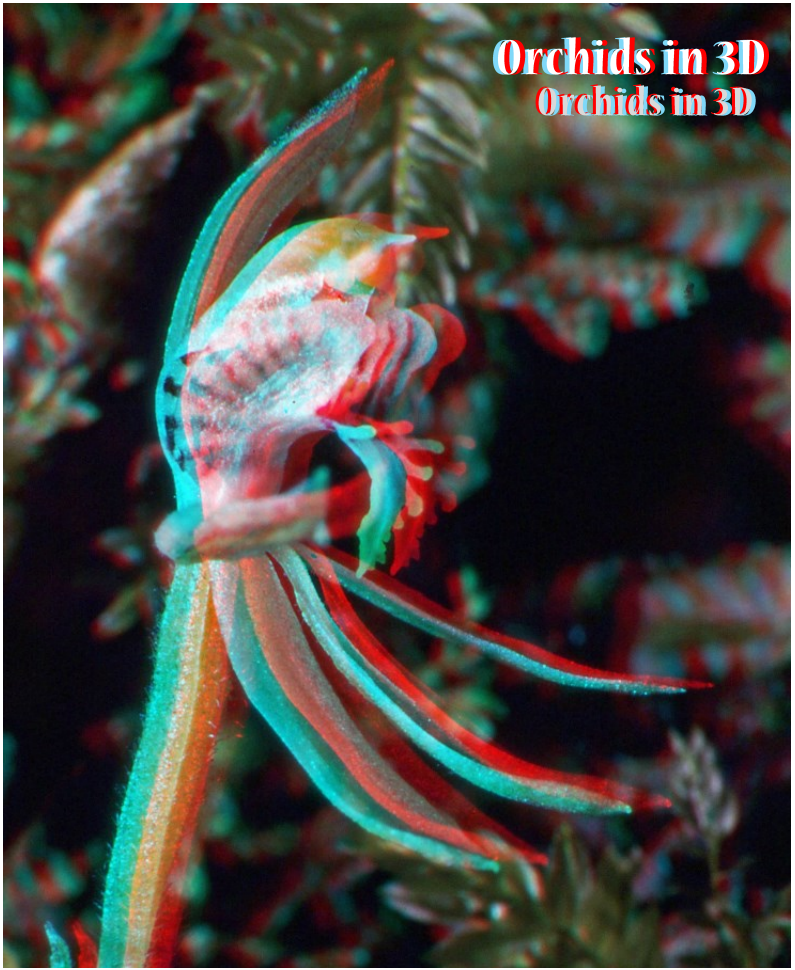
No. 152
May 2019

The New Zealand Native Orchid Journal

Contents

No 152 May 2019 ISSN 1177-4401



Cover
Thelymiytra cyanea in a Manapouri swamp, 14 Dec. 2017

The *Corybas trilobus* aggregate: Mark Moorhouse

Because there has been a lot of interest by our members in the recently named species of *Corybas*, especially in regard to how to tell them apart, there seemed a call to make an effort to address some of the difficulties that present themselves when trying to identify these species and the several taxa still awaiting in the wings for attention that have at present only 'Tag' names. Not to mention, clearly identifying exactly what is now deemed to be *Corybas trilobus* s.s. as collected by Dr Sinclair and Wm Colenso and named by Hooker.

The separating and naming of six entities once associated to the *Corybas trilobus* aggregate has certainly caused most of us to readjust how we think when we see a *Corybas* with trilobate leaves now. Sadly it may have had another effect on some members who now see such plants in the field, and still think, '*Corybas trilobus'* throw their hands in the air in despair of making a better ID, and quickly pass on.

Recognising there may be an issue, our Editor asked someone who is familiar with the newly named taxa to write something akin to a key that we can all understand and make use of. Having had an interest in the aggregate for some 25 years and having conducted some indepth study of same, it seemed logical to offer to respond to this request. Some attempt was also made at the recent AGM to address our failure to recognise things that make us think we are viewing something a bit different. Eg. the ageing process of *Corybas trilobus* flowers which was examined step by step highlighting just how much the appearance of the flower changes as it ages; also briefly discussed, how light factors alter appearances, and elevation changes the shape of some plants.

The key on page 4 was created first in a rather unorthodox format which, with the kind assistance of Graeme Jane, has been rewritten in a way which conforms to one of the standardised Keys [**Table 1**.] Graeme had over a decade ago, already created a key of his own using the then current tag names and a few of his own. Assisting me inspired him to make an update of his own work. It uses different features to circumscribe differences among the new species and remaining tagged plants.

The study, recategorising and sorting of nearly 10,000 images of the *C. trilobus* aggregate became necessary to identify some clear consistent features to work with. It was work overdue anyway because of the new species. Using data from 3 main sources, from the field, the photos, a combination of our personal collections and photos which appear on the *iNaturalist* website led to the discovery of two new forms which we deemed different enough to warrant new tags, at least temporary ones anyway. These included a number of colonies Graeme & Gael had discovered on the Hump Track [between Tuatapere and Hauroko in Southland] which may prove to be variants of *C. sulcatus* but are certainly unique in their looks and warrant further study. These have been tagged *C.* 'Hump' [**Figs 1–3, p.5**]. Secondly, yet another round-leafed form of *C. trilobus* which appears to be a 'kauri' species [tagged *C.* 'Northland roundleaf'] with very tiny flowers from Otangaroa, Northland, posted by Matt Ward on the *iNaturalist* site [**Fig. 4** & 3 by Matt].

