

Cladina (Nyl.) Harm.
(LECANORALES: CLADONIAACEAE)

After Ahti (1961, 1984), Thomson (1967, 1984),
and Harris (1990)

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Primary thallus crustose, ecorticate, short lived. Podetia repeatedly and intricately branched, hollow, cylindrical, slender, not cupforming, without squamules or isidia, rarely sorediate, dying at the base, new growth initiated at apices, forming matts or patches 2200 cm diam.; true cortex lacking; outer medullary layer with scattered to contiguous areolae or warts containing algae and forming a persistent or disintegrating pseudocortex. Inner medullary or cartilaginous layer well developed.

Apothecia terminal in clusters on podetia, cymose, minute, pale or brown, peltate; margin proper; hypothecium pale; paraphyses unbranched or little branched; asci clavate-cylindrical, unitunicate; tholus I+ blue; spores 8, simple, hyaline. Pycnidia terminal on tips of ultimate branchlets of podetia, black, globose to cylindrical; fulcrum exobasidial; pycnosporangia filiform, curved or straight. Usnic acid, atranorin, fumarprotocetraric, perlaolic, ursolic. Photobiont Trebouxia. On organic and inorganic, acidic soil or sand, arctic-alpine to tropical.

This genus has gone in and out of Cladonia, and there is no consensus as to whether it's truly distinct. The only taxa it is likely to be confused with are subg. Unciales, or with C. leporina in subg. Cocciferae, within Cladonia s. str.; it differs from them primarily in having an ecorticate surface.

Note: care must be taken to distinguish the branching patterns of the main branches versus the ultimate branches, which are sometimes quite different; many descriptions in the literature are ambiguous about this. If the location of the branching pattern is not specified, one can probably assume it applies to the thallus as a whole, but I won't guarantee it at this stage. Very careful study of good drawings sometimes helps.

Key Arranged After Ahti, 1961

1. Branching ± isotomic, the tips divergent; distinct main stems absent or only exceptionally present; thallus often forming compact, densely branched, regularly rounded "heads" with smoothish overall surface. 2

1. Branching anisotomic; distinct main stems usually present; thallus usually forming looser, more irregular and less densely branched tufts or mats, or somewhat scattered. 5

2. Southeastern U.S. (North Carolina to Florida and Texas). Thallus ashy whitish, K+ yellow, KC, or pale yellowish, KC+, with usnic acid (f. icterica (Des Abb.) Ahti), P, containing atranorin and perlatoric acid. Branching dichotomous. On bare white sand. C. evansii (des Abb.) Hale & Culb.

2. Western and eastern, borealarctic (rather rarely south to central Appalachians in C. stellaris). Thallus yellowishgray, K, KC+ yellow, containing usnic acid.

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3. Branching predominantly dichotomous, sometimes trichotomous. Pycnidial jelly colorless. Outer medulla very loose, thin.

Thallus P. Containing perlatoric acid. Coastal

Alaska. C. pseudevansii

3. Branching primarily tetrachotomous or polytomous, with 36 branches around central open axil, and often forming sympodia. Pycnidial jelly red. Outer medulla loose, thick. Thallus P+ yellow or P. With accessory perlatoric and pseudonorrangiformic acids and substances A and B. Podetia 5(10)18) cm tall, 11.4(2.5) mm diam., forming compact subglobose heads 23 cm diam., without conspicuous main branches; heads separate or loosely clumped into mats; surface pale yellowish gray to whitish, darker gray in deeper woods, the base blackening; texture matt, arachnoid to subtomentose with vaguely defined dispersed algal areolae, the older parts becoming translucent as the outer layers disperse. Branching very dense, mainly polytomous, (3)4(6) branches in a whorl, the branches mainly equal in size but sometimes forming sympodia, spreading widely and showing little tendency to curve in one direction, the axils almost always perforate, the ultimate brnchlets in small whorls of (3)46 members around a perforate axil. Pycnidia common. Apothecia very rare, on the tips of corymbosely grouped branchlets at the tips, brown or dark brown. BorealArctic, widespread, not restricted to coast. 4

