cultivate it in an old concrete laundry tub. But at this stage I would offer the following progress report.

In using the tub as a cultivation container I discovered that **tadpoles eat *Aldrovanda* traps.** While I did not catch them in the act there were no other possible candidates who could strip a 6 cm section of *Aldrovanda* of traps in a day, leaving the stalk behind. The frogs have lived and breed in my back yard tubs and trays for years.

I concluded that the tadpoles were after the prey trapped inside as they did not eat the axis of the plant nor the growing tip where there are no traps. With the planting of reeds and bottom debris in the tub the tadpoles are impossible to catch with a small hand net, particularly when they reach the carnivorous stage and a few eat the rest and become big and strong and fast.

I am now using a nylon "shark net" held up by a polystyrene float to protect the ***Aldrovanda***. While the mesh size of the net is sufficient to let a small tadpole enter I am hoping that I will exclude the larger tadpoles before they become carnivorous while leaving the smaller herbaceous tadpoles access to keep the algae in check. A fine mesh net would tend to isolate the environment for the ***Aldrovanda*** from that of the tub and I would like to avoid this.

Is this problem of tadpoles eating traps of ***Aldrovanda*** common to many species of frogs or is it only a few species of frog that do so? Frogs are becoming endangered and diminishing in numbers. So is ***Aldrovanda***. Are some species of frog being advantaged by the loss of other frog species and are these the ones whose tadpoles like eating *Aldrovanda* traps?

The pieces of Darwin ***Aldrovanda*** that were outside at Richard Sullivan's at Bathurst have not withstood the minus temperatures already experienced. Yet in Sydney, 3 hours drive from Bathurst, we still have days over 30°C and nights over 20°C. I have cancelled the cold climate outdoor growing trial for this coming southern hemisphere winter. I believe that it would be preferable to get some experience at 5°C minimums during Sydney winter first.

It is now apparent that ***Aldrovanda*** needs more light to flourish than can be provided by two 20 watt fluorescent tubes over an aquarium. By injecting carbon dioxide it seems that I was able to compensate for the reduced light but then other problems, such as algae blooms, predominate. On 28th March 1998 I "fired up" one of my trusty carbon dioxide brewers and started injecting carbon dioxide, via a fine airstone buried in the bottom litter, into the outdoors concrete tub containing Darwin and East Australian Coast ***Aldrovanda***. The different types are separated by floating in different nylon "shark nets". Hopefully the tadpoles that are still in the herbaceous stage of their growth will assist the snails in keeping the algae down.

In any case I have found that twisting a 1.5 mm diameter stainless seel wire around in the water will wind the algae onto itself. Having the room and as spillage is not a problem, as it was indoors, it is a simple matter to move the wire rapidly away, to break the thread of algae, should an ***Aldrovanda*** plant be drawn toward the wire. Alternatively **gentling twisting** the wire while preventing the ***Aldrovanda*** "twisting around" the wire with the other hand (under water) is useful in removing filamentous algae from the ***Aldrovanda***. The algae is not such a problem if the *Aldrovanda* is growing strongly in adequate light.

In Sydney *Aldrovanda* must not be placed in full sun in mid summer. It needs filtered sun around 50% or morning sun (4 hours), or around 2 hours of midday sun only and no afternoon sun. Shade cloth could also be used in summer giving, in Sydney, the advantage of easy removal in winter to permit the ***Aldrovanda*** to grow all year without having to move the tub. It can also survive in a shaded but brightly lighted area. It would appear best to commence in a low lit area and gradually increase the light intensity.

Always have two or preferably three bottles of any *Aldrovanda* variety growing before changing any growing condition for that variety and then only use one jar while changing the conditions.
If failure occurs produce a replacement jar from divisions before trying anything else.

Always cut off the senescent (dying) end with a small pair of scissors into sections with two whorl lengths when they have just "lost colour". Cut the stem in the middle of a internodal section. Once free of the main plant and the apical dominancy of that plant's growing tip the dying sections will shoot and produce more plants.

While looking for bottles to float ***Aldrovanda*** seeds in my aquarium I came across a piece of Darwin ***Aldrovanda*** that had been forgotten but has survived in a closed bottle for about 5 months, floating in the aquarium. The bottle had a healthy colony of prey as well as nutrients leaching from a block of peat. Its has not grown much but it is still green (dark green ... needs more light) but apparently otherwise healthy. This piece will be left to determine how fast it will grow and/or long it can survive in low light conditions. This could form the basis of a method to store Darwin ***Aldrovanda*** over winter in cold climates.