Identifying leaf differences in the *Corybas trilobus* agg.

The sorting out of so many images also inspired a new approach, with the goal being to be able to identify non-flowering colonies, or at least to be able to eliminate many of the possibilities.

Again, having a clear understanding of the subject became essential. Many have argued that leaves of the *Corybas trilobus* agg are so variable that they are of little value to us as a means of species ID. I dispute this. The confusing leaf shapes are mostly confusing to those

Continued on page 6

Key to *Corybas trilobus* [s.l.] aggregate & affinities

Key to abbreviations:
blk. = black, blackish red, blackish violet, fl = flower, lab = labellum, lf = leaf, mont.= montane, occ. = occasionally, sl. = slightly, sub- = below.
Key to terminology: Bib = lower part of labellum including fringe. Disc = central area of labellum below opening. Wing = lateral parts of labellum +/- right-angles to disc.
Acknowledgement: Thanks to Dr Graeme Jane for standardising the format of this key and working with my non-binary, multichoice system.

1 Mature sterile [non fl.] leaves mostly much shallower than wide; heavily trilobate, mucro broad
- a Fl. 5-8mm wide, us. fl in sub-litter zone, lab. bib margin, 2-lobed, erose, wings reddish. Dry mont-sub-alpine beech forest, **hypogae**us
- b Fl. 7-10mm wide, sub-lf., lab. wings blackish, deep. Ovate from front, low-mont beech **"Remutaka"**

2 Mature sterile [non fl.] leaves distinctly trilobate barely shallower than wide; mucro or apiculus prominent
- a Fl. mostly greenish white. Dorsal cap broad. Occ. with faint purplish blush ,stripes or spot **walliae**
- b Fl. totally greenish white, crystalline, all surfaces pappilate, dorsal cap ridged **"aff walliae"**
- c Fl. not mostly green.
  - i Fl. with broad green cap, upper wings purple, disc & inner labellum uniform whitish **vitreus**
  - ii Fl. as above, but fl Apr-Jun. Fl develops fully before lf does. Habitat often old sand-dunes **"pygmy"**
  - iii Fl large to 15mm wide, broad cap occ flecked, lab wings flaring broadly, lower edge erose/laciniate. Colour variable. Often translucent, can be striped. Dorsal tip usually notched **"Rewanui"** ['tri-wan, tri-brive]
  - iv Fl. with narrow-spathulate subacute flecked dorsal, longer than lab wings, lab wings dark
    - a Lab broadly flared, wings narrow, bib erose, disc large, pale. Petals long **sanctigeorgianus**
    - aa Lab somewhat saccate, dorsal subacute, with or without apiculus. Wings dark, disc narrow **"Remutaka"**
  - v Fl. sl. succulent. Coarse dull appearance. Bib us.striped, dentate, wings inrolled **trilobus s.s.**
  - vi Fl. with black tightly fitting, ridged or rugose dorsal = or shorter than lab.
    - a Fl almost entirely blk, lab wings flaring at bottom. Habitat mont-subalp beech forest **obscurus**
    - aa Fl mostly blk. Lab wings inrolled, hairy. Fl. much deeper than wide. Habitat .kanuka **"Trotters"**
    - aaa Dorsal sepal with dark ridges distal end. Fl ovate to flaring basally, Fl somewhat nutant. NZ wide. Habitat mixed scrub in wet seepages and stream banks. Lowland to montane **'aff Trotters'**

3 Mature sterile [non-fl] leaves mostly cordate, reniform or round, apiculate or not so, lobes poorly defined.
- a Fl. yellowish green, dorsal & lab freckled red, disc orange to yellow **"aff sulcatus" [= "Craigielea"]**
- b Dorsal sepal long, acute to acuminate, leaves thick, not apiculate, succulent, labellum flaring **macranthum & rivularis agg cf.**
- c Dorsal sepal somewhat longer than lab wings blunt –subacute
  - i Fl often blackish, waxy, dorsal smoothe. Habitat subalpine-alpine, inner lab. pappilate **confusus**
  - ii Fl much deeper than wide, disc pale, lightly striped, dorsal dark to heavily marked red, sl longer than lab wings "**Hump**"
  - iii Fl tiny. c 5mm across. Lab. wings broadly flaring. Habitat. Kauri forest Northland Dorsal narrow-spathulate, apiculate, lightly flecked red, sits free of labellum wings. Leaf apiculus needle like. **"Northland"**

Some divisions are clearly not at specific level but have easily notable differences from the closest affiliate. **NB**. The initial leaf characteristic is only diagnostic if selected as proscribed. The leaf must be: **i**. Not a juvenile and **ii**. Definitely not a flowering plant or one that has an aborted flower. Most taxa have a specific leaf shape in flowering plants that differs from those not flowering, usually the lateral sides of the leaf are straighter in flowering plants or the rear lobes at the stem are squarer and wider apart.

Figs 1–3: *Corybas* "Hump"

Fig.4: *C.* 'Northland roundleaf' ▼

who do not understand a basic fact about the genus, to wit, that leaves on flowering plants differ in shape from those of nonflowering specimens and also, juvenile leaves often differ from mature sterile plants as well as those which are flowering. So approaching a colony one must expect to find three basic shaped leaves to be present, that is, also in addition to natural variations of size and to a lesser degree proportions. Of course, there could also be one or two odd shapes too caused by physical restriction of litter. Recognising these and discarding them from the mix is important. Using the database mentioned above it was possible to identify some basic leaf shapes [**Table 2, next page**] for each species [and tag] and it became clear that while leaf shapes are similar in some cases, others are clearly different. It is important to note that these are averaged shapes. So when comparing this chart with a living colony one needs to assess the average general shape of the leaves.

