FERNS IN HAMPSHIRE: WORKSHOP NOTES

Issue 1
7th July 2012

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What is a fern?

Most people will have little difficulty recognising a "typical" fern, although of course many flowering plants have fern-like dissected leaves. But in fact, picking out one or a few visible characters to distinguish all ferns isn't straightforward.

- Ferns reproduce sexually, but what you normally see is the (usually) asexual stage of their life. At this point they are spore-bearing, but the spores are not the equivalent of seeds in flowering plants. We shall have more to say about this in the next section. However they are certainly not the only plants propagating by spores.
- Ferns are **vascular** plants; that is, they have cells aligned to form tubes to transport fluids through the plant. In this they are like flowering plants, but unlike some other groups of spore-bearing plants such as mosses. Since the vascular tissue is arranged in vascular bundles, often with some thickening of the cell walls, they also contribute to the rigidity of the plant, allowing many ferns to grow larger out of water than mosses, for instance.
- Nearly all ferns have their young leaves spirally coiled in bud; but a few don't, and there are other plants (for instance, cycads or even some Walnut species) that do the same.
- Many ferns have lines or ridges of aerating tissue (pneumatophores) running along both sides of the stem. But these can be difficult to make out, and although anatomically different, they can superficially look like ridges on flowering-plant stems.

So the fact that ferns form a natural grouping, and their relationship to other **vascular cryptogams** (i.e. plants with vascular bundles, but with the sexual stages of their development inconspicuous, unlike flowering plants) is largely now determined through DNA sequencing, together with a more refined interpretation of the fossil record which distinguishes similar features that arise on multiple occasions during the evolutionary process from those that have an origin in a single common ancestor. As a result of such studies, we now know that:

- Clubmosses (Lycophytes), which were formerly considered as "fern allies", are completely segregated from ferns as well as flowering plants.
- Horsetails (which were also considered "fern allies" but very distinct from ferns), are now considered true ferns of the order *Equisetales*, forming part of the group known as **eusporangiate** ferns (their spores have thickened spore-cases). In this they join with the Adder's-tongues and Moonworts *(Ophioglossales),* many of which are also not very "ferny" in appearance; but they are often separated off (in Stace, for instance) as Calamophytes. Although, consequently, they should really be considered in this workshop, they will be left for a future session of their own, since they are so distinctive.
- Other ferns are termed **leptosporangiate** ferns (their spore-cases are thin, just one cell deep). The most primitive of these are the Royal Ferns *(Osmundales*), followed by the Filmy Ferns (*Hymenophyllales*). All remaining British ferns belong to the *Polypodiales*, which both here and world-wide contains the lion's share of present-day species.

The good news is that, while ferns as a whole are not easy to characterise on field characters, each order is reasonably distinctive.

A little fern biology

Life-cycles

The life-cycle of a fern alternates between two generations. The more or less conspicuous generation is the **sporophyte**, where the plant produces terrestrial or aquatic fronds, on some or all of which are produced the spores.

Typically, spores are asexual. There are a few genera that produce different male and female spores; in Britain these are just the native *Pilularia* (Pillwort), and the introduced *Azolla* (Water Fern). It's no coincidence that most of these **heterosporous** genera are aquatic or live close to water; the next stage of their development depends on water, and although fern spores are small compared with most plant seeds, female spores are seriously bulky and develop *in situ,* needing to carry a payload of food since they can't photosynthesise. **Homosporous** spores take their chances on the breeze, their species relying on the vast numbers produced to get some into viable habitat.

The spore develops into a sexual plant, the **gametophyte**. Typically the gametophyte looks like a thallose liverwort; a little ephemeral green plate, often heart-shaped. Some species live a more or less independent life, and these often produce wefts of thread-like gametophytes, rarely or never throwing up the conspicuous sporophyte phase. A British example is the Killarney Fern, *Trichomanes speciosum*. Once thought to be one of our rarest ferns, it is now recognised as occurring widely but growing only in the gametophyte phase. It makes a green “fuzzy felt” across the surfaces of damp, shaded recesses in rocks.

The gametophyte is the arena on which the sexual life of ferns is played out. It gives rise to **antheridia** (structures which produce sperm) and **archegonia** (structures which receive the sperm and contain eggs). The sperm swims across to an egg (now you know why ferns do particularly well in damp climates) and fertilises it, the resulting embryo then growing (with luck) into the sporophyte structure with roots, stem and fronds with which we are familiar.

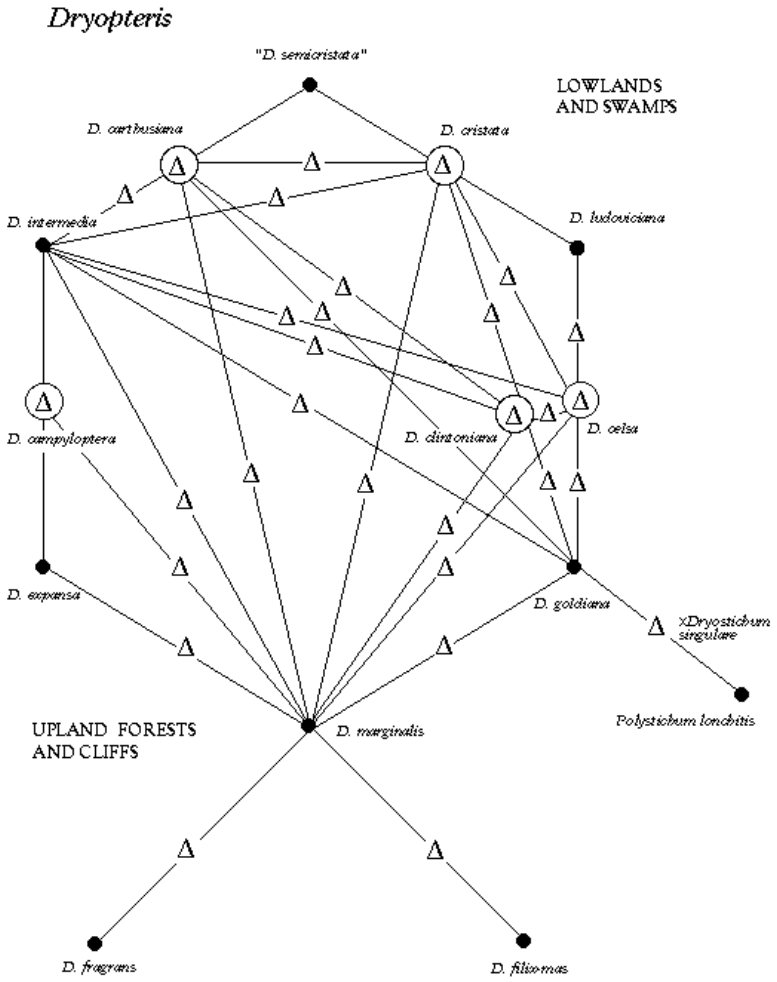
Gametophytes seem to be quite choosy about where they grow; humidity and shade are certainly necessary, but it seems that a freshly exposed soil face is also very favourable. If you want to find gametophytes locally, a good place to start looking is the damp, shaded cliff of an incised stream, for instance in the New Forest. But probably the best way to observe them is to grow your own. Gather spores on paper from a mature fern frond; fill a plant pot with a mixture of sand and loamy compost; sterilise it with boiling water (otherwise you'll get lots of non-ferny things!); sprinkle the spores over the surface; cover the pot in a plastic bag; put it somewhere fairly warm and out of direct sunlight; and wait a few weeks.

