Botanical Vampires!

Parasitic and Carnivorous Plants in the Ecology Reserve of Macquarie University

The Ecology Reserve of Macquarie University is adjacent to the Christie Park ovals just across the M2 to the north of the campus. It consists of Hawkesbury Sandstone Vegetation with some riparian vegetation along the river bank. Would you expect to find parasitic and carnivorous plants here? Does it surprise you to know that you could find more than ten different species? Many of these plants are hard to find: some are ephemeral (short-lived), some very small, a few grow high in the branches of trees and others are rare. The plants are not labelled or mapped – to find them you will have to look hard! Information about and photos of the carnivorous and parasitic plants you might find in the reserve are provided on the following pages. Good luck!

Parasitic plants

Parasitic plants derive some, or all, of their sustenance, both organic compounds (including carbohydrates and amino acids) and nutrients (such as phosphorus and potassium), from other plants. There are over 4000 parasitic plant species in the world. These can be either obligate parasites, which require a host plant in order to complete their lifecycles, or they can be facultative parasites, which are not completely dependent on host plants. Wholly parasitic plants, called holoparasites, do not produce chlorophyll and therefore cannot photosynthesise. Other parasitic plants, known as hemiparasites, do photosynthesise, but also obtain water, nutrients and some organic material from their host plant or host plants. Parasitic plants have specialised roots, called historian, which invade the host plant and connect to xylem and/or phloem from which they absorb water, organic compounds and nutrients. Parasitic plants can invade the roots or stems of their hosts. The range of plant parasites in the Ecology Reserve may take the form of trees, herbs or shrubs, including plants that parasitise stems and roots, and both hemi-parasitic and holoparasitic plants.

1. Exocarpus cupressiformis (native cherry) SANTALACEAE

Exocarpus cupressiformis is a small tree with roots that form a hemiparasitic association with nearby eucalypts. The plant is also unusual in that the flower stalks, rather than the fruits, grow larger and become succulent and full of flavour. The fruit remains hard and green but birds are attracted to the fleshy, tasty stalks, swallowing the fruit with the stalk and later spreading the seed. This method of attraction for seed dispersal differs from that of many other plants which have fruit with sweet, fleshy outer layers to attract birds and animals.

Clockwise from top left: *Exocarpus cupressiformis* flowers; ripe fruit with the bird-attracting fleshy stalk; *E. cupressiformis* with its eucalypt hosts; a developing seed.

2. Mistletoes LORANTHACEAE

Mistletoes are stem or branch parasites. Look for clusters of short branches growing from branches high in the canopy of scribbly gums (*Eucalyptus haemastoma*). Both branches and leaves of the mistletoes have a form and shape slightly different from that of the host scribbly gums. Three different mistletoe species, *Amyema pendula, Dendrophthoe vitellina* and *Muellerina eucalyptoides*[1], can grow on this particular eucalypt. In Australia, many mistletoes mimic the leaves of their hosts. It is not fully understood why, but some theories suggest convergence in leaf structure and function either through adaptation to the same environmental conditions or to avoid detection by herbivores. Despite a similarity in foliage, mistletoes produce flowers that are very unlike those of host plants so that they attract a different assemblage of pollinators to facilitate the dispersal of their own seeds. Australian mistletoes have co-evolved with the mistletoe bird, *Dicaeum hirundinaceum*, which eats the fruit produced by the mistletoes. The seeds pass quickly through the birds which digest the sweet outer layers and leaving the seed coated with a sticky substance. When the birds poo, they wipe their bottoms on tree branches, effectively gluing mistletoe seeds to ideal locations for germination, high in the canopy.

Clockwise from top left: *Muellerina eucalyptoides* in *Eucalyptus haemastoma*; mistletoe plant, with haustoria clearly visible; *M. eucalyptoides* flower; *E. haemastoma* leaves (upper) and *M. eucalyptoides* leaves (lower); leaves and buds of the mistletoe (upper) and leaves and buds of its host, *E. haemastoma* (lower).

3. Olax stricta **OLACACEAE**

Olax stricta is another root parasite. It is a slender, erect shrub that occurs in heath and woodland on sandstone, but it is not abundant and may not be easy to find. Parasitism results in harm to the host and may often limit the density of a host plant. A parasite must remain in balance with its host to minimise the risk of damaging too many hosts at the one time. Such impacts may limit the number of available hosts for the parasite in the future.

Above: The leaves and flowers of *Olax stricta*

4. Choretrum candollei (snow bush) SANTALACEAE

There are three plants in the reserve from the SANTALACEAE family, all of which are root parasites. *Choretrum candollei* is rare here, but is recognisable by its angular stems and lack of leaves. It is a shrub that grows to 2 m tall and produces an abundance of small, white, fragrant flowers in spring and summer.

Above from left: developing fruits of *Choretrum candollei;* flowers which produce a sweet, overpowering smell.

5. *Cassytha glabella* and *C. pubescens* (devil's twine) LAURACEAE

Parasitic plants can be generalists, parasitising multiple species, which may include several hosts. All *Cassytha* species are hemiparasitic vines often with several hosts at the same time. Soon after a *Cassytha* seed germinates, the shoot swings around in the air until it touches another plant. Haustoria form and penetrate the host plant. Two species of *Cassytha* may be found in the reserve; the hairy and warty *C. pubescens* and the thin stemmed *C. glabella*.

Above from left: *Cassytha glabella* haustoria; entwining host; fruit.

6. Leptomeria acida (acid drops, native currant) SANTALACEAE

Leptomeria acida is the third member of the SANTALACEAE family found in the reserve. This shrub is a root parasite that grows about 2 m high and has stems that are triangular in cross section, and, like the closely related *Exocarpus,* has leaves reduced to scales. *Leptomeria acida* produces very acidic edible fruits high in vitamin C[2].