There is just one issue that arises, and probably more frequently that we realise. This is recognising when we are looking at a colony that has two species sharing space. It is then certainly handy to have some flowers to compare. A check worth making is this. Do I see both flowers and fat seed pods, or some with elongated peduncles, while others appear to be in flower or bud? Do I see more than three basic leaf shapes? If you do then alarm bells should be ringing. Any of these questions you answer yes to, indicate likelihood of two mixed species.

A diagnostic system designed to identify, compare & create keys

I find keys are quite difficult at times. For quick ID's, photos such as those in the Field Guides are usually helpful in the field. However many of us don't carry our Field Guide in the scrub but do carry a note book, or have a good power of recollection, and more often than not we rely on photos viewed at home to make certain we have the right ID. Being one of them myself I felt there must be a better way, so went about devising a diagnostic system from scratch. I'm sure others must have done this too.

It is simple, can be expanded easily and has the advantage of offering comparisons, not only between species but also to compare one colony with the next, one area with the next, a colony with a species, etc and only takes a few minutes to add a new set of data to.

The system consists of two lists: the first is a species list to which a number is delegated for each species and tagged taxon [or colony, or area, or flower within a colony or photo number. The choice is entirely yours at what level you want to make it. Simply add it to the list and give it a number.]

The second is a list of features under each of which there are a number of options.

To make a new entry simply add its name to the 'species' list [List 1] and give it a number. Go to list 2 and jot that number at the end of every line of description that matches your plant. If it has variations between plants then enter your number more than once per category. When you are done you should have entered your number on at least one option per category [or most categories anyway].

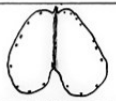
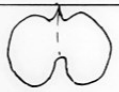
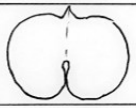
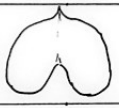
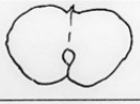
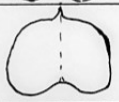
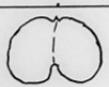
Lets say your plant had a broad green dorsal sepal. If you now return to that feature in list two, there will be several other numbers beside the one you wrote. A quick check of List 1 will tell you what other species [or colonies] had the same broad green dorsal. Your plant is likely to be a match for one of these. By checking a few other lines in similar fashion you can quickly discover what your plant matches and what it doesn't.

Using this system also has an added advantage. Should you ever want a full technical description of a species, colony, flower, etc then using List 2, it is a simple matter of finding each line that bears the number of your item of interest, jotting the relevant details down and stringing them into a few sentences. Really simple and good enough to publish should the need arise.

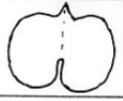
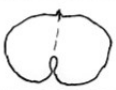
This system could be used for studying any genus, plant or animal. It would simply be a matter of adding suitable categories and options in List 2 until it satisfies every form in the genus. When it comes to forming a key it is immediately apparent which features are useful in the Key's elimination process as lines with few numbers mean the feature is more unique: just one number means it is the perfect feature to identify the plant.

Eg of diagnostic system applied to *Corybas trilobus* aggregate. 18. is example of colony.

Foliage key of *Corybas trilobus sensu lato* & Affiliated taxa.

Taxon	Juvenile	Mature sterile	Flowering plant
Corybas confusus [Old name: *C.* roundleaf']			
Corybas hypogaeus [Old names: *Nematoceras hypogaea. Corysanthes hypogaea*]			
Corybas obscurus [Old name: *C.* 'Darkie']			
Corybas sanctigeorgianus [Old name: *C.* 'trisept']			
Corybas trilobus sensu stricto Lectotype: Kew sheets K000364465, K000364469			
Corybas vitreus [Old names: *C.* 'Eastern Hills' *C.* 'Avalanche', *C.* 'Brook'] cf. *C* 'Pygmy'			
Corybas walliae [Old names: *C.* 'alba', *C.* 'triwhite']			
Corybas sulcatus [Old name: *Nematoceras sulcatum.]*			

Foliage key of *Corybas trilobus sensu lato* & Affiliated taxa.

Taxon	Juvenile	Mature sterile	Flowering plant
***Corybas* 'Remutaka'** [Old name: *C.* 'Rimutaka']			
***Corybas* 'Trotters'** [Alt names: *C. trilobus* ss. *C.* 'aff Trotters *sensu ignotus* ']			
***Corybas* 'Rewanui'** concurrently ***Cc.* 'tribrive', 'triwan'**			
Corybas* 'pygmy'** [Old name: *C.* 'sandhills'. now confused agg.] cf. ***C. vitreus			
***Corybas* 'aff sulcatus'** concurrently ***C.* 'Craigielea'**			
***C.* 'Hump'** Temp tag.			
***C.* 'Northland roundleaf'** Temp tag.			

List 1. Checklist of *Corybas trilobus* sensu lato & affiliated taxa
Taxon numbers are relevant to following diagnostic section.