Hybridisation and Allopolyploidy

From the account of the gametophyte, it may seem unlikely that sperm from one species can ever make it across to the gametophyte of another species. In fact, hybridisation in ferns is not that rare. Fern hybrids have high or complete spore sterility, and this can be observed with a compound microscope; sterile spores are misshapen and opaque. Clearly this is not a useful field character, given the size of spores, but like many flowering plants, ferns often display “hybrid vigour”, making taller and denser fronds than their parents, and so can be picked out for further examination.

While the original hybrids are spore-sterile, ferns are also remarkably good at chromosome doubling, giving rise to fertile plants known as **allopolyploids** which can be regarded as good species in their own right. Many of the present-day species of genera such as *Dryopteris* are now

known to have had such an origin, in species that are now sometimes geographically remote from them. Diagrams that show the relationships between ancestral species, hybrids and allopolyploids are known as reticulograms: here's an example for North America.



Relationships among some species of *Dryopteris*. Solid circles represent parental taxa; circled triangles represent allopolyploids; and triangles represent sterile hybrids. *Dryopteris semicristata* is a hypothetical ancestor.

Networks of relationships such as these, coupled with the fact that it is a process that can arise many times at different loci in the ancestors' respective gene pools, make for some of the difficulties of identification in some of the genera.

Apogamy and budding

Some ferns have an abnormal, asexual 'gametophyte' phase. When the spore division goes from 16 to 64 in a normally sexual fern, the chromosomes only double in number. Thus each spore has half the full chromosome complement (a state known as **haploidy**). The fusion of the egg and sperm brings the chromosome number back to the normal complement.

Apogamous ferns produce only 32 spores in a sporangium, and in the process each spore retains the full complement of chromosomes. When these spores develop into a gametophyte, it produces not sexual organs but a new baby fern with roots, stem and leaf.

About 10% of fern species in the world are apogamous; probably the best-known British examples are the Golden-scaled Male-ferns, *Dryopteris affinis* agg. Their combination of a hybrid history (perhaps involving three different ancestor species) with an apogamous present that tends to preserve non-lethal mutations through the generations makes for a taxonomy that is (to put it mildly) challenging!

Apogamy might be considered an exceptional form of another phenomenon seen in a number of ferns, namely the production of vegetative buds. These sometimes appear as bulblets on the fronds. This is not a phenomenon often seen in the wild in Britain, but it appears regularly in some cultivated forms of Shield-ferns *Polystichum*. Budding from stolons or the tips of fronds is commoner and occurs in several naturalised species in Britain, including the Ostrich Fern *Matteucia*.

Looking at ferns, and fern terminology

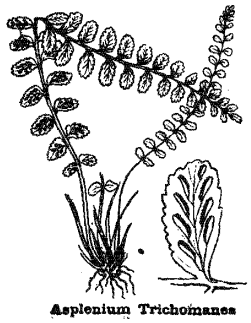
Fern sporophytes have their basis in a **rhizome** – from which roots emerge that are often spindly and much less conspicuous. Apart from the roots, the rhizome gives rise to fronds. These can arise singly, in small numbers, or in dense tufts or crowns; this is often a valuable recognition feature.

The rhizomes of most Leptosporangiate ferns are more or less elongated, simple or branched, scaly stems, giving rise either to single fronds or to tufts of fronds. The rhizome scales are sometimes a useful identification feature. But the Eusporangiate Adder's-tongues *Ophioglossum* and Moonworts *Botrychium* have short, corm-like, scaleless rhizomes with the fronds arising singly or in pairs. Water Fern *Azolla* rhizomes are very spindly and also lack scales. Pillwort *Pilularia* rhizomes are slender and hairy, not scaly.

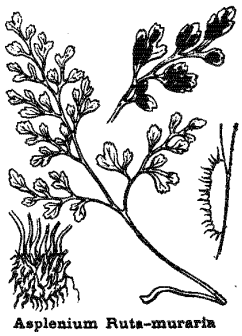
The **fronds** of a fern are normally taken to include the main stem and the leafy portion (if any) that it supports. Some authors take the frond as being only the leafy part, but for this we will use the more conventional term **blade.** The Adder's-tongues *Ophioglossum* and Moonworts *Botrychium* have separated fertile and sterile blades on the same stem. Hard Fern *Blechnum spicant,* Parsley Fern *Cryptogramma crispa* and the introduced Ostrich Fern *Matteuccia struthiopteris* and Sensitive Fern *Onoclea sensibilis* have separate sterile and fertile fronds with somewhat different looks. Royal Fern *Osmunda regalis* has some fronds with a sterile lower portion and a markedly different fertile upper portion. But most of our ferns have fronds all similar in appearance, even if not all bear spores.

That part of the main stem below the blade is referred to as the **stipe**, the part running through the blade is the **rachis** (or **rhachis**).

A few of our ferns have simple, undivided blades. But the majority are either pinnately divided (once or several times) or forked (once or several times).


Asplenium Trichomanes

In the former, the divisions of the blade are ranged along either side of a stem that runs more or less straight between them; an example is the Maidenhair Spleenwort *Asplenium trichomanes*. In the latter, the stem itself branches and the blade divisions are borne on the branches; an example is Wall-rue *Asplenium ruta-muraria*. This division is not always as clear cut as it sounds. For instance, Parsley Fern *Cryptogramma crispa* is usually described as having a pinnate blade, although the stalks of the blade segments and their midribs clearly fork. Whatever the arrangement, the first division of a divided blade is referred to as the **pinna** and subsequent divisions as **pinnules**.


Asplenium Ruta-muraria

A difficulty for beginners is deciding exactly how many times pinnate a blade is (often an important diagnostic feature). The problem is that the early divisions may be clearly **pinnate**, with well-separated and sometimes stalked pinnae, but the last divisions are better described as **pinnatifid**, with an incomplete separation. In the extreme parts of the frond, pinnae or pinnules may be little more than lobed. It is important when counting divisions to look at the part of the blade nearest the rhachis in the lower half of a well-developed frond. Where uncertainty exists, books sometimes refer to "1½ -2-pinnate", for example; Stace uses the rather more long-winded "1-pinnate with deeply divided pinnae, to 2-pinnate".

