A Guide to English *Cladonia* Species and Associated Lichens

This is a guide to identifying English *Cladonia* species, mostly those of heathland but with other *Cladonia* species added for completeness, along with similar and associated heathland lichens. It is split into mostly artificial groups based on general characteristics. This is intended as a rough key but, in identifying *Cladonia*, reading though and comparing descriptions of the potential species can produce better results than using dichotomous keys. The *Cladonia* key in the 2009 Lichens of Great Britain and Ireland 2, for example, tended to key out well developed specimens only. For example, immature or stunted specimens of *Cladonia polydactyla* without cups will key out as *Cladonia macilenta*, in spite of both species being quite distinct in their cortex characters. The 2021/22 Lichens of Great Britain and Ireland 3 volume 19/26 has tried to get way from this and account for the more typical poorly developed material. The following guide gives links to the LGBI descriptions transferred to the BLS website, with added comments and pictures, along with an aid memoir of the important features. (For technical terms used in the text see the Glossary).

The morphotypes used are listed below. The first important split is whether the lichen has squamules (leaf like structures) or not:

Without Squamules.

Reindeer Mosses, distinctive large, robust and much branched lichens. The podetia surface is felted.

Heathtthorns, similar to the Reindeer Mosses differ from them by their more sparingly branched podetia, which are more inflated below and abruptly tapered at apices.

Spinyheaths, *Cetraria* species, not *Cladonia* species but look-a-likes. Dark brown and shiny shrubby lichens, with thallus is angular rather than rounded, with lateral spinules and has small holes in the cortex (pseudocyphellae) which show as pale patches.

Heathtooth, *Pycnothelia*, closely related to *Cladonia* with a thick and persistent primary crust-forming thallus with small rounded tooth-like podetia develop from the thallus

With Squamules.

False Reindeer Mosses, tall branched bushy podetia, which can look superficially similar to Reindeer Mosses, but some squamules present and the podetia surface is smooth and not felted.

Pixie Cups, with well-developed typically goblet shaded cups, with deep hollows inside the cups.

Brown Pixie Cups, with brown apothecia/pycnidia:

Red Pixie Cups, with red apothecia/pycnidia:

Stacking Cups, also have cups, but these have narrower cups, with shallower or flat hollows and prominent basal squamules mats. In some species the cups proliferate in tiers from the centre of the cup. Other species rarely proliferate or do so from the cup edge.

Heathtails, *Cladonia* species which have small branched upright podetia, with no or small neat cups.

Devil's Matchsticks, A group distinguished by the presence of red apothecia or pycnidia, including species without cups (**Heathtail Group &** true **Devil's Matchsticks**), with cups (**Pixie Cups**) or dominated by squamules (**Squamule Mats group**).

Without cups (true Devil's Matchsticks)

With cups (Red Pixie Cups)

Squamule Mats, some sterile mats of squamules can be identified by look, spot tests or UV fluorescence, others are not easily identified. Those listed here are those mainly found and identified as sterile mats along with those which are possible to identify sterile but more typically found fertile.

Without Squamules

The large robust much branched **Reindeer Mosses** have podetia which originate from ephemeral granular crusts. With **Heathtooth** *Pycnothelia papillaria* the crust is dominant and perennial with the podetia small and rice grain like. The **Heathtthorns** *Cladonia uncialis* and *Cladonia zopfii* are quite like Reindeer Mosses but are much more sparsely branched with more inflated podetia. Finally, the **Spinyheaths** *Cetraria* species look like brown Reindeer Mosses but are actually not related, with some other *Cetraria* species being leafy (foliose) lichens. The shrubby *Cetraria* species are an example of convergent evolution.

Reindeer Mosses
The *Cladonia* group "*Cladina*" which are distinctive, robust and much branched lichens. The key feature is the lack of squamules; in this group the podetia originates from an ephemeral granular crust not from squamules. Some confusion is possible with the False Reindeer Mosses, especially *Cladonia rangiformis*. These are also tall and much branched but always have some squamules present somewhere. The Heaththorns (*Cladonia uncialis* and *Cladonia zopfii*) also have no squamules but have more inflated hollow podetia and like the False Reindeer Mosses they have a well-developed cortex; the surface is smooth and hard. Reindeer Mosses have no true cortex and the outer algae-containing layer is finely fibrous on the surface. Separating the individual species is not at all easy, with spot tests, UV florescence and subtle branching patterns important. The species arranged by order of frequency of occurrence in this section.