No.	Current epithet	previous and/or alternative epithets
1.	Corybas confusus [Lehnebach]	C. 'round leaf' [Irwin], C. 'tripot' [Scanlen]
2.	Corybas hypogaeus [Molloy as Nematoceras hypogaea]	Corysanthes hypogaea [Colenso]
3.	Corybas obscurus [Lehnebach]	C. 'darkie' [Irwin & Jane]
4.	Corybas sanctigeorgianus [Lehnebach]	C. 'trisept' [Scanlen] cf 17
5.	Corybas trilobus sensu stricto [Hooker fil]	Corysanthes triloba, Nematoceras trilobus
6.	Corybas 'pygmy' [Jane?]	aff C. vitreus [Lehnebach], C 'sandhills' [Jane]
7.	Corybas sulcatus	C. trilobus 'Chathams', C. 'Macquarie Is'
8.	Corybas aff sulcatus [Upson?]	concurrently C. 'Craigielea' [St George]
9.	Corybas 'Rewanui' [St George]	C. 'triwan' [Scanlen], C. 'Brive' [Scanlen]
10.	Corybas 'Remutaka' [St George]	C. 'Rimutakas' [Irwin], C. trilobus s.s. [Hook fil]
11.	Corybas 'Trotters' [St George]	? C. trilobus s.s. [Hook fil] ?
12.	Corybas 'aff Trotters Nelson' [Jane]	C trilobus s.s. [Hook fil]
13.	Corybas vitreus [Lehnebach]	C 'Eastern Hills' [Moorhouse], C 'Brook' [Jane] Avalanche [Lehnebach]
14.	Corybas walliae [Lehnebach]	C. 'triwhite' [Scanlen], C 'alba' [Irwin & Jane]
15.	Corybas 'aff walliae'	mooted albino form C. 'Remutaka' [Enright & Lehnebach]
16.	Corybas 'Hump' [Jane]	
17.	Corybas 'Northland' [Ward]	[may = C. sanctigeorgianus?]
18.	eg. Lake head track Nelson Lakes NP Colony 1 [result closest aff Trotters Nelson]	

List 2. Diagnostic list by characteristic, habitat or location.
[Includes natural & recorded variations so taxa may appear more than once per category]
Numbers refer to checklist above.

i. By location:

North Is: 1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 15, 17
South Is.: 1, 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18
Stewart Is. 5, 10, 11, 14
Sub-Antarctic Is: 5, 7, 10, 11
Chatham Is: 7

ii. By habitat:

Montane to subalpine: 1, 2, 13, 14, 18
Lowland to Montane: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17
Wet seepages & stream banks: 1, 8, 11, 12, 17?
Damp hollows and banks: 1, 3, 4, 5, 9, 10, 12, 14, 15
Drier banks, ridges, forest floor: 2, 3, 10, 13, 14
Old sand dunes: 6
Calcareous soils: 1, 5?, 13, 14
Beech forest & fringe: 1, 2, 3, 10, 12, 14, 16?, 18
Kanuka forest & fringes: 3, 5, 6, 8, 13, 16?
Broadleaf scrub, forest regeneration.: 10?, 12**.**

iii. By mature leaf shape

Leaf butterfly shaped: 2, 10.
Leaf trilobate but variable: 3, 5, 6, 9, 10, 11, 12, 13, 14, 15, 18
Leaf round, cordate or reniform but apiculate: 1, 4, 7, 8, 16, 17
Known to occur pandurate [with side notches]: 1, 2, 3, 5 [Kew, Sinclair], 6, 9, 10, 11, 13

iv. By Flower position

Flowering below litter line: 2, 10[occ]
Flowering below or = to leaf [short pedicle]: 2, 3, 4, 5, 9, 10, 11, 12, 13, 16, 17, 18
Flowering above leaf [long pedicel]: 1, 3, 5, 6, 7, 8, 13, 14, 15.

v. By flower texture

Flower semi succulent: 1, 5
Flower crystalline, translucent: 14, 15
Flower only partly crystalline, translucent: 2, 6, 9, 13, 16, 17
Flower none of above: 3, 4, 7, 10, 11, 12, 18

vi. By Flower shape, anterior [front] view

Roughly ball shaped: 5, 7, 8, 12, 15, 18
Oval maturing to round: 1, 4, 5, 8, 10, 11, 15, 17, 18
Somewhat deltoid: 3, 4, 6, 10, 12, 13, 14
Roughly rectangular: 2, 9
Much taller than wide: 11, 16

vii. By flower stance

1. Often slightly nutant [nodding]: 12, 13, 18
2. No recorded consistent nutant tendencies: 1 to 11, 14-17.

viii. By dorsal sepal coloration

Plain green: 4, 5, 6, 9, 10, 13, 14, 15
Plain green with light purplish blush: 15
Green with reddish striation: 2, 4, 16
Flushed red with red striation: 16
Green, partly flecked reddish [to 50%] : 1, 2, 3, 4, 7, 8, 9, 10, 12, 17
Yellow-green flecked red: 7, 8 [heavily so]
Dark blackish purple or red: 1, 3, 11, 12, 18

ix. By dorsal sepal texture

Surface +/- smooth: 1, 2, 4, 5, 6, 9, 10, 13, 14, 17
Surface with raised linear ridges: 3, 8, 11, 12.
Surface rough, pappilate or rugose: 3, 7, 11, 12, 15, 18

x. By dorsal sepal shape

Dorsal cap broad, spathulate: 3, 6, 7, 8, 9, 11, 12, 13, 14, 18

Dorsal sepal spathulate but not broadly so: 1, 2, 5. 10, 15, 16
Dorsal sepal narrow +/- linear: 4, 10, 16, 17