The spores are produced on the surfaces of the fronds. For most species, this means on the undersides of the fronds; but some have distinct and specialised spore-bearing fronds, or parts of fronds. Examples are the Adder's-tongues *Ophioglossum* and Moonworts *Botrychium*; and Royal Ferns *Osmunda*.

The spores are single-celled, and they are packaged up into structures called **sporangia**. The spores replicate by meiosis, and the doubling process ends at 64 spores per sporangium. The sporangium is a remarkable structure – a ball with a stalk and a special line of thickened but semi-flexible cells that become "spring-loaded" when they are charged with moisture and subsequently dry out. They then act as little catapults to fling the spores out into the world. Features of the sporangium are often useful recognition features in closely similar species, as is spore size in some critical groups.

The sporangia are grouped in clusters or lines on the frond, known as **sori**. In some species these clusters are bare, or with a few membranous scales; in others, they are partly hidden under a membranous flap called the **indusium**. The outline of the sori, and the shape and positioning of the indusium, are important recognition features.

Fern genera in Hampshire

This is a key to those fern genera (native and introduced) that occur in Hampshire, excluding Horsetails. It will not work for all cultivated members of the same genera.

1 Plant fully aquatic.....2
1 Plant not fully aquatic (though sometimes appearing in flooded ground).....3

2 Plant free-floating, fronds moss-like, 2-lobed, covering the water surface .....***Azolla*** **(Water Fern)**
2 Fronds fine, thread-like, ±upright, with coiled crosiers when young, arising singly from a delicate rhizome.....***Pilularia*** **(Pillwort)**

3 Fronds fine, thread-like, ±upright, with coiled crosiers when young, arising singly from a delicate rhizome.....***Pilularia*** **(Pillwort)**
3 Not as above.....4

4 Fertile frond or portion of frond distinct from sterile frond or portion.....5
4 Fertile and sterile fronds all alike.....10

5 Young fronds not coiled in bud; small plants (usu. < 25cm).....6
5 Young fronds coiled in bud; plants developing to greater size.....7

6 Sterile blade simple, elliptic-ovate to lanceolate; fertile spike simple with sporangia in two rows.....***Ophioglossum*** **(Adder's-tongues)**
6 Sterile frond pinnate; fertile spike branched.....***Botrychium*** **(Moonwort)**

7 Fertile fronds bearing spores only on upper, unleaf-like branches, with lower parts leafy and sterile, 2-pinnate.....***Osmunda*** **(Royal Fern)**
7 Fertile fronds entirely distinct from sterile fronds.....8

8 Sterile fronds 2-pinnate, or 1-pinnate with deeply lobed pinnae, pale green; forming striking “shuttlecocks”.....***Matteuccia*** **(Ostrich Fern)**
8 Sterile fronds 1-pinnate, pinnae divided or lobed only at base of frond, or more or less unlobed, pale or dark green, tufted or arising singly.....9

9 Fronds growing in tufts or as small tussocks; sterile fronds narrow, more or less parallel-sided but broadest at middle; pinnae tough, unlobed, soon becoming dark green, overwintering.....***Blechnum*** **(Hard-ferns)**
9 Fronds arising singly; sterile fronds broadly triangular, lowest pinnae divided or lobed, upper no more than shallowly lobed; pinnae delicate, flushing bronzy-red, becoming pale to mid green, dying at first frost.....***Onoclea*** **(Sensitive Fern)**

10 Sori forming lines along the edge of the pinnae / pinnules, more or less covered by the inrolled margin.....11
10 Sori on the flat surface of the pinnae / pinnules.....13

11 Fronds tufted; stems thin, wiry; ultimate pinnules fan-shaped, lobed at outer margin; sori and indusium discontinuous.....***Adiantum*** **(Maidenhair Ferns)**
11 Ultimate pinnules not fan-shaped; sori continuous around the pinnule margins, with a continuous indusium and inrolled edge.....12

12 Fronds arising singly; robust plant with sturdy upright stems; fronds 2- to 3-pinnate, ultimate pinnules triangular-lanceolate, small in relation to total frond .....***Pteridium*** **(Bracken)**

12 Fronds tufted; plants less robust; fronds 1- to 2-pinnate, pinnules narrowly lanceolate, large in relation to total frond.....***Pteris*** **(Ribbon Ferns)**

13 Sori with conspicuous indusium when young (may shrivel, crack or vanish with age)..14

13 Sori without obvious indusium.....21

14 Sori circular or elliptical.....15

14 Sori oblong (sometimes shortly so) or linear (straight or curved).....20

15 Indusium attached underneath the basal side of the sorus, at first forming a hood, then reflexed and soon shrivelling.....***Cystopteris*** **(Bladder-ferns)**

15 Indusium attached in centre of sorus, more or less circular, at first forming an "umbrella" over the sorus, later cracking or shrivelling but persistent.....16

16 Indusium somewhat kidney-shaped with a deep sinus on one side, attached at the base of the sinus.....17

16 Indusium circular, attached in the centre.....19

17 Sori large (2mm or more); indusium persisting until spores are released .....***Dryopteris*** **(Buckler-ferns)**

17 Sori smaller; indusium vanishing before spores mature.....18

18 Stipe much shorter than blade; lower pinnae gradually shortening to base, lowest very short; frond glandular on underside, glands becoming golden and glistening at maturity; lemon scent when crushed (not detectable by everyone); sori arranged towards margin of pinnule.....***Oreopteris*** **(Lemon-scented Fern)**

18 Stipe about as long as blade; lower pinnae not or slightly shortening towards base; frond not glandular; sori about half-way between midrib and margin of pinnule .....***Thelypteris*** **(Marsh Fern)**

19 Pinnae <1.5cm wide, 2-pinnate or at least with lobed pinnae in Hants species, with one lobe on the rhachis side making a conspicuous "thumb"; sori in one row either side of midrib.....***Polystichum*** **(Shield-ferns)**

19 Pinnae >1.5cm wide, 1-pinnate with large unlobed pinnae; sori all over lower side of pinna.....***Cyrtomium*** **(Asian Holly-ferns)**

20 Sori oblong or curved ('J'-shaped).....***Athyrium*** **(Lady-ferns)**

20 Sori linear, more or less straight, sometimes paired.....***Asplenium*** **(Spleenworts)**

21 Sori linear; frond densely scaly beneath.....***Asplenium*** **(Spleenworts)**

21 Sori round or elliptical; fron not densely scaly.....22

22 Fronds breaking cleanly from rhizome after maturity, 1-pinnate with pinnae sometimes lobed or even frilly, but not deeply pinnatifid; blade soon becoming dull mid to dark green, or yellowish in exposed sites; sori large (2-3mm), always lacking indusium .....***Polypodium*** **(Polypodies)**