Small pieces of ***Aldrovanda*** can be dragged to the bottom of the container in a peat storm, caused by shaking the bottle, and buried by the peat. There they will die from lack of light.

I will experiment with shading the ***Aldrovanda*** container with shade cloth and with "bubbling air through the container" to keep it cool in summer as used by Lubomír Adamec[5].

References:

[1] KONDO Katsuhiko, KOKUBUGATA Goro, VARGHESE Sindhu Balu, ITOYAMA Miyoko, BRECKPOT Christian, KROMER Krystyna and KAMINSKI Ryszard, **Conservation of Endangered *Aldrovanda vesiculosa* by Tissue Culture**,
Carnivorous Plant News Letter Vol 36 No 3, September 1997, International Carnivorous Plant Society, p89 to 92.

[2] ADAMEC Lubomir, **How to grow *Aldrovanda vesiculosa* Outdoors**,
Carnivorous Plant News Letter Vol 36 No 3, September 1997, International Carnivorous Plant Society, p85 to 88.

[3] BRECKPOT Christian, ***Aldrovanda vesiculosa* Description, Distribution, Ecology and Cultivation**,
Carnivorous Plant News Letter Vol 36 No 3, September 1997, International Carnivorous Plant Society, p73 to 82.

[4] ADAMEC Lubomír, DUSÁKOVÁ Karla, JONÁCKOVÁ Marcela, **Growth Effects of Mineral Nutrients Applied to the Substrate or onto the Leaves in Four Carnivorous Plant Species**, Carnivorous Plant News Letter Vol 20 Nos 1 & 2, March - June 1992, International Carnivorous Plant Society, ISSN 0190 9215, p18 to 24.

[5] ADAMEC Lubomir, **Flowering of *Aldrovanda vesiculosa* in Outdoor Culture in the Czech Republic and Isozyme Variability of its European Populations**, Carnivorous Plant News Letter Vol 36 No 3, September 1997, International Carnivorous Plant Society, p99 to 103.

[6] SCHELL Chris, **Growing *Aldrovanda vesiculosa*, A Simple method for its Captive Propagation.** FlyTrap News Vol 11 No 2, October/November/December, 1997, The Carnivorous Plant society of NSW, ISSN 1323-8159, pages 13 to 15.

[7] DALY Denis, **Change of method of growing *Aldrovanda vesiculosa*** FlyTrap News Vol 11 No 2, October/November/December, 1997, The Carnivorous Plant society of NSW, ISSN 1323-8159, pages 17 to 20.

Germinating European *Aldrovanda vesiculosa* Denis Daly

On the 9th March 1998 I received 10 European ***Aldrovanda vesiculosa*** seeds from Christian Breckpot in Belgium. They came in water in a small tube. They had not been allowed to dry out. It would be very likely that ***Aldrovanda vesiculosa*** seeds are recalcitrant.

I treated them with gibberellic acid (GA_3) by soaking them for a day in a solution of 20 mL boiled (and cooled) tap water and 0.2 mL of a methanol tincture of gibberellic acid containing 100 grams of gibberellic acid per litre. While the seeds were soaking they were floating in a clear plastic bottle floating in an aquarium heated to 25°C.

The concentration of gibberellic acid was thus 1 g/L, some 20 to 50 times greater than that used by Professor Kondo et all in inducing ***Aldrovanda*** seed germination "in vitro".[1] I choose this concentration because after being advised to use it at that strength by Allen Lowrie several years ago, it has always proved successful with ***Byblis*** and ***Pinguicula*** [3] seeds. It obviously works for ***Aldrovanda*** seeds. It worked but it was a guess or stab in the dark, rather than a scientific assessment.

On the 10th March 1998 I transferred the seeds to a clear plastic container containing boiled (but cooled) tap water and once again floated them in the 25°C aquarium. See cover photograph of this issue of FlyTrap News.

On the 13th March 1998 I was pleased to find that three seeds had germinated. By the 17th March 1998 one more had germinated. At that time I transferred one of the germinated seeds and one of the un-germinated seeds to another plastic container containing water from an outside tub in which North Australian (Darwin) ***Aldrovanda*** was growing.

The stages of germination that were observed, were substantially as documented in reference[1] except that I have not observed the "pin point root tip" changing colour to red and the root grew a little longer viz:-

1. The first sign of germination was a translucent shoot (root) that protruded from the hilum of the seed. Except for the dark "pin head" spot on the end it would have been difficult to see at first.