xi. By dorsal sepal length

Dorsal sepal longer than lab wings, projecting, subacute, may be apiculate: 1, 4, 10, 16, 17
Dorsal sepal longer than lab but capping, downturned blunt tip: 2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 18
Dorsal sepal = lab wings, often emarginate [notched]: 2, 3, 5, 8, 9, 11, 12, 15
Dorsal shorter than lab wings: 3

xii. By dorsal sepal tip

Tip apiculate: 4, 10, 17
Tip sub-acute to acute: 1, 4, 10, 16, 17
Tip blunt : 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14, 18
Tip may be emarginate, [notched]: 1, 2 [occ], 3, 7, 8 [occ], 9, 11, 12, 13, 14.
Tip consistently emarginate. 9, 15

xiii. By general labellum shape [Flower fully open but not ageing]

Oval to round. Wings deep and tend to remain saccate: 1, 3, 5., 7, 8, 10, 11, 14, 16, 18
Deltoid. Lower wing rolled out flat, bib flat: 2, 3, 4, 5, 6, 9, 12, 13, 14, 15, 16. All taxa with age.

xiv. By labellum wing-edge decoration [Progression top to bottom]

Smooth - pimpled, bib barely dentate 1, 3, 5, 6, 7, 8, 10 [occ], 11, 12, 14, 15?, 16, 17, 18
Pimpled to dentate, bib dentate: 4, 10, 13
Pimpled to erose and laciniated: 2, 9

xv. By labellum disc colour

Disc white or translucent, not well defined from inner labellum: 4, 6, 9, 13, 14, 15, 16, 17
Disc orange or yellowish: 7, 8, [also at maturity 6, 13.]
Disc green: 1, 2, 3, 9, 10, 11, 12. [Pale green 13, 14, 15] 18
Disc dull green infused with purple or violet, often striped: 5, [occ 9]

xvi. By labellum entrance sinus

Sinus narrow, up to 30 degrees: 1, 2, 3, 4, 8, 14
Sinus medium, 30-60 degrees; 1, 2, 9, 10, 12, 13, 15, 17
Sinus broad, more than 60 degrees: 7, 12, 15.
Sinus deep with secondary opening: 1, 8, 9, 12, 13, 15, 18
Sinus shallow, may progress to groove: 3, 7, 14, 17

xvii. By comparative filament length

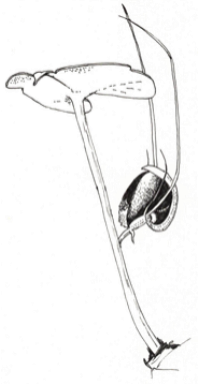
Petals short, less than 30% of sepals: 2, 4, 10, 14, 15, 17, 18
Petals 30-50% of sepals: 1, 4, 8, 9, 10, 13, 15
Petals long, more than half sepals: 1.

xviii. By auricle stance and length

Forward pointing: 2, 7, 8, 9, 10, 13, 15
Down pointing:1, 9, 10, 12, 13, 14, 17, 18
Laterally pointing:1, 3
Short: 2, 7 [& large], 8, 9, 12, 13, 14
Long: 8, 10, 15, 18
Flaring broadly:1, 2[occ], 8, 9[occ],10, 13, 14, 17, 18

xix. By flowering time

May: 6
Jun: 6, 10
Jul: 5, 10, 17
Aug: 2, 5, 10, 13, 17
Sep: 2, 4, 5, 9, 10, 13, 14, 17
Oct: 1, 2, 7, 8, 9, 10, 11, 12, 13, 14, 15
Nov: 1, 2, 3, 7, 8, 9, 11, 12, 14, 15, 18
Dec: 2, 3, 15, 16
Jan: 3, 16
Feb:
Mar:
Apr: 6



1. The Lord Treasurer of Botany's NZ orchids

Editorial: Ian St George

There are five New Zealand orchids in the Smith herbarium at the Linnean Society in Piccadilly. Three (upper row right) were collected by JGA Forster on Capt. Cook's second *(Resolution)* voyage and two by Archibald Menzies on Capt. Vancouver's voyage 20 years later. They are shown here with permission.

The fate of Forster's plant collections is "very confused" but "Some time during 1777–8 JGA Forster sent Linnaeus small specimens and descriptions…. these specimens are in the Linnean herbarium".[1] The six orchids were probably in that lot. On the death of Carl Linnaeus the younger in 1783, James Edward Smith purchased his collections and in 1788 founded the Linnean Society of London and became its first President, a position he held for life. He was "The Lord Treasurer of Botany".[2]

Menzies is known to have sent specimens to Joseph Banks and WJ Hooker; his own herbarium went to Edinburgh. Perhaps Hooker sent these to Smith.

Forster.
LINN-HS 1392.4. Thelymitra forsteri. *Thelymitra longifolia* annotated, probably in Forster's hand "Thelymitra longifol. N Zeeland". In another hand, possibly Smith's Serapius regularis Banks Ms. Thelymitra Forsteri Swartz Act. Holm. 1800. 228.
LINN-HS 1395.22. Epipactis indet. *Microtis unifolia* annotated"Ophrys unifolia. N Zeeland".
LINN-HS 1397.14. Cymbidium indet. *Earina autumnalis* "Epidendr. autumnale N Zeeland".
Menzies
LINN-HS 1401.1. Epidendrum mucronatum. *Earina mucronata* "New Zealand. Menzies. 1803".
LINN-HS 1404.12. Dendrobium pygmaeum. *Bulbophylluym pygmaeum* "New Zealand Mr. Menzies 1803. Epid pygmaeum."