Cladonia portentosa link. UV+ bright blue-white, Pd–, the commonest of the group, UV + separates it from all other frequent species, terminal branches not orientated across the head but, they can be straight or recurved, predominantly in threes at the apices, distinct yellow green tinge when dry. Widespread in acid habitats.

Cladonia ciliata* var. *tenuis link. UV–, Pd+ orange-red, fine elegant podetia branching mainly in twos, the branches notably recurved and markedly orientated in one direction across thallus. With usnic acid, so has greenish grey to yellowish thalli. In good quality habitats, more prominent in less acid habitats than var. *ciliata*.

Cladonia ciliata* var. *ciliata link. UV–, Pd+ orange-red, like *Cladonia ciliata* var. *tenuis*, but with without usnic acid, so is brown to grey-white morph, more prominent in acid habitats than var. *tenuis*.

Cladonia arbuscula* ssp. *squarrosa link. UV–, Pd+ orange-red, the branches notably recurved and markedly orientated in one direction across thallus, and branched predominantly in fours or and fives at the apices, distinct silvery colour when dry. High quality heaths and acid grasslands.

Cladonia rangiferina link. UV –, Pd+ orange-red, K+ yellow, a large bulky lichen with recurved branches, resembling *Cladonia arbuscula* but the podetia has distinctive pale ash-grey and brown colours, a more visible felted cortex surface and a K+ yellow spot test. Rare in montane heaths and east coast dunes.

Cladonia portentosa* morph *azorica link. UV+ bright blue-white, Pd+ orange-red, chemotype of *Cladonia portentosa* reacting to Pd at the branch tips. Uncommon on mossy rocks in the west. Described as a species but now regarded as chemical variant of *C. portentosa*.

Cladonia mediterranea link. UV+ bright blue-white, Pd–, as *Cladonia portentosa* but predominantly dichotomous branching, a compact smooth and matt cortex and the axils closed or infrequently with small axil holes. Very rare on sunny heaths in the south west.

Heaththorns
Cladonia uncialis and *Cladonia zopfii* which differ from the Reindeer Mosses by their more sparingly branched podetia, which are more inflated below and abruptly tapered at apices. The effect is a stiff and spiky thallus as opposed to the more elegant tufts of the Reindeer Mosses. The most upright and bushy *Cladonia zopfii* specimens, are easily overlooked as Reindeer Mosses, but otherwise a distinctive group. Within the group identification is made by branching angle, cortex colour and patterning, the presence of open and closed axils in podetia, and the type of surface observed on the inner surface of the hollow podetia when split open.

Cladonia uncialis link. UV± bright blue-white, Pd–, very characteristic, sparingly branched podetia, inflated below and abruptly tapered at apices. Surface smooth, with a 'giraffe-skin' pattern, yellow-green or greyish green. See *C. zopfii* for differences. Declining in many areas but can be locally abundant in high quality heaths. Subspecies *uncialis* link & *biuncialis* link are difficult to tell apart.

Cladonia zopfii link. Like *Cladonia uncialis* but podetia more decumbent, branches more widely divergent, the axis closed with long-pointed apices, not darkened. Surface rough, lacks the 'giraffe-skin' pattern, silver-grey. Very local in high quality heaths and dunes but probably under recorded.

Spinyheaths
Shrubby *Cetraria* superficially like the Reindeer Mosses but brown and shinny and with a very different anatomy if looked at closely. The thallus is angular rather than rounded, with lateral spinules and has small holes in the cortex (pseudocyphellae) which show as pale patches. The pycnidia are also stalked. The two species are sometimes not regarded as separate species but can be found growing together, when the differences between them are quite apparent. Identification is by the branching pattern, podetia cross section and the shape of the pseudocyphellae.

Cetraria aculeata link. Branching open and coarse, main branches becoming ± flattened; pseudocyphellae concave-elongate, often in pits.

Cetraria muricata link. Branching compact, main branches rounded, even, delicate, branches ± densely spinulose; pseudocyphellae flattened, rounded.

Heathtooth
This group includes only one species, the very distinctive *Pycnothelia papillaria*. It is closely related to *Cladonia* and like the Reindeer Mosses has no primary squamules but the primary crust-forming thallus is thick and persistent rather than ephemeral. Small rounded tooth-like podetia develop from the thallus. A declining species across lowland Europe.

Pycnothelia papillaria link. A distinctive white crust studded with small tooth-like podetia. Very locally frequent on open hard humus, but rare and declining over much of Britain south of the Highlands.