22 Fronds, if breaking after maturity, doing so above the joint with the rhizome, 2-pinnate or 1-pinnate with deeply pinnatifid pinnae; blade remaining a fresh green; sori smaller, sometimes with indusium when young.....23

23 Stipe much shorter than blade; lower pinnae gradually shortening to base, lowest very short; frond glandular on underside, glands becoming golden and glistening at maturity; lemon scent when crushed (not detectable by everyone); sori arranged towards margin of pinnule; indusium may be present when young.....***Oreopteris*** **(Lemon-scented Fern)**

23 Stipe roughly as long as blade; lower pinnae reducing slightly in length, if at all, towards base; frond not glandular and fragrant on underside; sori variously arranged 24

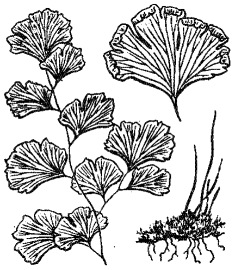
24 Blade triangular to broadly ovate; lowest pair of pinnae usually angled towards base and slightly raised above rhachis; base of pinnae running onto the rhachis and making a "wing"; sori arranged towards margin of pinnule; indusium never present .....***Phegopteris*** **(Beech Fern)**

24 Blade lanceolate; lowest pair of pinnae spreading more or less at right angles; sori about half-way between midrib and margin of pinnule; indusium may be present when young .....***Thelypteris*** **(Marsh Fern)**

Hampshire species

Adiantum L. (Maidenhair Ferns)

There is a single species of this genus in in Hampshire *(Adiantum capillus-veneris*), where it occurs as a rare naturalisation in sheltered places on the masonry of buildings and structures.



Asplenium L. (Spleenworts)

1 Blade comparatively large (to 60cm), unlobed and undivided (apart from occasional 'sports'), leathery; sori long across much of width of blade, arranged in pairs with open sides facing each other.....***A. scolopendrium*** **(Hart's-tongue)**

1 Blade shorter, regularly lobed or divided; sori shorter, not arranged in facing pairs.....2

2 Blade pinnatifid, with lobes rounded, arranged in a zig-zag pattern either side of the rhachis; sori usually hidden by dense felting of rusty brown scales on mature fronds .....***A. ceterach*** **(Rusty-back)**

2 Not as above.....3

3 Fronds 1-pinnate.....***A. trichomanes*** **(Maidenhair Spleenwort)**

3 Fronds 2- or 3-pinnate or -forking.....4

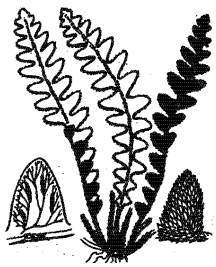
4 Stipe reddish- to blackish-brown; blade up to 30cm, tapering to an acute apex with pinnae decreasing in size and top pinnules fused and no more than lobed; indusia without ragged fringe to margins.....***A. adiantum-nigrum*** **(Black Spleenwort)**

4 Stipe dark only at extreme base; blade up to 8cm, not tapering to a markedly acute apex; pinnae irregularly cut into ±equal segments; indusia with ragged fringe to margins .....***A. ruta-muraria*** **(Wall-rue)**

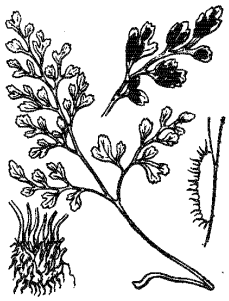
This is a genus which, especially with recent taxonomic revisions, encompasses plants of widely different appearance.

A. adiantum-nigrum could be overlooked for a fern of a different genus, but its rather stiff fronds coupled with the shape of its sori are distinctive. It is a widespread but not very common fern in Hampshire, occuring mostly on wood-banks and hedge-banks on non-calcareous soils.

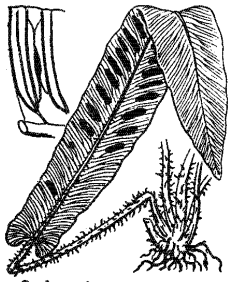
A. ceterach is unlikely to be mistaken for any other Hampshire fern, with its neat and furry fronds. It is found chiefly in the north and west of the county, confined here to man-made habitats such as mortared walls. It seems to have declined considerably, perhaps because of cleaning up or destruction of old walls. In periods of drought it will furl up and appear desiccated and dead, reviving at the next rain.



A. ruta-muraria is another species unlikely to be mistaken for any other species in the county, with its broadly traingluar to fan-shaped blades and distinctive leaf segment shapes. It one of the most widespread of the "wall ferns" in Hampshire, with concentrations around the old built-up areas and on railway bridges.



A. scolopendrium is unmistakeable, widespread, common and often abundant in the county on masonry and in shady situations, mostly on base-rich substrates. It is a strong coloniser and appears to be getting more abundant.

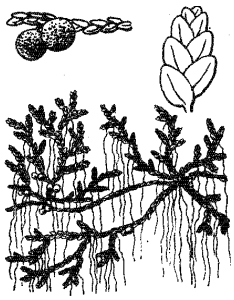


A. trichomanes is a widespread "wall fern" but markedly less common in Hampshire than *A. ruta-muraria*. The only subspecies here, of the three occurring in Britain, is subsp. *quadrivalens*, the most generalist in its requirements.

Athyrium Roth. (Lady-ferns)

Only one species occurs in Hampshire, *Athyrium filix-femina* (Lady-fern). As well as the diagnostic key characters, it can be told from ferns with similar-shaped fronds by its more delicately divided ultimate pinnules, and the characteristic down-turning of the bottom pair of pinnae on the frond. It is strongly crown-forming and old plants often make substantial tussocks. In Hampshire it is widespread and often common in damp, non-calcareous habitats in shade and in the open.

Azolla Lam. (Water Fern)



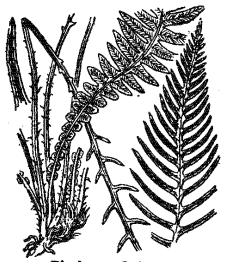
If not overlooked as something other than a fern, this introduced species, *Azolla filiculoides*, is unmistakeable. It frequently takes on a bright red colouration in autumn. This is sometimes billed as a serious pest of waterways, but in Hampshire, although widespread, it rarely dominates and is often impersistent. It is found in quiet water chiefly along the main river systems.