1. Carolin RC 1963. JR and JGA Forster and their collections. *Proc. Linn. Soc. NSW* 88: 108–111.
2. https://www.linnean.org/research-collections/smith-collections.

2. Mycoheterotrophy

Mycoheterotrophy is a relationship between a plant and a fungus, in which the plant gets all or part of its food from the fungus rather than from photosynthesis. A mycoheterotroph is a parasite.

Obligate mycoheterotrophy exists when a nonphotosynthetic plant (a plant largely lacking in chlorophyll or at least lacking a functional photosystem) gets all of its food from the fungus.

Partial mycoheterotrophy exists when a plant that is capable of photosynthesis, parasitises fungi to supplement its food supply.

Many terrestrial orchids are obligately mycoheterotrophic for seed germination, becoming photosynthetic and partially mycoheterotrophic or nonmycoheterotrophic for the rest of their life cycle.

In the past, nonphotosynthetic orchids (for NZ: *Gastrodia, Corybas cryptanthus, Danhatchia*) were called "saprophytes". We now know they are not capable of directly breaking down organic matter, so they must parasitise organisms that can do so, through mycoheterotrophy—ie, they are parasites, not saprophytes.

The roots of the plant interface with the mycelium of the fungus. Mycoheterotrophy therefore closely resembles mycorrhiza (and indeed is thought to have evolved from mycorrhiza), except that in mycoheterotrophy, the flow of food carbon is from the fungus to the plant, rather than plant to fungus as in mycorrhiza.

Mycoheterotrophs usually parasitise fungi with big energy reserves to draw on—mycorrhizal fungi, or parasitic fungi that form extensive mycelial networks, such as *Armillaria*.

—Modified from Wikipedia: "Myco-heterotrophy".

Research on mycoheterotrophy in European orchids similar to ours may shed light on some puzzling NZ orchid phenomena.

Green *Gastrodia*

The leafless NZ orchid *Gastrodia cunninghamii* often has green in its stems, bracts and flowers yet is regarded as an obligate mycoheterotroph. The leafless European orchid *Corallorhiza trifida* has chlorophyll in its stem and bract and can photosynthesise, but has been regarded as an obligate mycoheterotroph. Nitrogen and carbon isotope research showed, however, that it gains only 52% of its total nitrogen and 77% of its carbon from fungi, so should be referred to as a partial mycoheterotroph.[1]

While we are on *Gastrodia,* it is worth noting that Philip Cribb and colleagues described two new species from tropical Africa: "The holomycotrophic terrestrial orchids of tropical Africa are reassessed. Two new species of *Gastrodia* from tropical Africa are described, *G. rwandensis* from Rwanda and *G. ballii* from south central Africa.[2] The genus now comprises three species in tropical Africa." Also Hu and colleagues have described *G. damingshamensis* from China.[3] Go to https://en.wikipedia.org/wiki/Gastrodia for a list of the world's *Gastrodia* species. While you are there, look at *Pterostylis* on https://en.wikipedia.org/wiki/Pterostylis for species and undescribed taxa.

Corallorhiza trifida ►

White *Pterostylis*

Several of us have noted very pale individuals of various species of *Pterostylis* and have described them as "achlorophyllous" (leaves lacking chlorophyll). Research on green and achlorophyllous individuals of the European forest orchid *Cephalanthera damasonium* showed that they reach the same size and that the achlorophyllous forms gain all of their carbon from fungi that form mycorrhizae with trees, whereas green forms are only partially mycoheterotrophic. Research on two populations with variegated leaves showed leaf chlorophyll concentrations and degree of mycoheterotrophy intermediate between those of the green and white forms.[4]

Variegated individuals of *Cephalanthera damasonium*[4] ▲

These authors had found, in an earlier study of two species of *Cephalanthera,* that in these partially mycoheterotrophic forest orchids, the balance between the amounts of food derived from photosynthesis and parasitism varies according to the amount of light. Low light levels resulted in strong mycoheterotrophy while higher irradiances successively drive the orchids towards autotrophy (photosynthesis). "Our results demonstrate that partial myco-heterotrophy in these species is not a static nutritional mode but a flexible mechanism driven by light availability which allows a balanced usage of carbon resources."

Brown *Thelymitra*

The beech forest orchids, *Thelymitra purpureofusca* and an undescribed even smaller entity usually have narrow wiry brown leaves and usually grow in shade. Some other shade dwelling orchids adapt by increasing green leaf size (*Corybas* "Trotters", *Pterostylis auriculata*), but these brown *Thelymitra* have not, so I have assumed they lack chlorophyll and are obligate mycoheterotropes. Perhaps not so, however: a brown leaf may contain the red pigment anthocyanin *and* green chlorophyll (red + green = brown). "At low light levels, green leaves are most efficient at photosynthesis. On a sunny day, however, there is essentially no difference between red and green leaves' ability to trap the sun's energy."[5] These brown leaved *Thelymitrae* grow in low light so are probably poor photosynthesisers. I am still left thinking they could be predominantly mycoheterotrophic.