With Squamules
The subgroups devised for lichens with squamules are not natural groups, but are convenient groupings based on general physical characteristics. Some species are found in more than one group. The **False Reindeer Mosses** have large well branched podetia, which could be confused with the true Reindeer Mosses, but always have some squamules. Very distinctive and well known are the **Pixie Cups**, with their robust goblet-like podetia with cups much wider than the stem with deep hollows. Most have brown apothecia, but there are also Pixie Cups with red apothecia. Also with cups are the **Stacking Cups**, but these have narrower cups, with shallower or flat hollows and prominent basal squamule mats. The two species in the group, *Cladonia cervicornis* and *Cladonia verticillata* frequently have distinctive tiers of cups proliferating from the centre of the cup below, others proliferate less so and more unevenly. These species and the others in the group are often sterile and are included within the **Squamule Mats** group as well. The largest group is the **Heathtails**, which have little branched upright podetia, with no or small neat cups. The **Devil's Matchstick** group is defined by the presence of red apothecia or pycnidia. The final group, the **Squamule Mats**, are those *Cladonia* species with prominent mats of basal squamules that either have small podetia, are rarely fertile, or are sometimes sterile but can still be identified.

False Reindeer Mosses
Tall branched bushy podetia, which can look superficially similar to Reindeer Mosses, but some squamules present and well developed with the cortex well developed; the podetia surface is smooth and hard. In true Reindeer Mosses the surface is looser and more felted.

Cladonia furcata* ssp. *furcata link. Differs from *Cladonia rangiformis* in that lichen having a more richly branched thallus, with the branches diverging at a wider angle. Normally has a uniformly coloured cortex, typically brownish, but can show a crazy-paving effect of mosaic-like white with grey-green patches. A very common species of less acid habitats.

Cladonia furcata* ssp. *subrangiformis link. A habitat morph on calcareous ground with swollen prostrate and little branched, worm-like, podetial and robust appearance. Podetia nodular due to large calcium oxalate crystals.

Cladonia rangiformis link. Can resemble true Reindeer Mosses but usually has some squamules if searched and has a smooth surface, not a felted one. Differs from *Cladonia furcata* in that lichen having fewer branches diverging at a narrower angle. Aways has the surface showing a crazy-paving effect of mosaic-like white with grey-green patches, but this can occur on *C. furcata* too. Typically found in quite base-enriched soils.

Cladonia scabriuscula link. Very similar to *Cladonia furcata*, but differs in the peeling squamules on the surface of the podetia. Probably just a morph and found in the same habitats.

Cladonia stereoclada link. Like *Cladonia furcata*, but the podetia are thinner, more flexuous, with fewer and shorter branches and a distinct shade of grey–green tinged brown. The solid, dense, translucent white to grey-black central axis provides conformation once spotted. A very rare western coastal species a few records from Cornwall, but could be elsewhere.

Pixie Cups
Lichens with well-developed typically goblet-shaped cups, with deep hollows inside the cups. Mostly with brown apothecia or pycnidia but there are Pixie Cups type lichens with red apothecia or pycnidia. Basal squamules not prominent in most species. Lichens with smaller cups referenced here as well but the **Stacking Cup** group species are not. These have narrower cups, with shallower barely indented cups and usually prominent basal squamules mats. The *Cladonia chlorophaea* s. str. and *Cladonia grayi* s. lat. (*Cladonia chlorophaea* s. lat. group) are among the most difficult of *Cladonia* spp and simply separating *Cladonia chlorophaea* s. str. and the *Cladonia grayi* s. lat. group is safest.

Brown Pixie Cups, brown apothecia/pycnidia:

Cladonia chlorophaea s. str. link. Podetia with course soredia or granules, and are usually greenish with any exposed medulla being white and it lacks K+ or C+ spot tests or UV fluorescence. Less acid habitats, rare in acid heathland.

Cladonia cyathomorpha link. Like *Cladonia pyxidata*, but with large squamules with white veined undersides, along with cups with corticate granules. On the cups, the granules are largely confined to the inside of the cup with a mostly verrucose outer surface. Found in sheltered and humid locations on acid mossy rocks and the trunks of older trees.

Cladonia fimbriata link. With golf tee shaped podetia with fine green soredia and a white medulla when exposed. Very common but probably a bit over recorded in very acid habitats for *C. cryptochlorophaea* with slender podetia, but this has a KC+ wine red (fleeting) spot test.