Blechnum L. (Hard-ferns)

1 Fronds to 100 x 20cm; pinnae of sterile fronds shallowly lobed, narrowing at attachment to rhachis to a ±cordate base.....***B. cordatum*** **(Greater Hard-fern)**
1 Fronds not more than 75 x 7.5cm; pinnae of sterile fronds unlobed, attached to rhachis by their full width.....2

2 Fronds mostly not more than 20 x 1.5cm.....***B. penna-marina*** **(Little Hard-fern)**
2 Fronds mostly 20-40 x 2.5-5cm.....***B. spicant*** **(Hard-fern)**

Of these, only *B. spicant* has so far been recorded in Hampshire; the other two (non-native) species have been included here as both are popular garden plants and capable of naturalising.



B. spicant is often characterised by gently up-curving pinnae. Old plants can sometimes make substantial tussocks, quite tall in relation to their width. It is completely intolerant of lime and so is confined to areas of Hampshire off the Chalk, and is also absent from many coastal areas. Elsewhere it is widespread, mostly in woodland or ancient hedged landscape, especially on wood-banks and stream-sides.

Botrychium Sw. (Moonwort)

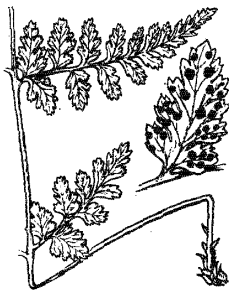
A single species *Botrychium lunaria*, unmistakable with its pinnate sterile frond, and fertile frond with bunched sporangia, on a single stem; but often diminutive and easily overlooked. Generally rare in Hampshire and apparently declining, dependent on short turf with reduced competition; all recent records are from the New Forest. It had a bit of a heyday in the "Verderer's Strips" established around the Forestry Commission's new plantations of the 1960s and 1970s, but seems to have declined again since.

Cyrtomium C. Presl (Asian Holly-ferns)

1 Pinnae 3-11 pairs, glossy on upperside, entire, or shortly toothed at base only .....***C. falcatum*** **(Japanese Holly-fern)**
1 Pinnae 12-26 pairs, dull on upperside, usually toothed almost to apex .....***C. fortunei*** **(Fortune's Holly-fern)**

So far there is only a single record of either of these non-native ferns in the county, for *C. falcatum* in Portsmouth Dockyard; but they are both widely available at nurseries and garden centres (especially *C. fortunei* at present), and have both shown themselves capable of naturalising.

Cystopteris Bernh. (Bladder-ferns)



Only one species is recorded (*Cystopteris fragilis*, Brittle Bladder-fern); although this is a native elsewhere in Britain, it has only been recorded twice in the county as an adventive on buildings, and has not been seen for 40 years.

Dryopteris Adans. (Buckler-ferns)

1 Fronds 1- to 2-pinnate, if 2-pinnate then pinnules not lobed to more than half way to midrib.....2 (Male-ferns)

1 Fronds 2- to 3-(4-)pinnate, if 2-pinnate then pinnules lobed almost to midrib .....6 (Buckler-ferns)

2 Stipe with sparse to dense greyish-brown scales; pinnae without dark blotch at junction with rhachis; pinnules distinctly tapering, rounded to obtuse at apex .....***D. filix-mas*** **(Male-fern)**

2 Stipe with fairly to very dense golden- or gingery-brown scales; pinnae with dark blotch at junction with rhachis; pinnules more or less parallel-sided at least in lower half, rounded to truncate (but often toothed at tip).....3 (Scaly Male-ferns)

3 Stipe usually not less than ¼ length of frond, with fairly dense, light golden-brown, scales; blade somewhat truncate at base, with lower pinnae at least ½ as long as longest, not shiny; tips of pinnules truncate but often with a pair of teeth ("cat's ears") one at either side.....***D. borreri*** **(Borrer's Male-fern)**

3 Stipe usually less than ¼ length of frond, scales denser and redder; blade narrowing at base, with lower pinnae ½ as long as longest or less, ±shiny; tips of pinnules ±rounded with short obtuse teeth.....4

4 Stipe scales golden-brown; frond shiny, leathery; lowest pinnule on basal side of pinna not noticeably larger than its neighbour, with inconspicuous or no lobe on the rhachis side.....***D. affinis*** **subsp.** ***affinis*** **(Golden-scaled Male-fern)**

4 Stipe scales golden- or reddish-brown; lowest pinnule on basal side of pinna larger than its neighbour, with a distinct lobe.....5

5 Stipe scales golden-brown; frond shiny, leathery; lobe on basal pinnule small, not overlapping whole of rhachis.....***D. affinis*** **subsp.** ***palaceolobata***

5 Stipe scales reddish or gingery-brown; frond less shiny and leathery, rather narrow in relation to its length; lobe on basal pinnule substantial, usually overlapping whole of rhachis.....***D. cambrensis*** **(Narrow Male-fern)**

6 Stipe thickening rather rapidly towards base, often purplish; pinnules distinctly concave on upper side, giving the leaf a rather crisped, "parsley-like" appearance; bottom basal pinnule of lowest pinna usu. large and more divided than its neighbours; fronds with numerous minute glands on lower side.....***D. aemula*** **(Hay-scented Buckler-fern)**

6 Stipe thickening only gradually towards base; pinnules flat or convex on upper side; few or no glands on lower side of fronds.....7

7 Stipe scales broadly triangular (almost equilateral), with no dark central stripe; blades narrowly triangular to lanceolate; lower pinnae often twisted to lie horizontally; pinnules usu. flat; pinnule teeth mucronate, almost spiny in appearance .....***D. carthusiana*** **(Narrow Buckler-fern)**

7 Stipe scales more narrowly triangular, with a dark stripe or region at the centre; blades broadly triangular; pinnules often convex; pinnule teeth acuminate but not spiny in appearance.....***D. dilatata*** **(Broad Buckler-fern)**

Dryopteris has two challenging areas for identification:

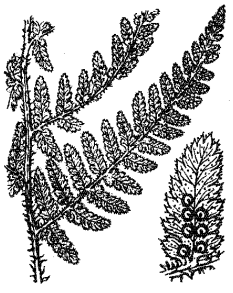
- The Scaly Male-fern aggregate (*D. affinis* agg.) is complex, with local races, and there are many intermediate plants that are difficult to place. Hybrids with *D. filix-mas* also occur occasionally *(D.* x *complexa*).
- Hybrids between Broad and Narrow Buckler-ferns (*D.* x *deweveri*) are fairly common and intermediate between the species, without any striking features such as hybrid vigour.

D. affinis agg. (the Scaly Male-fern group) is scattered but widespread in Hampshire, mostly in ancient woodland. *D. affinis* (including its subspecies *palaceolobata*) can make exceptionally robust plants, fronds sometimes approaching a couple of metres. It tends to stay winter-green although fronds may collapse sideways. *D. borreri* is typically a much less sturdy plant although it, too, will stay at least partially green through the winter. *D. cambrensis* has been a rather problematic plant in Hampshire. In its typical upland haunts it tends to be a plant of modest size (more like typical *D. borreri* but with a narrower frond) which does not overwinter. A number of previous determinations of robust overwintering plants have now been reassigned to *D. affinis* subsp. *palaceolobata*. There are still a few good records of *D. cambrensis* that have been determined by one of the experts.