1. Katja Zimmer, Cornelia Meyer, Gerhard Gebauer. The ectomycorrhizal specialist orchid *Corallorhiza trifida* is a partial myco-heterotroph. *New Phytologist.* https://nph.onlinelibrary.wiley.com/doi/full/10.1111/j.1469-8137.2007.02362.x
2. Cribb, P., Fischer, E. & Killmann, D. *Kew Bull* (2010) 65: 315. https://doi.org/10.1007/s12225-010-9193-4
3. Ai-Qun Hu, Tian-Chuan Hsu, Yan Liu. *Gastrodia damingshanensis* (Orchidaceae: Epidendroideae): A new mycoheterotrophic orchid from China. *Phytotaxa* 175(5):256-262 · August 2014
4. Marcus Stöckel Cornelia Meyer Gerhard Gebauer. The degree of mycoheterotrophic carbon gain in green, variegated and vegetative albino individuals of *Cephalanthera damasonium* is related to leaf chlorophyll concentrations. *New Phytologist.*
5. Katja Preiss, Iris K. U. Adam, and Gerhard Gebauer. Irradiance governs exploitation of fungi: fine-tuning of carbon gain by two partially myco-heterotrophic orchids. *Proc Biol Sci.* 2010 May 7; 277(1686): 1333–1336. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2871938/
6. https://baynature.org/article/photosynthesis-in-leaves-that-arent-green/

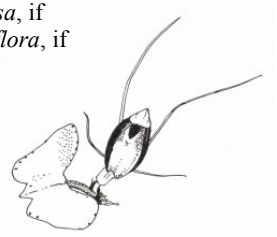
The 2018 field days near Wellington

Mike Lusk recorded the following (if = in flower; caps = capsules formed)

1. Korimako/Kereru Loop, Day's Bay.
Acianthus sinclairii, caps
Caladenia chlorostyla, if
Caladenia chlorostyla, 'red stem' if
Corybas cheesemanii, caps
Corybas 'Remutaka', caps, known to Carlos
Dendrobium cunninghamii
Drymoanthus adversus
Earina fine leaf, possibly *E. aestivalis*
Earina autumnalis, if
Microtis unifolia, if
Pterostylis alobula, caps
Pterostylis banksii, early caps
Pterostylis cardiostigma, early caps
Pterostylis graminea, if
Pterostylis trullifolia, caps
Thelymitra longifolia, if. strap leaf and finer erect leaf
Thelymitra formosa, in bud
Thelymitra nervosa, if
Thelymitra pauciflora, early caps
Thelymitra purpureo-fusca, bud opened

2. Kaeaea Track. Eastbourne
Acianthus sinclairii, caps
Caladenia chlorostyla, in bud
Caladeniia chlorostyla, 'red stem'
Chiloglottis cornuta, caps
Corybas cheesmanii, caps
Corybas "Remutaka", caps, known to Carlos
Cyrtostylis rotundifiolia, caps
Drymoanthus adversus
Drymoanthus flavus
Earina autumnalis
Gastrodia cunninghamii, if (pale form)
Pterostylis alobula, caps
Pterostylis banksii
Petrostylis cardiostigma, if
Pterostylis graminea
Pterostylis montana agg, if
Thelymitra hatchii, if
Thelymitra longifolia, if. strap and finer erect leaf
Thelymitra nervosa
Thelymitra purpureofusca

3. Catchpool Reserve (South of Wainuiomata)
Caladenia atradenia, old plants, known to Bill
*Caladenia bart*letti, caps. flowers previously seen by Bill
Caladenia chlorostyla, if
Caladenia chlorostyla "red stem", if
Caladenia variegata, if
Chiloglottis cornuta, caps
Corybas cheesmanii, caps
Corybas oblongus, late flower
Corybas "Remutaka", known to Carlos
Cyrtostylis rotundifolia, cap
Dendrobium cunninghamii
Drymoanthus adversus
Drymoanthus flavus
Earina autumnalis
Earina mucronata, if
Microtis unifolia, if
Pterostylis alobula, caps
Pterostylis banksii, late flower
Pterostylis graminea, if
Pterostylis trullifolia, caps
Thelymitra hatchii, late bud
Theymitra longifolia, strap and slim leaf, if
Thelymitra nervosa, if
Thelymitra pauciflora, if

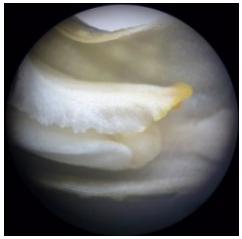


The inbox . . .

Joe Grossman found *Gastrodia molloyi* growing under his walnut tree at Temuka, flowering on 13 January.

Tips of labellum and column ▶

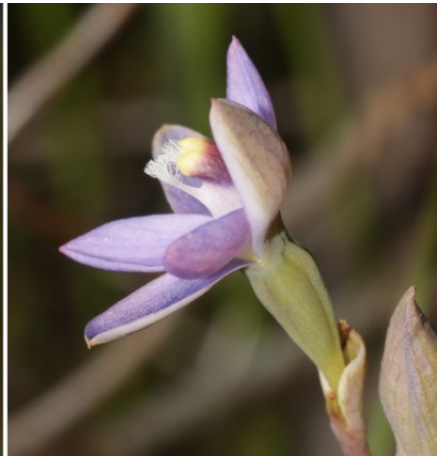
Upper stem ▼



Kathy Warburton emailed, " I first found *Gastrodia molloyi* ▶ some 10 years ago (it had already been there at least 3 years in a row without my realising what it was). But it had not reappeared in the intervening years until now. Growing in the same spot, underneath my *Rhododendron cornubia*. I was absolutely thrilled to see it there again after looking in vain for it for so long. This summer has been an extraordinary one with many *G. cunninghammi* on the local tracks, where I had never seen them before."