Cladonia grayi s. lat. link. Podetia with course soredia or granules, the podetia are typically browner and have pink-brown tinged exposed medulla, and can have K+ or C+ spot tests or UV fluorescence. On more acidic habitats and common on heathland. Several very cryptic species included. The in this group TLC is required for definitive separation, but well developed podetia can separated with spot tests and morphological characteristics.

> ***Cladonia cryptochlorophaea*** link. KC+ wine red, C± yellow, UV+ pale yellowish, podetia greyish green with smaller, ± farinose rather than granulose soredia. The commonest member of the *C. grayi* group.
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> ***Cladonia grayi*** s. str. link. KC–, C–, UV+ bright mauve-white, more distinctive than other *Cladonia grayi* group species due to bright UV+ mauve-white reaction (grayanic acid), which separates from all other similar species.
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> ***Cladonia merochlorophaea*** link. KC+ wine red, C+ red, K–, KC+ wine red, UV+ faint blue similar to *Cladonia cryptochlorophaea* but with more coarsely granular podetia.
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> ***Cladonia novochlorophaea*** link. KC–, C+ yellow, UV+ white, very similar to *Cladonia merochlorophaea*, but with a different chemistry.

Cladonia humilis link. typical material easily separated by the combination of rather bright green-grey colours, short abruptly tapered cups, farinose soredia but with podetia corticate at base and a K+ yellow reaction. In dry or sandy, less acid but non-calcareous and often disturbed ground, (see also *Cladonia conista* link. A similar cryptic species)

Cladonia humilis "schizidiate morph" link. A very confusing form with large corticate granules (schizidia) instead of farinose soredia. These resemble *C. pocillum*, but the schizidiate morph of *C. humilis* has bright green-grey basal squamules with unturned ends showing the white underside, while *C. pocillum* has browner squamules with downturned ends.

Cladonia monomorpha link. Very similar to *Cladonia pyxidata*, but found on acid low productivity heaths, the basal squamules of *Cladonia pyxidata* are typically small and dissected, while those of *Cladonia pocillum* are appressed to the substrate. Very rare in sandy heaths. Not accepted as a valid species in some accounts.

Cladonia pocillum link. similar to *C. pyxidata*, with only corticate granules and no soredia or decorticate granules, separated by the very different basal squamules, with *C. pocillum* having well developed, ± horizontally spreading, contiguous and overlapping brown-green basal squamules forming compact rosettes. On calcareous substrates.

Cladonia pyxidata link. Defined by the combination of podetia and cups with smooth corticate granules, while lacking any decorticate granules or soredia, along with small rounded basal squamules. On mossy rocks, walls, tree trunks and mildly acid to mildly base rich soil.

(***Cladonia ramulosa*** link). Has a small cups but is described under the Heathtails.

Red Pixie Cups, red apothecia/pycnidia:

Podetia yellow-green in colour (with usnic acid), K–.

Cladonia coccifera group link. A distinctive group of Pixie Cups with red apothecia and yellow-green podetia (usnic acid) with Pd– reactions. The three species recorded in England can be told apart by subtle morphological distinctions.

> ***Cladonia coccifera*** link. With wider cups than *C. diversa* and the podetia are regular, continuously corticate but often irregularly granular in the upper part. Local, mainly in upland heath but also species-rich lowland heath
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> ***Cladonia diversa*** link. With a narrow evenly tapering cup with the podetia stalks covered in small squamules, which often flake off. Widespread and common in acid habitats.
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> ***Cladonia borealis*** link. Similar to *Cladonia coccifera* s. str., with wide flaring cups with corticate granules inside, however, in contrast it has a smooth cortex broken into plates on the podetia base. Very under recorded but probably frequent in the uplands in the north but rare to the south.

(***Cladonia sulphurina*** link.) occasionally with narrow cups, see Devil's Matchsticks.

Podetia various shades of gey (without usnic acid), K+ yellow.

Cladonia digitata link. With large rounded basal squamules with fine soralia on the lower surface, the podetia with cups, with fine soredia on the outside with a corticate cortex inside the cup. Found mainly on dead wood, rarely on humus and damp rock.

Cladonia polydactyla link. Characterised by the blue-grey podetia colour, supporting narrow cups when mature, with the podetia surface having coarsely granular soredia mixed with squamules. Widespread and often common on rotting wood, also on soil and amongst mosses, especially in damp or shaded habitats. Often occurs without cups: see Heathtails to distinguish this morph from *C. macilenta*.]