D. filix-mas is widespread and common thoughout the county on all but the chalkiest of soils. It can usually be distinguished fairly readily from the Scaly Male-ferns by the lack of a dark blotch on the base of the pinna where it joins the rhachis. However by late autumn it may develop a darkening in this region. Also, it is sometimes necessary to scrape away scales on the Scaly Male-ferns to reveal the blotch.

D. aemula was not found in the county until 1987, but is now known from a number of spots in the central and southern New Forest, and has been recorded in very small numbers from three places elsewhere in southern Hampshire. Possibly the closing of woodland canopies, with resulting higher humidity and shade, has helped it to colonise; it is mostly a plant of the western, Oceanic fringes of Britain, with outliers in the Sussex Weald. The crinkly appearance bestowed by the concave pinnules helps to pick it out from a little distance.

D. carthusiana is widespread in the county but generally absent from the chalk, except in the river valleys where they may be some accumulation of peat. Although it is most commonly seen in somewhat shaded acidic wetlands, it quite frequently occurs in ancient woodland, particularly on clay soils. Here it may hybridise with Broad Buckler-fern; the hybrid *D.* x *deweveri* is generally intermediate in most characters, particularly in the shape and colouring of the stipe scales. Although Narrow Buckler-fern tends to make a more diffuse, less leafy "shuttle-cock" than Broad Buckler-fern, the young fronds are usually held very upright and help to pick it out at a distance.



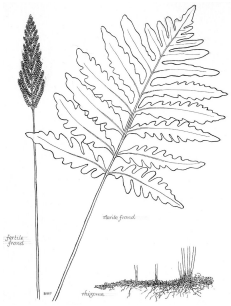
D. dilatata is one of commonest ferns in the country, widespread everywhere except in parts of the chalk where there are few woodlands or hedgebanks. It is often a good coloniser of secondary woodland. Apart from the key characters

given, the broad fronds and dull bluish-green coloration often pick it out; but plants growing out in the open can have a rather unhealthy yellowish-green cast.

Matteuccia Tod. (Ostrich Fern)

There is a single species here, *Matteuccia struthiopteris*, introduced from northern and montane Europe. It has been recorded from the wild only once in Hampshire so far (although it is rampant over many parts of the Hillier Gardens at Ampfield). It is a popular garden fern and may well turn up more widely. Although looking somewhat like a Male-fern from a distance, it is very distinctive in detail; rhizomes throwing up crowns at intervals; crowns forming very regular "shuttle-cocks", with separate fertile and sterile fronds; pinnae very gradually narrowing to the base of the frond where they are little more than stumps; pinnae at the top of the frond shortening dramatically to form a broad-based triangular tip; and a rather silvery cast imparted by the pale scales.

Onoclea L. (Sensitive Fern)



This (*Onoclea sensibilis*) is another introduction, native to North America and East Asia. It has been recorded in four spots in Hampshire in the wild, and once established (usually in damp shady ground) can spread rapidly by its rhizomes, which throw up fronds singly. The lobed pinnae, usually flushing bronzy-red before turning a pale green, are distinctive and rather delicate. Fronds die back at the first frosts.

Ophioglossum L. (Adder's-tongues)

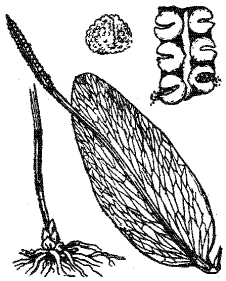
1 Fronds usually arising singly; sterile blade mostly >4cm, held upright or rather steeply ascending; sporangia 10 or more on each side of fertile spike .....***O. vulgatum*** **(Adder's-tongue)**

1 Some fronds arising in paris; sterile blade <3.5cm, held out at right angles or shallowly ascending; sporangia 6-14 on each side of spike....***O. azoricum*** **(Small Adder's-tongue)**

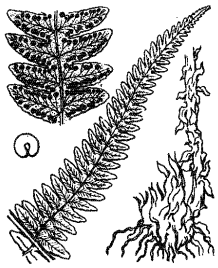
One should not rely on any single feature to distinguish these two species, and especially not the sporangium count, which overlaps and is often at the lower end of the range in depauperate *O. vulgatum*. In Hampshire the two species grow together and there are nearly always plants that are hard to assign.

O. azoricum in Hampshire is a rare plant of the New Forest, discovered relatively recently but now known from a number of sites. It favours very short damp turf and is a feature of some of the World War II sites as well as more natural habitats on the marls in the south of the Forest. West of the Avon Valley, however, there are records from sandy Bracken-dominated heaths.

O. vulgatum is a widespread but uncommon and decreasing plant in Hampshire, found in a wide range of damp neutral to alkaline grassland.



Oreopteris Holub (Lemon-scented Fern)

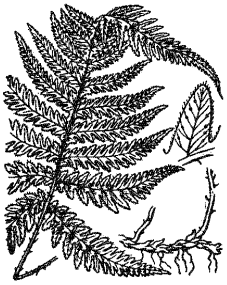


There is a single species here (*Oreopteris limbosperma*) which is widespread and sometimes abundant on the northern and western parts of the New Forest, more scattered on the Thames Basin heathlands, and very rare elsewhere in the county. It occurs in damp woodland, often along stream courses. At a distance it might be mistaken for a Male-fern, but the untoothed pinnules with neatly triangular tips, the disposition of the sori around the margins of the pinnule, the lack of the characteristic *Dryopteris* indusium, and the lemon-scented glands will readily distinguish it.

Osmunda L. (Royal Fern)

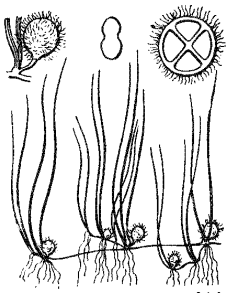
Again, there is a single species in the county, *Osmunda regalis*, and with its large broad pinnules and branched fertile frond tips, it is unmistakeable. It is widespread on the New Forest and Thames Basin heaths and scattered on the Wealden heaths and elsewhere in southern Hampshire. It is to be found in bogs, ditches, swampy woodland and occasionally in the field layer of drier ancient woodland.

Phegopteris (C. Presl.) Fée (Beech Fern)



Yet another genus with a single species in Hampshire, *Phegopteris connectilis*. Reasonably common in western and upland Britain, it has just two Hampshire sites, in swampy stream-bottom woodland in the New Forest. The outline of the blade, and the distinctive down-turning of the lowest pinnae, are distinctive, as is the tendency shared with other members of the genus for the lowest pinnule to run out onto the rhachis, forming a narrow 'wing' down either side.

