broader, taper more abruptly into the petiole, and are somewhat thinner. An even better feature, though hardly drawn out by the literature, is that *P. elatus* tends to have a spiny leaf apex and *P. macrophyllus* a bluntly rounded one.

Other features sometimes useful in the genus, such as the prominence of the midrib and the size and shape of the apical bud, do not work for these two species. But the leaves, despite their rather uniform exterior, have much information to offer internally, and this was fully drawn on in the classic "anatomical method" revisionary work of American botanist Netta E. Gray (1913-1970).

Gray (1958) described an absolute and readily-appreciated distinction between the two species in the distribution of the hypodermal fibres, the layer of thick-walled cells immediately inside the epidermis. In *P. elatus* the hypodermis is continuous below the upper epidermis and discontinuous above the lower epidermis (where the fibres occur just between the longitudinal rows of stomata). In *P. macrophyllus* the upper layer of fibres is discontinuous and the lower layer is lacking.

Such a distinction might possibly be seen in the way in which the leaves of the two species decay, but is not obvious in the dried leaf itself - the fibres are perhaps not large or stiff enough to make a difference to the way in which the tissues shrink around them. Fortunately, botanical hand-sectioning is not yet an utterly forgotten craft.

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A fern propagation report (2005-2009)

John Rugis

Introduction

I've been experimenting with fern propagation for nearly four years with some success. The beginnings of this interest can be traced back to six months before that when we relocated to our present bush clad section in Maraetai, South Auckland. Even in my then botanically uninformed state, the presence of ferns and their influence on me was undeniable. Subsequent count revealed that there were already twenty fern species present on the property!

Overview and Background

In my particular experience, the task of fern propagation has consisted of

1) identification,
2) location,
3) collection,
4) propagation.

As an identification study guide and reference manual, I have found the book *New Zealand Ferns* (Brownsey & Smith-Dobsworth 1989) indispensible. Historical accounts, such as contained in Field (1890) and Dobbie (1921), provide additional background and interesting insight into past, as well as possible present, species distributions. Locating ferns in the wild is often not easy.

"One word of warning, O trustful reader; when you see a species marked 'abundant,' do not be too sanguine, I have searched for some so described for 40 years, and never found them."
H.B. Dobbie, Auckland, 1916.

Fortunately, now at least travel throughout New Zealand is much easier than it was in Dobbie's time. I have personally observed *Blechnum nigrum* in the Hunua Ranges, *Sticherus flabellatus* on Great Barrier Island, *Loxsoma cunninghamii* in the Coromandel peninsula, and an extensive stand of *Ptisana salicina* in Taranaki.

For me, propagation from spore was chosen as the method of choice because it is by far the least disruptive to existing populations. However, this method imposes an often frustrating timing constraint on collection. Each year, the "window of opportunity" for collecting mature spore can range from as long as a number of months (*Cyathea*), to several weeks (*Leptopteris*), through to seemingly almost non-existent (*Hymenophyllum*).

I collect only small cuttings consisting of one to perhaps six pinnae, cleanly cut, with care taken not to otherwise damage the parent plant. Note – the land owner's permission should be obtained before any spores are collected.

Propagation Method

Noteworthy accounts of propagation methods are given by Field (1890) and Dobbie (1921, 1951). My approach has been to glean the principles from the past but update to present materials and technology.

I place cuttings in folded white A4 paper (Fig. 1) for spore release, which often occurs within 24 hours. Most species are left at room temperature for this and unforced desiccation of the sample occurs. However, for green spore species, anything other than very slight drying can kill the spore. For these species, the paper packet is placed in a plastic zip bag and additionally sometimes in a refrigerator. After spore is

released, I remove the dry pinnae and then tap the paper to separate out the spore from detritus, which is discarded (mostly empty sporangia shells). Working with "pure spore" helps prevent subsequent destructive contamination.