4. Thallus P, without psoromic acid. Youngest branches rather thin and acute; outer medulla rather thin. Arcticboreal, common

from Alaska to Greenland and south to the Great Lakes area, southeast Canada and northeast U.S. (rarer S to central Appalachians), rare S to northern California in the west. On rocks and soil and occasionally old wood and stumps, on tundras and in open woods. C. stellaris (typical chemotype)

4. Thallus (at the very tips only) P+ yellow, with psoromic acid. Youngest branches frequently very thick and obtuse; outer medulla rather thick. On soil and among mosses, sometimes over thin soil on rocks. Arcticboreal, Alaska, NW Canada, and Greenland, with scattered populations in other parts of Canada, and northeast U.S. (including Great Lakes area). ... C. stellaris ("f. aberrans (des Abb.) ined. not accepted as a distinct taxon by Ahti)

5. Thallus whitish to ashgray, KC, lacking usnic acid. 6

5. Thallus yellowishgray, KC+ yellow, containing usnic acid, (and, at least partly, ursolic acid and substance A). 13

6. Thallus P+ red, containing fumarprotocetraric acid. 7

6. Thallus P, lacking fumarprotocetraric acid. 12

7. Thallus K+ yellow, containing atranorin. (Note: a very rare strain of C. mitis, with stictic acid, will also key out here) 8

7. Thallus K, without atranorin. 11

8. Florida. Branching dichotomous. Pycnidial jelly red. C. sandstedei (des Abb.) Ahti

8. Mostly arcticboreal or alpinemontane (but also to Florida in C. rangiferina), eastern and western. Branching mainly tetrachotomous to polychotomous, or mainly trichotomous to dichotomous. Pycnidial jelly red or colorless. 9

9. Pycnidial jelly red. Branching at least partly dichotomous or trichotomous. Podetia strongly blackened at base with scattered white areoles, otherwise usually pale gray (light olive gray when wet), usually extensively browned in open habitats; surface rather strongly verruculose; ultimate tips loosely and roughly fibrose; branching often rather divergent. Usually in bogs. Arcticboreal, south to Washington and Montana in the west, and to Great Lakes and Appalachian regions in the east. C. stygia

9. Pycnidial jelly colorless. Branching mainly tetrachotomous or partly polytomous. Podetia at most with occasional blackened

patches towards base. 10

10. Branching often starlike at the tips, polytomic (dominated by trichotomy and tetrachotomy, but also with common 5 and 6tomies), moderately dense, fairly irregular.; ashy to whitish gray; exposed apical branches concolorous, with even the tips scarcely browned. Pycnidial jelly colorless. Podetia 512 cm tall, necrotic basal parts grayish, not blackened. Branchlets thick, obtuse, divaricate or recurved, oriented in various directions; main axes distinct, ca. 1.22.5 mm thick, tending to become swollen; axils perforate; surface with a continuous, smooth layer of felty tissue, becoming only slightly verrucose towards the base. Apothecia waxy yellow to rarely brown, peltate, 0.20.6 mm diam. In treeless coastal or mountain heaths, Newfoundland, apparently rare. C. conspicua Ahti

10. Branching mainly tetrachotomous (more rarely trichotomous at tips), whorled. Podetia pale graywhite, usually strongly tinged bluish gray or purplish towards the tips (but usually not strongly browned), not blackening at base (except for occasional patches). Podetia 410 cm tall; surface uniformly, finely cottony arachnoid (x10), not or only weakly verruculose; main axes distinct; branching usually distinctly oriented in one direction, not divergent; young apices to 2 mm diam., blunt; tips not loosely and roughly fibrous. Apothecia, rare, inconspicuous, brown. On exposed, mossy heaths and in pockets of soil on cliff ledges and rock outcrops, usually not in bogs. Widespread and often very common, Arctic, S to Washington in the west, and throughout much of eastern Canada and U.S., south to Florida, apparently very frequent and common, especially in the arctic and the northeast (but many reports may be based on C. stygia). C. rangiferina (L.) Nyl. ssp. rangiferina (ssp. grisea (Ahti) Ahti & Lai has also been reported, from Alaska and British Columbia, but those reports have not yet been confirmed)