Many terrestrial orchids, even some that can photosynthesise, have dormant periods during which they increase their energy reserves by feeding off mycoheterotrophic fungi, until they have the energy to produce flowers, which they then do, presumably if other conditions are right. G. molloyi flowers produce strong fragrance and the production of scent volatiles is known to be energy-intensive, so they do have to wait. To conserve energy they stop producing fragrance once they are fertilised—Ed.

Jan Kelly sent *Microtis* photos from Wanaka: "This year's long thick grass may have contributed to the length of the stem, but close by where the grass is more sparse, stem height is 200mm to 300 mm, multiple flowers on each stem. (Flowering late November–early December). We also have a single patch of a blue *Thelymitra*, all buds and seed capsules: it has been very difficult, over several years of looking, to find an open flower to see its detail." *M. arenaria*?



Mike Lusk found this in the Kaweka on 2 Feb 19. Is it Colenso's *Microtis longifolia*?

The Column: Eric Scanlen

Caladenia minor was *C.* "green stem"!

Mark Moorhouse depicted the Type specimen of *Caladenia minor,* enlarged and in colour (reprinted here as **Fig. 1**) on p28 of his article in Journal 151, *Comments on Caladenia minor.* The depiction was from W.H. Fitch's drawing, from J.D. Hooker's Type sheet, Plate LVI. See **Fig. 2** herein for the whole sheet. This Plate LVI. has appeared previously in the Journals, usually in part, and often in black & white, but Mark's enlargement of the flower in Fig. 1, was a revelation, because it closely resembles what we have been calling *C.* "green stem". This taxon, was tagged [1] by Allan Ducker who studied colonies of it, at the back of Waikumete Cemetery, from 2010 to 2013, alongside the taxon previously named *Caladenia minor,* now hereby tagged *C.* "imbroglio". Allan had shown them to be different taxa, flowering some ten days apart, in distinct colonies with few crosses.

The Column has had serious doubts about the Type sheet, Plate LVI. Fig. 2 (thus doubts of any of the incomparable W.H. Fitch's drawings) because of the lower right corner drawing, showing *C. minor*'s labellum, with the 11 or 12 pairs of disc calli, unheard-of for any Caladenia. **Fig 3.** Guess-work from a mangled specimen perhaps?

Fig. 1 ▼ Drawing by Walter Hood Fitch from J.D. Hooker's Plate LVI Type sheet. Photo by Mark Moorhouse. Note the close resemblance to *C. minor* (*C.* "green stem" as tagged by Allan Ducker). The three red stripes under the labellum vary but can occur in rare hybrids with *C.* "imbroglio".

Fig. 2. ▲ Type sheet, Plate LVI from J.D. Hooker's *Flora NZ. Caladenia minor* (was *C.* "green stem") does have an all green stem and ovary. It usually has red trichomes packed atop the dorsal sepal.

The Column admits to previously having *C. minor* (was *C.* "green stem") lumped with *C.* "imbroglio" thus the third colour field guide (CFG 3) of 2011, has, by good luck, correctly depicted *C. minor* with its green stem, from Manapouri, South Arm.

How does one identify these similar taxa in the field? Salient details are in the captions to the illustrations, including, incidentally, *C.* "red stem" and *C.* "pink" Baton.

Eric Scanlen

References

Scanlen, E. *C. minor* identity, J 129, p. 31 & J103 p22, *C. minor* family.

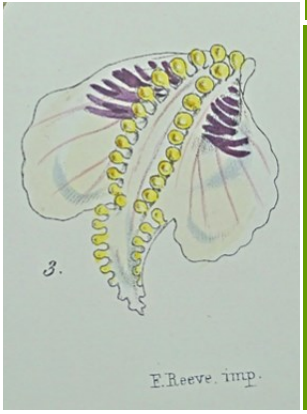


Fig. 4 ► *Caladenia* "imbroglio" (was *C. minor*) by Pam Shearer at Sharps Bush, Henderson Valley 25-11-12. Note the red stem and green ovary, red striped. Note also the three red stripes under the labellum; did Hooker's *C. minor* Type specimen have some genes from *C.* "imbroglio" to account for the red stripes on Fig. 1?

◄ **Fig. 3.** Misleading labellum on *C. minor*, on Type sheet LVI, has sewn doubts for many re this Type specimen. No *Caladenia* has as many as 11 or 12 pairs of disc calli on the labellum. Please disregard Fig. 3.

Fig. 5 ▼ *Caladenia minor* by the author from Lake Manapouri Sth. Arm, 21/1/04. A widespread species. Note the green stem and ovary, also sparse red trichomes atop the dorsal sepal and perhaps one red bar under the labellum. This is a variable trait. See 3D on p2.

Fig 6 ▲ *Caladenia* "red stem" has a dark red stem, ovary and bud. Puffer track and Brunner peninsula, for 2-4 flowered ones, Bealey spur, and Arthurs Pass for single flowered ones, not to be confused with *C.* "imbroglio" with its red stem.

Fig 7 ▲ *Caladenia* "pink" from Baton Valley, Nelson, by Georgina Upson. Mark proposed this as *C. minor* but this striking but rare taxon, is more like a pink *C.* "imbroglio" and is not found in *C. minor*'s far north.