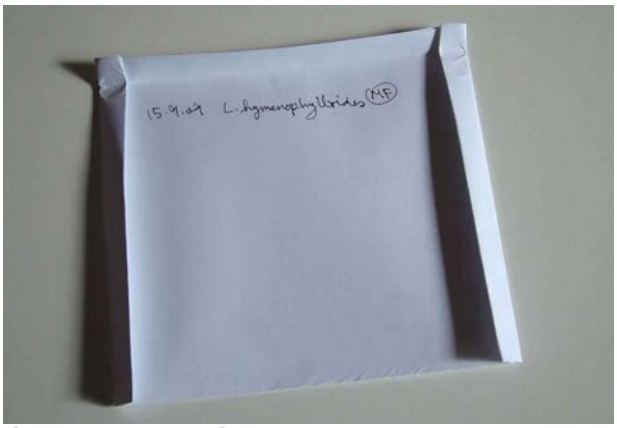

Fig. 1. A spore packet.

Most recently I've been using purchased seed raising mix as propagation media. I sterilise the media in a glass dish by adding distilled water until thoroughly moist and subjecting it to several eight minute cycles in a microwave set to high power.

Fig. 2. Propagation boxes on a purpose built wooden rack (with shade cloth) located outdoors.

After cooling, media is spread in clear PVC clam-shell lid food grade boxes (Fig. 2). Spore is dusted in, misted with distilled water, and the lids are shut tight. The boxes are placed out-of-doors on racks (Fig. 3) and opened only once a week for misting and inspection. Spore germination and the first hint of the green coloured gametophytes typically takes anywhere from several weeks (*Pteris*) up to several months (*Cyathea*).

The gametophyte phase of the fern lifecycle is rarely observed in the wild due to the small size of individuals (2-10mm) and their inconspicuous appearance. Fern gametophytes have deservedly been the subject of study in their own right (Nayar 1971, Raghavan 1989).

Anywhere from at least several months to, more commonly, a year or more is required for gametophyte fertilisation and the subsequent appearance of the first sporophytes, the more familiar phase of the fern lifecycle.

Fig. 3. Wooden racks are also used for the next few stages of propagation.

Fig. 4. *Rumohra adiantiformis* climbing up the trunk of a tree fern.

Among other influences, temperature, light intensity, light wavelength, humidity, and media chemistry all play a part in gametophyte development and fertilisation (Raghavan 1989). In my experiments, given the fact that the propagation boxes are placed in a relatively uncontrolled environment, there is variability in the development timeline.

I prick-out individual sporophytes and replant them usually after the appearance of the third frond. Successful hardening-off is aided by frequent misting and some initial protection from the elements.

An example: *Rumohra adiantiformis*

In New Zealand, *R. adiantiformis* is found as an epiphytic climber on tree ferns (Fig. 4). The fronds have a distinctively nearly opaque plastic appearance.

As a challenge for the collector, fertile fronds are usually located inconveniently above head height and out of reach. (*Blechnum filiforme* does this too!).
Mature sori are round, rather large and unmistakably very dark black which is an aid to identification in the field (Fig. 5).

Fig. 5. *Rumohra adiantiformis*: distinctive black sori.

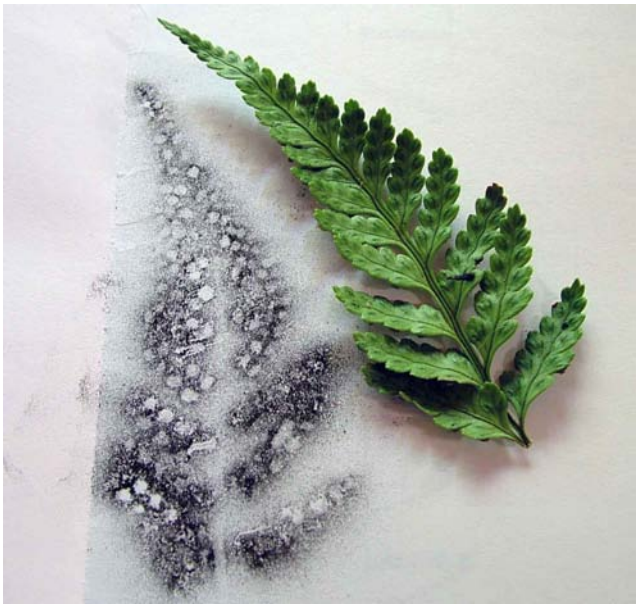

Fig. 6. *Rumohra adiantiformis:* spore imprint.