11. Eastern (Connecticut to Florida, west to the Ozark region). Main stems indistinct and branching dichotomous. Conspicuous in sun populations of the species. C. subtenuis f. cinerea (Ahti) Ahti

11. Pacific NW, and Newfoundland. Branches thin; surface roughened. Branching dichotomous. Pycnidial jelly red. C. ciliata (Stirton) Trass. v. ciliata

12. Thallus K+ yellow (atranorin). Branching primarily dichotomous. Newfoundland and Quebec. C. terraenovae f. cinerascens

12. Thallus K (without atranorin). Branching predominantly

trichotomous or sometimes dichotomous; main branches distinct. With perlatoric acid. Branching often sparse; apical branches unilaterally deflexed. Pycnidial jelly colorless. Alaska to Washington. C. portentosa ssp. pacifica f. decolorans

13. Thallus P+ red, containing fumarprotocetraric acid. 14

13. Thallus P, lacking fumarprotocetraric acid. Pycnidial jelly colorless. 17

14. Branching predominantly dichotomous. Pycnidial jelly red. 15

14. Branching predominantly trichotomous or tetrachotomous. Pycnidial jelly colorless. 16

15. Branches curved to one side; main stem distinct; apices clearly deflexed; rather sparsely branched. Thallus yellowish (usnic acid). Pycnidial jelly red. Very variable; large, coarse specimens with terminal branches not strongly oriented may resemble C. portentosa, which is however, P. UV+. Pacific NW. C. ciliata v. tenuis (Flörke) Ahti

15. Branches straight or curved in all directions; main stem often indistinct; apices erect or less deflexed; densely branched. Podetia 48 cm tall, often forming mats up to a foot in diameter. Pycnidia common. Apothecia rare. Common on sandy soil in open pine forests and along roadsides. Eastern (Nova Scotia to Florida, west to the Ozark region). C. subtenuis (des Abb.) Hale & Culb. f. subtenuis

16. Crown densely branched, often strongly unilaterally deflexed, conspicuously brown; main stem robust, 12(4) mm diam., pale yellowishgray (becoming greenish glaucescent in more moist and shady habitats). Podetia 410(15) cm tall; forming tufts or extensive mats; surface ± roughened; branching primarily trichotomous and tetrachotomous, the whorls of unequal branching so that the podetium forms a sympodium with unilateral growths, especially in the lower part, the upper part showing more equal branching, the uppermost branches terminated in 23(5) short, stout (to 2 mm diam.), blunt young apices which are all recurved towards one side, the fertile branchlets in a corymbose arrangement. Axils mainly open, sometimes widely so. Surface matt, little arachnoid to tomentose, smooth or rarely verruculose, rarely with soredia, impellucid (i.e., opaque). Apothecia rare,

small, inconspicuous, dark brown, solitary or grouped at the tips of corymbose branchlets. Pycnidia common, the jelly colorless. With accessory perlatic acid and substance A. Common on sandy soil and humus in open pastures and fields, over earth on rock outcrops, and in bogs, eastern arctic, south to Maryland and Wisconsin. C. arbuscula (Wallr.)

Hale & Culb. spp. arbuscula

16. Crown sparsely branched, erect or slightly deflexed, conspicuously browned; main stem slender to robust, usually very yellow. Common in the western Arctic, S in Canada to Alberta, Saskatchewan, and Ontario), and to Washington. C. arbuscula ssp. berengiana

17. Thallus K+ yellow, containing atranorin. Branching predominantly dichotomous. Coastal bogs and heaths, SE Canada, and New York. C. terraenovae (Ahti) Hale & W. Culb. f. terraenovae

17. Thallus K, lacking atranorin. Branching often trichotomous or tetrachotomous. 18

18. Branching predominantly trichotomous at the apices or sometimes dichotomous; main branches distinct. UV+ white in decorticate parts, with perlatic acid. Podetia 410 cm tall, robust, graygreen often with a yellowish tinge, the surface often roughened, areolate, particularly towards base; axils often perforate. Pycnidial jelly colorless. Very variable, often forming neat tufts amongst low vegetation, sometimes with distorted main branches; inflated and grossly modified morphs occur in boggy situations.