Clockwise from top left: *Leptomeria acida;* flowers; edible fruit; flowers.

7. Cryptostylis erecta and *C. subulata* (orchids) ORCHIDACEAE

Some plants derive nutrients from mycorrhizal fungi which, in turn, obtain carbon from plants. These are not parasites but rather myco-heterotrophs as both plants and fungi benefit from a mutualistic relationship. Many orchids in the Ecology Reserve, including *Cryptostylis erecta* (hooded orchid) and *C. subulata* (large tongue orchid), are myco-heterotrophs. For much of the year, all that can be seen of these two species are single leaves protruding from the ground. The under surfaces of leaves of *C. erecta* are characteristically purple. In spring several flowers are produced at the top of a long stem. These are pollinated by male ichneumon wasps (*Lissopimpla excelsa)* which mistake them for females because the flowers mimic the pheromones produced by the female wasps[3]. This pollination strategy is called sexual deception. The orchids produce minute, dust-like seeds with almost no stored reserves, making it essential for germinating orchid seeds to be rapidly inoculated by mycorrhizal fungi in order for the plant to survive.

Clockwise from top left: *Cryptostylis erecta* flowers; and leaves; a *C. subulata* flower; and leaves; and there are many other orchids you could find in the reserve including *Calochilus* sp.; *Aciathus sp.; Thelymitra ixioides; Dipodium punctatum*; *Pterostylis nutans; Caleana major*.

Carnivorous Plants

There are over 600 species of carnivorous plants worldwide; most are aquatic or grow in boggy or damp, sandy soils where nitrogen, an essential component of proteins, is in short supply. To overcome this deficiency, carnivorous plants obtain nitrogen from amino acids in the bodies of captured insects. However, in contrast to parasitic plants, carnivorous plants still need to carry out photosynthesisis in order to produce carbohydrates.

8. Drosera peltata and *D. spathulata* (sundew) DROSERACEAE

Both *Drosera peltata* and *D. spathulata* grow in damp patches of earth. *Drosera spathulata* is easily distinguished by the rosette of leaves that grows flat on the surface of the ground. All leaves are embellished with reddish, glandular hairs, each tipped with a drop of clear, sticky liquid. When small insects become trapped in the sticky liquid, the leaves roll up, enclosing the insect which is then dissolved and digested by enzymes secreted by the plant. *Drosera peltata* has tall, erect stems with stalked, crescent-shaped leaves, each of which is capable of catching small animals. Sundews have the capacity to photosynthesise and absorb nutrients through their roots, so nutrients derived from insects supplement the carbohydrates produced by the leaves.They are very attractive plants, both because of their pretty flowers and glistening, colourful leaves. On some Sundews, you may find insects that have not been captured by the leaves; instead they walk delicately between the sticky hairs and remove ensnared insects. These bugs, called mirid bugs or *Setocoris* spp., are known kleptoparasites which means parasitism by theft.

Clockwise from top left: delicate stem of *Drosera peltata*; crescent-shaped leaves of *D. peltata* covered in sticky hairs; a captured insect; *D. spathulata* flowers; *D. spathulata leaves;* a mirid bug on another sundew.

9. *Utricularia* species (bladderworts) LENTIBULARIACEAE

Along the Lane Cove River, or in its small tributaries, you could find some *Utricularia* plants. Like *Drosera* and *Stylidium,* these are carnivorous plants, but use a different mechanism to capture food. Microscopic organisms in the water are captured by modified leaves that grow from low down on the stem. The leaves form small bladders ending in tufts of hairs. Small amounts of water together with micro-organisms are sucked into the bladders and digested by enzymes secreted by the plant. When digestion has been completed, the trap resets itself. There are several species of *Ultricularia* that may occur in the reserve, including *U. biloba*, *U. dichotoma*, *U. gibba*, *U. laterifolia*, *U. uliginosa* and *U. uniflora*.

Clockwise from left: *Utricularia dichotoma*; *U.dichotoma* flower in profile*;* roots of *U. dichotoma; U. lateriflora*; *U. uniflora*; *U. dichotoma.*

10. Stylidium productum (trigger plant) STYLIDIACEAE

Stylidium productum is a perennial herb that can be found all year round. Look for rosettes of glossy green leaves and bright pink flowers which have a very unusual pollination mechanism. Two anthers and the style are fused together into an elastic stalk which is normally bent back behind the petals. When the centre of the flower is touched by an insect attracted to the flower, a trigger releases the fused style and anthers which fly forward, either bombarding the pollinator with pollen or collecting pollen from a previously insect which has been hit. The trigger resets itself. You can trigger the mechanism by gently inserting a small twig into the middle of the flower. There are over 140 species of *Stylidium*, most come from Australia. In addition *Stylidium* species are carnivorous; flowers and stems have glandular trichomes which can catch and digest small insects[4]. However, trigger plants are better known for their triggered pollination mechanism than for their carnivory.

Above, clockwise from left: *Stylidium productum* flowers; carnivorous trichomes on the stem and one of the hammers; a triggered flower; foliage that can be found all year round.

Conclusion

What a range of parasitic and carnivorous plants can be found in this little patch of bush! Why are there so many? The sandy soils derived from Hawkesbury Sandstone are very poor in nutrients, not only low in phosphorus but also in nitrogen[5][6]. Carnivory and parasitism in plants are considered adaptations to low nutrient soils, providing an alternative to the absorbtion of nutrients through the roots of plants[7]. This is just one explanation as to why there are so many carnivorous and parasitic plant species here. Can you think of any others?

How did you go?

2-4 species: Good botanical vampire hunter with potential
5-8 species: You're a natural botanical vampire hunter
9+ species: Supreme botanical vampire hunter!

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