Stacking Cups
These also have cups, but these have narrower cups, with shallower or flat hollows and prominent mats of basal squamules. The core species in the group, *Cladonia cervicornis* and *Cladonia verticillata* have distinctive tiers of cups proliferating from the centre of the cup below (calling all proliferating material *C. verticillata* is wrong), others either proliferate mainly from the cup edges or do not proliferate. Several species in the group are often sterile (indicated brackets) and are also included within the **Squamule Mats** group.

Cladonia cervicornis link. Forms mats of elongated and dissected squamules with greenish brown upper surfaces, with the white undersides typically tinged grey-brown. Frequently have podetia that often proliferate irregularly from the centre, sometimes forming several tiers of proliferation. Widespread on mildly acid to basic soils, in more productive heath and in grassland.

(***Cladonia firma***) link. Usually occurs as a sterile squamule mat but can have non proliferating cups, see **Squamule Mats**.

(***Cladonia foliacea***) link. Usually occurs as a sterile squamule mat but can have non proliferating cups, see **Squamule Mats**.

Cladonia phyllophora link. A tricky species to spot unless fully mature, the best feature that can be on less well developed material is the subarachnoid surface between the areolae on the podetia. As the lichen develops then blackened bases and irregular proliferations from the cup rim become more obvious and in prime material the proliferations form extensive ± interlocking tiers. A local species of high quality habitats.

Cladonia pulvinata link. Pd + yellow, rarely recorded species similar to *C. verticillata*, probably as it mainly occurs as difficult to spot sterile squamule mats. Podetia are more gracile when they occur and with only up to two tiers of proliferations. Squamules rounded basal greenish-brown and somewhat bronzed squamules with white undersides, which are strongly tomentose, sometimes pruinose at the tips.

(***Cladonia strepsilis***) link. Usually occurs as a sterile squamule mat but can have distorted non proliferating cups, see **Squamule Mats**.

(***Cladonia subcervicornis***) link. Usually occurs as a sterile squamule mat but quite often has sometimes distorted non proliferating cups, see **Squamule Mats**.

(***Cladonia symphycarpa*** link.) Mainly occurs as a sterile squamule mat but rarely can have distorted non proliferating cups. See **Squamule Mats**.

Cladonia teuvoana link. A recent segregate from *Cladonia cervicornis*, from which it differs from in having a less well-developed primary thallus with a white underside, darkening towards the base, and narrower cups that abruptly widen. Few records yet but so far found in short and open, or disturbed lichen rich heaths and parched acid grasslands on drier and less acidic soils, likely local but widespread.

Cladonia verticillata link. Commonly occurs as podetia with visually striking tiers of cups stacked one on the other growing from the centre of the cup below. *Cladonia cervicornis* also does this and the two species are best distinguished by their basal squamules. Those of *C. verticillata* are rounded and little indented compared to the elongated and indented to dissected basal squamules of *C. cervicornis*. Found in strongly acid habitats.

Heathtails
These include *Cladonia* species which have little branched upright podetia, with no or small neat cups. Overlaps with the **Devil's Matchstick group**, with red apothecia, the more branched **False Reindeer Mosses** and the **Squamule Mats group** for plants that are mainly sterile. () = species also included in other groups.

(***Cladonia callosa***) link. UV+ strongly blue-violet, mainly found as a sterile squamule mat, with a distinctive UV fluorescence, but podetia occur infrequently and are typically branched at one point, essentially formed by proliferating branches from the rim of a small perforated cup. See **Squamule Mats**.

Cladonia cariosa link. K+ yellow, readily recognised by the longitudinally multi-fissured podetia and large, clustered, terminal brown apothecia and K spot test. Found in moderately base enriched, but not strongly calcareous, disturbed soils. Often post-industrial sites.

Cladonia coniocraea link. With fairly small grey-green, green when wet, podetia mostly pointed at the apices, which are predominantly farinose-sorediate but usually with a persistent corticate zone at least at the base. Robust podetia sometimes bear small, abruptly expanded terminal cups, that may hardly exceed the breadth of the podetium (*Cladonia ochrochlora*). A ubiquitous Heathtail, on acid bark, also found on lignum and less often acid soils.

Cladonia cornuta link. Similar to *C. coniocraea*, but generally more robust with the half-corticate and half-sorediate, pointed, usually brownish, unbranched podetia diagnostic. A mainly north eastern species, but occurring rarely in good quality habitats elsewhere.