2. This shoot grew to about 1 to 2 mm and gradually became green.

3. After 3 to 7 days the true leaves emerged, from the end of the green shoot closest to the seed, and grew. The seed coat remained attached.

I await with great interest to see what is under the seed coat that still remains firmly attached. If I had many seeds I would investigate this further by dissecting a seedling. I am taking a sequence of photographs documenting the germination process of ***Aldrovanda vesiculosa***.

On the 21st March 1998 when no other seeds had germinated I collected the six remaining un-germinated seeds and again soaked them in gibberellic acid (strength and method as above) for a further 24 hours. I also placed one of the germinated seeds into water in which "fresh" peat had been boiled.

I will have to persist with the un-germinated seeds for a long time, perhaps for a few years, as Lubomír Adamec reports a germination rate of 50% with seeds germinating over a period of a year[2]. I got 40% in four days. How lucky can you be! Yes I know it is a small sample of seeds!

References:-

[1] KONDO Katsuhiko, KOKUBUGATA Goro, VARGHESE Sindhu Balu, ITOYAMA Miyoko, BRECKPOT Christian, KROMER Krystyna and KAMINSKI Ryszard, **Conservation of Endangered *Aldrovanda vesiculosa* by Tissue Culture**,
Carnivorous Plant News Letter Vol 36 No 3, September 1997, International Carnivorous Plant Society, p89 to 92.

[2] ADAMEC Lubomir, **Flowering of *Aldrovanda vesiculosa* in Outdoor Culture in the Czech Republic and Isozyme Variability of its European Populations**, Carnivorous Plant News Letter Vol 36 No 3, September 1997,
International Carnivorous Plant Society, p99 to 103.

[3] DALY Denis, **The use of Gibberellic Acid in seed germination**,
FlyTrap News Vol 9 No 2, October/November/December, 1995, The Carnivorous Plant society of NSW, ISSN 1323-8159, pages 12 to 19.

Cultivation of Carnivorous Plants at Bathurst (Part 4) *Nepenthes* Richard Sullivan

I grow my *Nepenthes* in an enclosure under my ***Drosera*** trays in my glass house. The raised trays under which they grow are three meters long, one meter wide and one meter off the ground. I have lined outside the space under this tray with 0.5 mm thick, 1.5 meter wide plastic. The plastic is wrapped around the back, sides and 2/3 of the front. The bottom of the plastic is buried under the soil surface of the glass house floor. The entire enclosure is within my glass house.

I have a second piece of plastic that covers up the 1/3 that is not covered that acts as a door. The plastic sheets overlap by 200 mm. This keeps a high humidity and a high temperature (in winter). The glass panels in my glass house do not go to the ground so there is only 400 mm height of glass providing light to the enclosure. The enclosure receives direct sunlight on the right side in the morning and the left side in the afternoon in summer. In winter the left side does not receive direct sunlight.

In the photograph the plastic sheeting forming the door has been folded up and the left side sheet, which is partly visible in the upper left of the photograph has been lifted out of the soil and folded back in order to take the photograph.

The glass house is warmed in winter, but the temperature can get down to 2°C. Where I grow the *Nepenthes* I also have a fish tank heater in a fish tank (not visible in photograph). The heater is only on in autumn, winter and early spring. Last winter (1997) the temperature did not fall below 5°C with a lot of condensation on the plants. The official minimum was minus 9°C for the winter of 1997.

Richard Sullivan's Bathurst *Nepenthes* collection.

Some of the plants are planted in live sphagnum moss, some in a mix of 1 part sand, 1 part sphagnum moss, 1 part orchid bark and 1/2 part peat moss. I can see no difference in growth between the two mixes. The sphagnum moss is a good indicator. If the sphagnum is growing good so is the ***Nepenthes***.

I water by a hand spray using rain water when available, if not town water. Once a week in spring, summer and early autumn I spray the plants with a week solution of Maxicrop. Once a month in winter or when the temperature is very hot I water every day. The main reason is to wet the foliage and to raise the humidity.