In my experiments, after storage for several days, each collected sample released a copious amount of spore which left an (easily disturbed) imprint inside its paper packet (Fig. 6). Spore separation was easy as there was almost no detritus mixed in with the black coloured spore.

Germination occurred within several weeks. Notably, ten months after sowing spore, mature *R. adiantiformis* gametophytes retained a relatively fresh clean featureless look (Fig. 7).

The first sporophytes appeared after twelve months total had passed. I observed that the very first fronds of *R. adiantiformis* have a characteristically elongated heart shape (Fig. 8). Nine months after that, the sporophytes exhibited a slight growth spurt when the propagation box lid was propped open for initial hardening-off, but grew very slowly after that (Fig. 9).

Overall Results and Summary

When taking identification, location, collection and propagation all into account, there is probably no universal answer to the question of which species are easy and which are difficult. Sometimes good fortune prevails and at other times it is elusive.

However, with that said, through no effort on my part, some uninvited (but not unwelcome) "guest" ferns have appeared in my propagation boxes. The guests were indeed very easy!

Fig. 7. *Rumohra adiantiformis:* mature gametophytes.

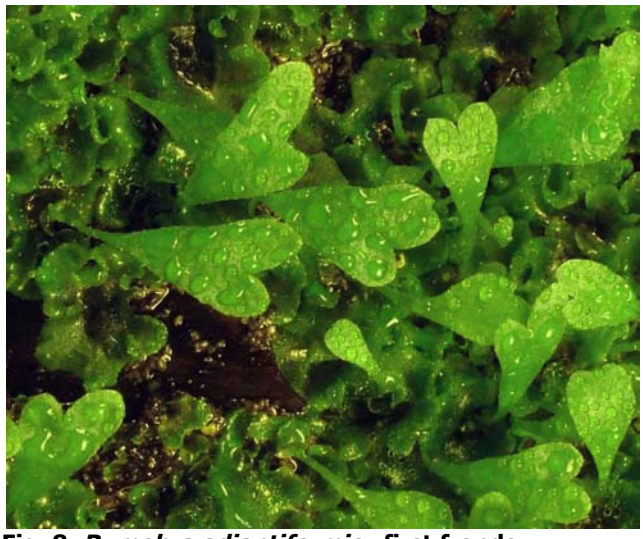

Fig. 8. *Rumohra adiantiformis:* first fronds.

Guest fern species:
Pteris tremula (numerous),
Deparia petersenii (numerous),
Diplazium australe (a few),
Paesia scaberula (a few).

Overall, I have collected cuttings for propagation from nearly fifty fern species, the majority of which released viable spore.

Species that at least germinated: 38.
Failed at a subsequent stage: 5.
Lost to misfortune (a flood!): 5.
Progressed to planting-out: 17.
Still in progress: 11.

Fig. 9. *Rumohra adiantiformis:* ready for planting-out.

In my personal experience to date, I would characterise the majority of the (non-guest) species which have progressed to the planning-out stage as being moderately difficult. The exceptions, *Pteris tremula*, *Pteris macilenta, Adiantum hispidulum* and *Diplazium australe* were easy. *Doodia squarrosa*, *Lastreopsis hispida*, *Pneumatopteris pennigera* were difficult. My success with *Cyathea dealbata* has been limited, but I suspect that is because I haven't paid sufficient attention to that species.

Additionally, although the focus of this report is propagation from spore, I have propagated a small number of fern species by other means.

Species propagated other than from spore:
Asplenium bulbiferum (bulbils),
Microsorum pustulatum (rhizome cuttings),
Microsorum scandens (rhizome cuttings),
Ptisana salicina (by root division).

Table 1. Summary of results by species for the first four years (11/2005-10/2009). Attempts that produced very few gametophytes and no sporophytes, or that failed completely, are not listed. Species listed as "not yet" are still in progress.