Pilularia L. (Pillwort)



There is no mistaking this plant (*P. globulifera*) for any other British fern; it is more likely to be overlooked as a diminutive Rush or Sedge relative, but when the sterile fronds are young their tiny coiled tips show its true nature, and later the brown balls on short stalks that make up the fertile fronds are highly

distinctive. The Hampshire headquarters for this species are in the New Forest and the Thames Basin heaths, in shallow ponds and small watercourses and wet rather open ground around mires.

Polypodium L. (Polypodies)

1 Blades broad (mostly <2x as long as wide), triangular-ovate, often strongly contracted into a long terminal pinna, yellowish and quite leathery in sites exposed to the sun; pinnae with markedly acute tips, often serrate or shallowly lobed, lowest usu. markedly turned down; sori with branched hairs (paraphyses) amongst the sporangia (use 20x or higher lens or dissecting microscope).....***P. cambricum*** **(Southern Polypody)**

1 Blades at least 2x as long as wide, often much more; pinnae rounded or somewhat acute at tips, usually entire or slightly serrate, lowest turned down or not; sori without branched hairs among the sporangia.....2

2 Mature blades ± parallel-sided at least in lower half, if with long terminal pinna then less dramatically contracted; pinnae entire or very slightly toothed, lowest pair rarely down-turned; sori usu. rounded (best seen when first maturing); maturing sporangia brown, with a higher average number (10-14) of thickened annulus cells .....***P. vulgare*** **(Polypody)**

2 Mature blades narrowly ovate or somewhat triangular, tapering more extensively in upper half and usu. more gradually to tip; pinnae entire, somewhat toothed or very occasionally lobed, lowest pair often down-turned; sori usu. elliptical; maturing sporangia yellow to orange, with 7-10 thickened annulus cells .....***P. interjectum*** **(Intermediate Polypody)**

The key may suggest that these species are fairly easy to tell apart, but this is not always the case. In particular:

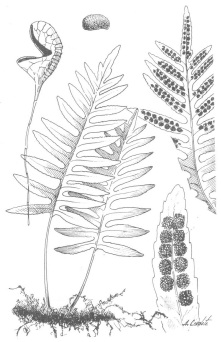
- Frond shape may vary quite considerably. Avoid trying to make a judgement on young or small fronds.
- Pinna shape may also vary. Some ID guides talk about the "herringbone" arrangement of pinnae along the rhachis being distinctive in *P. vulgare*, but often this is just as apparent in *P. interjectum*.
- Sorus shape can be difficult to determine on fully matured fronds.
- All species pairs can give rise to hybrids; two out of three are known in Hampshire.

Doubtful cases between *P. cambricum* and *P. interjectum* are best resolved by looking for the branched hairs in the sori.

Doubtful cases between *P. vulgare* and *P. interjectum* are best resolved microscopically, using the number of thickened cells in the sporangium, averaged out over several sporangia, and the top-to-bottom height of the annulus cells (60-80µ in *P. vulgare*, 75-85µ in *P. interjectum*). Spores are smaller in *P. vulgare* than in *P. interjectum* but there is disagreement between authors about what the absolute ranges are.

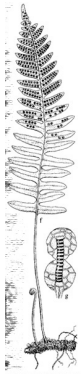
The two hybrids detected in Hampshire are *P.* x *mantoniae* (*P. vulgare* x *P. interjectum*) and *P.* x *shivasiae* (*P. interjectum* x *P. cambricum*). The former is widespread at least in South Hampshire, but rarely recorded; the latter has been recorded in just two sites so far. Hybrid plants often display hybrid vigour, especially *P.* x *mantoniae*, but must be confirmed by microscopic examination of spores. Hybrid spores are abortive and are misshapen and an opaque slatey-grey in colour. Areas to the south of the New Forest in particular often have plants forming vigorous and extensive patches

like *P.* x *mantoniae*, but prove on examination to be fully fertile and must be ascribed to *P. interjectum*. R. Prelli has noted the same phenomenon in France, and suggests that such plants need further cytological analysis.



P. cambricum is a plant of two habitats in Hampshire; the mortar and limestone of mediaeval walls, where it is present in many of the mediaeval towns and archaeological sites in southern Hampshire and must presumably be an ancient introduction; and as an epiphyte (almost exclusively on Oak) in humid ancient woodland in the New Forest. It is a broad Mediterranean species and puts up fronds comparatively late in the year (August or early autumn), maturing through the winter, sometimes suffering from frost damage, and dropping in May. In fact the two habitats support rather different-looking plants, the former with yellowish leathery blades and well-branched hairs (paraphyses) in the sorus, the latter with more mid-green, thinner, softer-textured leaves, sometimes strikingly 'frilly', and paraphyses with just one or two stubby branches rarely formed of more than one cell. They may be taxonomically separable, but no work has been done on this.

P. interjectum is found most often on hedgebanks, wood-banks and epiphytic (mostly on Oak), rarely on masonry. Its Atlantic affinities are reflected in its distribution in Hampshire, where it appears particularly in south-west Hampshire, often most abundant not far from the coast, and thins out rapidly except in the higher rainfall area of the Hampshire Hangers. Occasionally it also produces strikingly lobed fronds like some forms of *P. cambricum.* New fronds are put up from late June onwards and are mature through the winter, often not disappearing until well into the following year. It is is a hexaploid species considered to have formed by chromosome doubling from hybrids of the diploid *P. cambricum* and the tetraploid *P. vulgare*.



P. vulgare is more of a generalist species; although it does best in areas of higher humidity, it is more generally distributed in the county and is able to tolerate more exposed sites on walls. It also grows in hedgebanks and wood-banks, and epiphytic above all on Oak. It can put up new fronds from May onwards which mature by August and die early the next summer.

Polystichum Roth (Shield-ferns)

1 Fronds 1-pinnate, pinnae shallowly toothed and with a single basal lobe to each .....***P. munitum*** **(Western Sword-fern)**

1 Fronds 2-pinnate (sometimes with pinnatifid pinnules).....2

2 Fronds to 50cm; stipe scales linear, black; blades narrowly lanceolate-triangular; pinnae with one conspicuously larger, often lobed pinnule at the base on the upper (distal) side of the pinna; other pinnules unlobed or with a single inconspicuous lobe on the distal side.....***P. tsus-simense*** **(Tsus-sima Holly-fern)**

2 Fronds usu. larger; stipe scales brown; blades widest at or above middle.....3

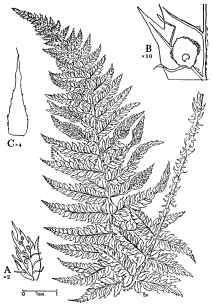
3 Fronds to 1.5m; blade rather soft in texture; pinnae somewhat separated; lowest pinnae nearly as long as longest, ending at shortish stipe; pinnules nearer rhachis in centre of blade short-stalked, with the base making a ±right angle; basal pinnule on the upper (distal) side of each pinna not conspicuously larger nor making a conspicuous double rank down each side of the rhachis.....***P. setiferum*** **(Soft Shield-fern)**