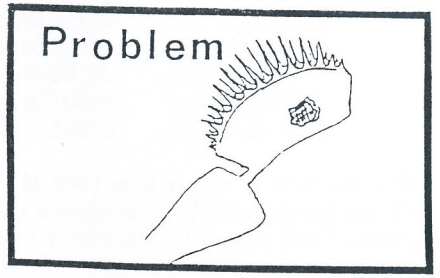
Before I made my ***Nepenthes*** a new home they were under a plastic bag (one that can cover a pallet) and they went down to 0ºC with only one dying (***N. alata***). The plants that survived were ***N. khasiana***, ***N. fusca***, ***N. ventricosta***, and ***Nx rokko***. The growth of all the plants slowed down for a couple of months but when spring and the warmer weather came all the plants started to grow and produce new pitchers. ***Nx rokko*** is unusual in that pitchers formed from leaves that were fully formed in autumn (but did not produce pitchers) and produce pitchers in late spring early summer. This has happened for 3 years.

Over the years my collection of ***Nepenthes*** has grown from the first, seedling of ***N. ventricosa*** from Fred Howell, to over 18 different sorts with only the size of the growing area stopping me from obtaining every new highland ***Nepenthes*** I see. I stick to highland species and hybrids and I do not know how lowland species would go for me.

Also growing with my ***Nepenthes*** are ***D. adalae***, ***D. prolifera***, ***D. schizandra*** (flowered 1997), ***U. longiflora***, ***U. tricolor***, and ***U. reniformis***.

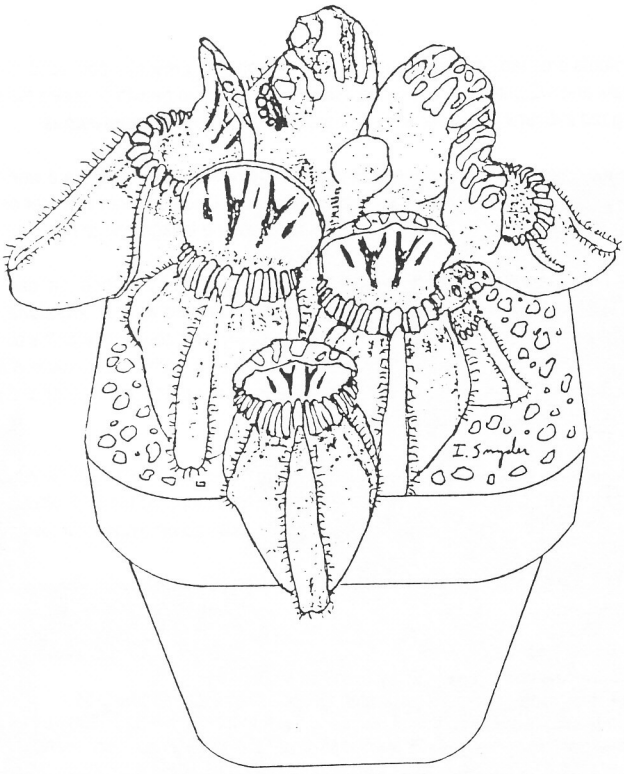
References:-

[1a] SLACK Adrian, **The Carnivorous Plants**, 1979, Alphabooks, ISBN 0 589 50142 9
[1b] SLACK Adrian, **Insect Eating Plants and how to grow them**, 1986, Alphabooks, ISBN 0 906670 35 7
[2] SCHELL, Donald E., **Carnivorous Plants of the United States and Canada**, 1976, John F. Blair ISBN 0 910244 90 1
[3] PIETROPAOLO, James and Patricia, **Carnivorous Plants of the World**, 1986, Timber Press, ISBN 0 88192 356 7
[4] CHEERS, Gordon, **A guide to the Carnivorous Plants of the World**, 1992, Colins, Angus and Robertsons, ISBN 0 207 16186 0
[5] Conversations with Allen LOWRIE
[6] Personal Observations
[7] Conversations with Denis DALY
[8] Conversations with and correspondence with Fred HOWELL
[9] Conservations with Phillip REYTER
[10] ERICKSON, Rica, **Plants of Prey**, 1982, University of Western Australia Press, ISBN 0 85564 099 5
[11] Conservations and correspondence with Russell DIXON
[12] DALY Denis, Propagation of some Specific Species of Carnivorous Plants, **FlyTrap News Vol 9 No 1**, July/August/September, 1995, The Carnivorous Plant Society of NSW, ISSN 1323-8159.
[13] Correspondence with Paul GEE
[14] LOWRIE Allen, Carnivorous Plants of Australia Volume 2, 1989, University of Western Australia Press, ISBN 0 85564 300 5



Solution: cripple the bugger and try again!

courtesy of Ivan Snyder



Drawing of ***Cephalotus follicularis*** by of Ivan Snyder