Cladonia crispata* var. *cetrariiformis link. UV+ white, Pd–, a distinctive brown bushy heathtail with the tips of the podetia terminating in very narrow cup-like structure consisting of a single perforation surrounded by short spines giving a star like effect. Less well-developed material lacking the terminal perforations can be very similar to *C. furcata* but this is Pd+ red and UV–.

Cladonia crispata* var. *crispata link. Apparently, a rare taxon, likely a separate species from var. *cetrariiformis*. Differs from var. *cetrariiformis* in the sturdy podetia with well-developed perforate cups with shorter, awl shaped proliferations, which can from tiers of podetia. Previously, mainly found in coastal, grey dune systems, but recently spotted as a rarity in damp heaths in the south west.

(***Cladonia furcata* ssp. *furcata***) link. See False Reindeer Mosses.

(***Cladonia furcata* ssp. *subrangiformis***) link. See False Reindeer Mosses.

Cladonia glauca link. UV+ white, Pd–, a pale grey to brownish heathtail with pointed apices or rarely narrow perforate cups. Typically densely squamulose or roughly granular in the lower part, densely and finely sorediate in the upper part. Most easily confirmed by the UV+ vivid white florescence.

Cladonia gracilis link. A tall elegant Heathtail, with straight largely unbranched poditia, which, when mature, end in small regular cups which are not perforate. Ranges from dark brown to pale grey. In drier heathland and moorland habitats and dunes and rarely on lignum.

(***Cladonia macilenta*** link). K+ yellow can occur without red pycnidia as a yellowish-grey finely soridiate Heathtail, see Devil's Matchsticks.

Cladonia ochrochlora link. Now regarded as a robust morph of *Cladonia coniocraea* with cups.

(***Cladonia polydactyla*** link.) K + yellow, mature material (see Red Pixie Cups) has cups but poorly developed cupless podetia often mistaken for *Cladonia macilenta*, but *C. polydactyla* has blue-grey podetia, with a surface of coarsely granular soredia mixed with squamules. See Red Pixie Cups.

Cladonia ramulosa link. A rather scruffy *Cladonia*, which is very variable and can be mistaken for several other species. A combination of characters picks it out, including small yellowish indented brittle basal squamules, short podetia with a cracked, and peeling cortex, often with extensive decorticate areas developing, and blunt or irregular obscure cups on apices with clusters of ± contiguous apothecia. A widespread species found in a wide range of acid to neutral habitats, on soil, humus, decaying vegetation and wood.

Cladonia rei link. UV+ white, slowly Pd+ orange, a brownish moderately sized Heathtail which is partly to entirely farinose to coarsely granular soredia and lacks cups. Not very distinctive, but the often somewhat contorted podetia are a useful feature to look out for. The key identification features are the spot tests with white UV+ fluorescence, which is only easily seen from the podetia medulla or the undersides of the squamules and a slow Pd+ orange spot test. In high quality heathland as well as acid woodland and wasteland.

(***Cladonia scabriuscula*** link.) see False Reindeer Mosses.

Cladonia squamosa link. UV± vivid white, K± yellow, very variable with very different appearances in different habitats. In damp shaded habitats characterised by a perforate podetia, with a narrow flaring cup with a pale interior, numerous peeling squamules and absence of soredia. In open heaths the podetia have more or less intact cortex and a more strongly developed perforate trumpet like cups with glossy chestnut interiors. A widespread species in woods and heaths on bark, lignum and humus.

Cladonia squamosa* var. *squamosa link. UV+ vivid white, K–, a chemotype commoner in damp habitats.

Cladonia squamosa* var. *subsquamosa link. UV–, K+ yellow, a chemotype commoner in damp habitats.

Cladonia subulata link. A very distinctive Heathtail, taller than similar species, with antler like irregular proliferations from the margins of the small cups and pointed apices on younger podetia. The podetia are usually entirely farinose-sorediate throughout, but can be corticate at the base. A common species on dry acid habitats.

(***Cladonia sulphurina*** link.) A yellow sorediate heathtail but usually with red pycnidia, see Devil's Matchsticks.

Devil's Matchsticks
A group distinguished by the presence of red apothecia or pycnidia, including species without cups (**Heathtails**), with cups (Pixie Cups) or dominated by squamules (**Squamule Mats**).

Without cups (true Devil's Matchsticks)

Cladonia bellidiflora link. UV+ bright white, has red apothecia, held at the ends of grey-green to yellow-green unbranched podetia, which are densely covered in elongated peeling squamules. The very bright UV fluorescence is distinctive plus the yellow-green coloration, but the latter is not always easy to see in stunted or wet material. Strongly developed *Cladonia floerkeana* can look similar but at best has week UV+ fluorescence. An upland and northern species, common in upland Scotland in acidic habitats and extending south mainly on higher ground.