Genus / species	Gametophytes	Sporophytes	Planted-out
Adiantum fulvum	prolific	very few[3]	failed
Adiantum hispidulum	prolific	prolific	yes
Adiantum viridescens	yes	yes	failed
Blechnum discolor	yes[2]	no	-
Blechnum fluviatile	prolific	yes[1]	-
Blechnum membranaceum	prolific	yes	yes
Blechnum nigrum	few	very few	not yet
Blechnum novae-zelandiae	yes	yes	yes
Blechnum procerum	prolific	yes	not yet
Cheilanthes sieberi	prolific	prolific	not yet
Christella dentata	prolific	prolific	yes
Cyathea dealbata	prolific	yes	very few
Cyathea medullaris	prolific	prolific	yes
Diplazium australe	prolific	prolific	yes
Doodia australis	prolific	prolific	yes
Doodia milnei	prolific	yes	yes
Doodia mollis	prolific	few	not yet
Doodia squarrosa	prolific	few	few
Lastreopsis glabella	prolific	prolific	yes
Lastreopsis hispida	prolific	few	few
Lastreopsis microsora	prolific[1]	-	-
Lastreopsis velutina	prolific	prolific	yes
Leptolepia novae-zelandiae	prolific	yes	not yet
Leptopteris hymenophylloides	prolific	not yet	?
Lindsaea trichomanoides	few	few[1]	-
Loxsoma cunninghamii	prolific	not yet	?
Lygodium articulatum	few	few[1]	-
Microsorum scandens	yes[2]	no	-
Pellaea falcata	prolific	prolific	not yet
Pellaea rotundifolia	yes[2]	no	-
Pneumatopteris pennigera	prolific	yes	few
Polystichum cystostegia	prolific	very few	not yet
Pteris macilenta	prolific	prolific	yes
Pteris tremula	prolific	prolific	yes
Ptisana salicina	few[2]	not yet	?
Rumohra adiantiformis	prolific	prolific	yes
Todea barbara	few[2]	not yet	?
Trichomanes elongatum	few	few[1]	-

1) Washed away in a flood in 2008. The remaining propagation boxes were subsequently moved to higher ground away from the stream.
2) Without the appearance of sporophytes, the identity of the gametophytes remains uncertain.
3) Sporophytes appeared, but perished. However, after nearly two years, the gametophytes are still alive.

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Moth plant takes wing at Tawharanui

Maureen Young

When driving out to the car park at Anchor Bay, Tawharanui Regional Park (NE Auckland), a cabbage tree (*Cordyline australis*) swamp leading up to a bush clad gully can be seen on the right hand side of the road. This gully has been given the, now inappropriate, name of Possum Gully. Between Christmas and New Year 2009, I went on one of my annual searches for the non-green orchid, *Danhatchia australis*, this time in Possum Gully. I was satisfied to count c. 45 flowering spikes of the orchid, and I also found a healthy sapling of the coastal milkwood, *Streblus banksii*, and a good population of the fern *Doodia mollis.* On the ground I came across a small bird's nest, probably that of a chaffinch, lying squashed at my feet. It had a lovely soft lining of a white thistledown-like substance. As both pukatea (*Laurelia novae-zelandiae*) and *Parsonsia* spp. have silky hairs that act as parachutes to help carry the seed away from the parent plant, and both grow in the gully, I was curious to know which of these was the source of the silk. At home I put the nest in a pot of soil and kept it watered. To my dismay, c. 5 weeks later a crop of moth plant (*Araujia hortorum*) seedlings began to appear. On checking with

Fig. 1. Moth plant seedlings, Feb, 2010. Photo: Alison Wesley.

Auckland Regional Council staff, Bec Stanley and Holly Cox, I was informed that there are half a dozen known sites for moth plant in the park, and these are regularly monitored and the plants treated. My experience shows that weeds have many allies when it comes to dispersal.

Acknowledgements
Alison Wesley for photograph. Paul Asquith and members of the Auckland Branch of the Ornithological Society for identifying the rotting remnants of the nest.

Reference

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