3 Fronds to c. 1m; blade stiff in texture; pinnae close-set; lowest pinnae very much shorter than longest, ending at very short stipe; pinnules nearer rhachis in centre of blade unstalked, making an acute angle at base, or joined to midrib; basal pinnule on the distal side of each pinna larger, making a double rank down each side of the rhachis .....***P. aculeatum*** **(Hard Shield-fern)**

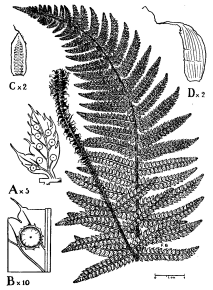
P. munitum and *P. tsus-simensis* are included here because they are popular horticultural ferns and may appear in the wild. So far only the latter has cropped up in Hampshire; it was on a brick wall behind a leaky drain-pipe in Winchester but was destroyed, and the leak fixed, three years after its discovery.

P. aculeatum and *P. setiferum* form the hybrid *P.* x *bicknellii*, which has been recorded a few times in Hampshire. It is intermediate in character between the other two, and may show hybrid vigour. It is best determined microscopically from its largely sterile spores.

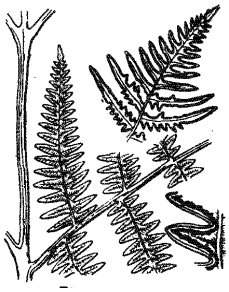
P. aculeatum is widely but rather patchily distributed in Hampshire; it is much more lime-loving and less drought-tolerant than *P. setiferum*, and is particularly a feature of the East Hampshire hangers. It is chiefly in woods and hedgebanks.



P. setiferum is much the commoner Hampshire species, and often more abundant where it does grow. While not avoiding calcareous soils altogether, and found frequently in East Hampshire as well as in more acid areas in northern and southern Hampshire, it is rare over much of the central Chalk plateau. In the New Forest it is sparse in much of the central woodlands but frequent to the south and west. It is in woods and shady hedgebanks, and frequent along incised streams. Sports of this species with finely dissected leaves are widely cultivated, and may turn up in the wild.

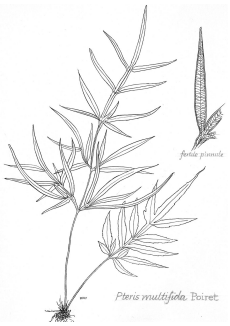


Pteridium Gled. ex Scop. (Bracken)



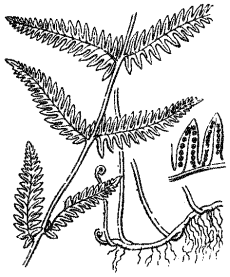
A single species occurs, *Pteridium aquilinum,* which is almost cosmopolitan in distribution. Attempts have been made to divide it into a number of species and subspecies, but only one of those named for Britain has been recorded in Hampshire (*aquilinum* subsp. *aquilinum*), though it is quite possible that one other (*aquilinum* subsp. *atlanticum*) occurs. Anyone interested in investigating variation in bracken should consult Page (1997). With its singly arising long upright stems and its distinctive 2-3-pinnate fronds with marginal linear sori, it is an unmistakeable plant. Records from the western half of the central chalk plateau are sparse but elsewhere in Hampshire it is ubiquitous. It is often considered as a 'pest' plant, but Bracken-dominated communities in the New Forest can be species-rich and valuable for conservation.

Pteris L. (Ribbon-ferns or Brake-ferns)



As yet only a single species, *Pteris multifida*, has been recorded in Hampshire and this is arguably not 'in the wild', as it occurs only in two well-shafts both indoors in pubs! A good guide to cultivated *Pteris* species that are either appearing in the wild in Britain, or are likely to do so, appeared in the *Pteridologist* magazine (2008), Vol 5 pp 31-35.

Thelypteris Schmidel (Marsh Fern)



Again there is a single species, *Thelypteris palustris*, in Hampshire. It is a rare plant of boggy woodlands; in the New Forest it is sometimes found in the central carr of valley mires. It is also found in the Thames Valley and Wealden heathlands.

Further reading

Hutchinson, G & Thomas, B.A (1996): *Welsh Ferns*, 7th ed., National Museum of Wales,Cardiff
Don't be put off by the title – this covers all British species and a selection of naturalised non-natives. Good keys (for sporing plants), good practical descriptions and excellent detail drawings.

Jermy, C & Camus, J (1991): *The Illustrated Field Guide to Ferns and Allied Plants of the British Isles*, HMSO, London
Clear, well laid out identification notes, and good drawings of sorus details. Unfortunately out of print and expensive second-hand.

Merryweather, J & Hill, M (1995): *The Fern Guide*, 2nd ed., Field Studies Council, Preston Montford
A detailed, well-illustrated, user-friendly identification key.

Moran, R.C (2004): *A Natural History of Ferns*, Timber Press, Portland
An exemplar of good popular science writing – lively and entertaining short articles, providing a substantial introduction to many topics in fern biology, evolution, and man's relationships with ferns.

Page, C.N (1988): *A Natural History of Britain's Ferns*, Collins New Naturalist, London
Strong on fern ecology and phytogeography. The writing style makes it hard going at times.

Page, C.N (1997): *The Ferns of Britain and Ireland*, 2nd ed., CUP, Cambridge
Encyclopaedic, and with full detailed coverage of hybrids, but nothing on introduced species. Expensive.

Prelli, R (2001): *Les Fougères et plantes alliées de France et d'Europe occidental*, Belin, Paris
At first glance this looks like a coffee-table book, but it is a superb guide which is essential reading if you read French and want to know the fern flora of neighbouring parts of Europe. Even if you don't read French, the pictures alone are worth the price.

Tierra, E.S (1990): *Guía de Helechos de la Peninsula Ibérica y Baleares*, Ediciones Pirámide, Madrid
A useful pocket-sized field guide for Spanish-reading visitors to Spain, Portugal and the Balearic islands. Well-illustrated with line drawings and (small) photos.

The British Pteridological Society is the British society devoted to the study of ferns and other vascular cryptogams. See: http://www.nhm.ac.uk/hosted_sites/bps/

The full text of the paper by Chris Fraser-Jenkins that is the basis of the modern treatment of the *D. affinis* group, published in the *Fern Gazette*, is available online at:
http://www21.us.archive.org/details/mobot31753003432140

Roger Golding hosts an excellent (developing) site for photos of British ferns at:
http://www.ferns.rogergolding.co.uk/