Cladonia floerkeana link. UV± pale white, K–, distinguished by the combination of red apothecia on coarsely granular podetia without cups and normally K– spot test. A widespread and distinctive species of acid substrates, especially strongly acidic humus in heaths and moors, but also on lignum.

Cladonia incrassata link. UV+ bluish-white, a small mat forming *Cladonia*, podetia small, and can be sparse and inconspicuous barely rising above the squamules, with red apothecia at the tips, see Squamule Mats.

(***Cladonia polydactyla*** link.) K + yellow, mature material (see Red Pixie Cups) has cups but poorly developed cupless podetia often mistaken for *Cladonia macilenta*, but *C. polydactyla* has blue-grey podetia, with coarsely granular soredia mixed with squamules.)

Cladonia macilenta link. K+ yellow, characterised by lacking cups, even when mature, with a usually unbranched and slim podetia, with farinose soredia and red apothecia and pycnidia. A K+ yellow spot test is characteristic, but a morph with a K– reaction exists. Found in well-lit strongly acid humus and lignum in acid open woodlands and heathlands but much over recorded in the past for stunted *Cladonia polydactyla* lacking cups.

Cladonia sulphurina link. UV+ bright white, A distinctive Heathtail with yellow to yellow-green podetia, usually distorted and lacerate, covered in fine soredia, usually with pointed apices with pycnidia red, at the tips, but occasionally with narrow cups. A northern and eastern upland species found on peat and sometimes dead wood

With cups (Red Pixie Cups) see Red Pixie Cups (*Cladonia coccifera*, *Cladonia digitata*, *Cladonia diversa* & *Cladonia polydactyla*)

Squamule Mats
Some sterile squamule mats can be identified by look, spot tests or UV fluorescence, others are not easily identified. Those mainly found and identified as sterile mats are listed below, with those which are possible to identify sterile but more typically found fertile in brackets.

Cladonia brevis link. Pd+ yellow, an apparently rare lichen typically forming sterile squamule mats of small mid-brown shallowly lobed squamules with white smooth white undersides with a smooth arachnoid surface. When dry there is a distinctive white edge to the squamules where the underside is just visible. Distinctive features are the Pd+ yellow reaction of the medulla and the large black pycnidia on the squamules that are constricted at the base. Seems to be very rare in open low productivity habitats on old mine waste and in grazed heathland.

(***Cladonia cervicornis*** link). Often found sterile, with elongated dissected squamules with the white undersides typically tinged grey-brown, but usually some cups about, see Stacking Cups.

Cladonia callosa link. UV+ strongly blue-violet, mostly occurring as sterile mats of basal squamules with brown to grey-green upper surfaces and bright white tomentose undersides, but occasionally supporting small distinctive branched podetia (see Heathtails). A local pioneer found on banks and open ground in heathland and moorland and post-industrial sites, most easily found using the UV fluorescence.

Cladonia incrassata link. UV+ bluish-white, a small mat forming *Cladonia* with yellowish grey-green incised and crenulate squamules which are usually conspicuously farinose-granular sorediate below. Podetia small, and can be sparse and inconspicuous barely rising above the squamules, often deformed, unbranched or distorted, with red apothecia at the tips. Local, found in a variety of damp acid habitats on humus, peat, soft sandstone and lignum.

Cladonia firma link. K + yellow, with large basal squamules dominant, forming dense mats, with ascending, elongated and indented grey-green to brown squamules, which curl over when dry to expose the underside white at tip, becoming suffused with pale to dark violet tinged grey-brown lower down. Podetia occasional, small shallow cups with a partly corticate surface. Resembles a brown form of *Cladonia subcervicornis*, with which it can grow. Past records from strongly maritime coastal slope habitats are mainly errors for a K+ yellow from of *Cladonia symphycarpa*. Confirmed records are from more acidic habitats, both near the coast and well inland in open pans in heaths and seasonally wet slabs in moorland.

Cladonia foliacea link. Forming often extensive squamule mats, with large basal squamules which are yellow-green on top and snowy white below but can occasionally have non proliferating cups, see Stacking Cups. Typically found in less acidic open grasslands, often in coastal habitats, but also occasionally inland. Very large forms with squamules over 2cm long, and usually found in limestone grassland, were called ***Cladonia convoluta***, while costal forms with narrow bifurcating squamules have been called ***Cladonia angustiloba***, but neither of these have been supported as distinct species by phylogenetic studies.

Cladonia luteoalba link. K–, Pd–, usually found as large curled, often contorted, pale yellow squamules, with a thick cottony-arachnoid lower surface. Sometimes found growing on other *Cladonia* species (especially the *C. coccifera* group) and potentially starting life as a parasite. In the uplands, on peaty soils, especially peat hags, mossy boulders and on rock ledges and walls, more rarely on tree bases.

Cladonia parasitica link. K+ yellow, a squamule mat of greatly dissected, often coralloid-branched squamules, podetia short and usually only shortly elevated above the squamules and are distorted and partly decorticate, with dark brown apothecia at the tips. It is a woodland dead wood specialist found on damp hard lignum, rare on heathland humus.

Cladonia peziziformis link. Small but distinctive Cladonia, with a mat of appressed rounded or ear-shaped basal squamules which are grey-green, often with a blueish tinge when damp. The podetia have terminal brown apothecia exceeding the width of the partly decorticate, sometimes fissured podetia, but are often absent. Short developing podetia with clustered brown pycnidia are usually present, however, and are characteristic. A rare species of slightly less acidic soils with short well-lit vegetation.

(***Cladonia phyllophora*** link). Sterile squamule mats occur, similar to *Cladonia cervicornis* but with white undersides, but *Cladonia teuvoana* has white undersides as well but is smaller, none of these are reliably identifiable without podetia see Stacking Cups.

Cladonia pulvinata link. Pd + yellow, rarely recorded species similar to *C. verticillata*, probably as it mainly occurs as difficult to spot sterile squamule mats. Podetia are more gracile when they occur and with only up to two tiers of proliferations. Squamules rounded basal greenish-brown and somewhat bronzed squamules with white undersides, which are strongly tomentose, sometimes pruinose at then tips.

(***Cladonia ramulosa*** link). Can form small yellowish mats of small dissected squamules which are quite distinctive, but usually also with podetia nearby, see Heathtails.

Cladonia strepsilis link. C+ green, a large *Cladonia* mostly occurring as sterile mats of basal squamules, with a distinctive mottled green-bronze colour when dry, pale apple green when wet, rarely with podetia, with a characteristic C + green spot test. Characteristic of open damp and wet heathland and moorland.

Cladonia subcervicornis link. K+ yellow, occurs as sterile squamule mats, with the large basal squamules dominant, elongate, with slightly indented margins, forming ± compact interlocking cushions; upper surface bluish (wet) to lead-grey (dry), usually pruinose at the tips, with the lower surface white, usually ± blackened towards the base. Common in the uplands on humus on rocks, but rare and declining in the southern lowlands on humus in heathland.

Cladonia symphycarpa link. K+ yellow to red or K + yellow, a normally sterile squamule mat with the upper surface of the squamules is pale grey-green but often brownish at the apices, with the lower surface starkly white, with edges sometimes darkened with violet tones. Podetia very rare, a small stacking cup. The K+ yellow to red form is very rare in open vegetation on calcareous soils from the coast to montane habitats. A K + yellow form is more widespread in strongly maritime coastal slope habitats, where it was previously miss-recorded as *C. firma*.

(***Cladonia verticillata*** link). Rarely occurs as a sterile squamule mat, see Staking Cups.

Glossary

This guide attempts to use as few technical terms as possible but some are unavoidable.

Apothecia: the fruiting body of an Ascomycete, with the hymenium (the spore producing) exposed at maturity

Conidia: an asexually produced fungal spore.

Crustose: (of lichen thalli), crust-like, without a lower cortex

Cortex: the outer layer of the thallus, a discrete outer layer of a thallus differing in structure from more internal layers

Podetia: the lichenized stem-like portion of an apothecium; in Cladonia, when present, it comprises the upright, fruticose part of the thallus, although apothecia are frequently not developed.

Primary crust: some fruticose lichens (e.g. *Baeomyces*, *Cladonia*, *Stereocaulon*) have two types of thallus, the primary one (crustose or squamulose) giving rise to the fruticose structures (podetia)

Pseudocyphellae: dot-like to fusiform or irregular pale areas of the thallus where the medulla is exposed at the surface (and not surrounded by specialized cells)

Pycnidia: a structure (frequently flask-shaped) in which conidia are produced.

Spinules: small spines

Squamules: a small, scale-like lobe attached only at its edge or centrally.