... 1918. **Branching predominantly tetrachotomous (on welldeveloped podetia). Without perlatic acid.** 20

19. Branching often sparse; apical branches unilaterally deflexed, greenish to yellow. Western (Alaska to California), strictly coastal. C. portentosa ssp. pacifica (Ahti) Ahti f. pacifica

19. Branching often dense; apical branches multilaterally deflexed, gray to yellowish. Europe; reported from New Jersey and Newfoundland, but probably misidentifications of C. terraenovae. [C. portentosa (Dufour) Follm. ssp. portentosa]

20. Main stems robust, dark green, often wrinkled at base; outer medulla very compact. With pseudonorrangiformic acid and substance A. Branching mostly tetrachotomous. Borealarctic, S

to northeastern U.S. (Massachusetts). C. submitis

20. Main stems slender to fairly robust, usually lighter in color, smooth; outer medulla less compact. Without pseudonorrangiformic acid. 21

21. Crown rather sparsely branched; tips rather fine, erect or multilaterally deflexed (pointing in various directions), not strongly browned; main stem usually slender, 11.5(4) mm diam. and usually pale bluishgray (sometimes yellowish); branches pale whitishgreen, usually slender, the extreme tips scarcely browned. Branching generally trichotomous, sometimes dichotomous, rarely tetrachotomous, forming a sympodium with rather remote nodes, each node with 12 short branches ramified in turn in the same unequal fashion; towards the tips the branching becomes equal, the sterile branchlets ending with 25 points all recurved to one side, or in the case of unequal branches, with some recurved and others spreading, the entire appearance less tufted and less "well combed" than C. arbuscula; axils mainly open; surface matt, scarcely arachnoidtomentose, smooth or verruculose with age, mainly opaque, rarely semipellucid; normally lacking soredia. Often with rangiformic acid. Podetia 48(10) cm tall, forming extensive mats or tufts, intricately but loosely branched. Apothecia small, borne singly or \pm in corymbs at tips of branches, brown. Pycnidial jelly colorless. With accessory rangiformic acid and substances A and B. On sandy soils and in bogs, as well as on soil rich in humus, widespread in open pine forests and fields, especially common in spruce forests of the north, sometimes on soil over rock outcrops. Arcticboreal, south to Oregon and Colorado in the west, less common south to northeastern U.S. and west to the Great Lakes region and Virginia in the east. C. mitis (Sandst.) Hustich (also called C. arbuscula subsp. mitis (Sandst.) Ruoss

21. Crown densely branched; tips strongly deflexed, often unilaterally, strongly browned; main stems generally robust and yellowish gray; branches yellowishgreen, usually coarse. Without rangiformic acid. Very common in continental parts of Canada(eastern), but the limits are illdefined. C. arbuscula unnamed subspecies.

Alternative Totally Artificial Key

I. Growing in Eastern N. America

Ia. Thallus P+ yellow, orange, or red.

1. Thallus P+ yellow, with psoromic acid. Branching primarily tetrachotomous or polytomous, with 36 branches around central open axil, and often forming sympodia. Pycnidial jelly red. Outer medulla loose, thick. With accessory perlatoric and pseudonorrangiformic acids and substances A and B.

BorealArctic. C. stellaris ("f. aberrans)

1. Thallus P+ orangered, with fumarprotocetraric acid. 2

2. Thallus K+ yellow, containing atranorin.

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2. Thallus K, without atranorin. 6

3. Pycnidial jelly colorless. Branching mainly trichotomous to tetrachotomous or polychotomous. not blackening at base (except for occasional patches). 4

3. Pycnidial jelly red. Branching at least partly dichotomous or trichotomous. 5

4. Branching mainly tetrachotomous, whorled. Podetia pale graywhite, usually strongly tinged bluish gray or purplish towards the tips. Widespread, N to arctic, S to Florida. C. rangiferina (incl. ssp. grisea)

4. Branching mainly trichtomous to tetrachtomous, but also commonly polytomous and starlike towards tips. Podetia concolorous throughout, not darkened towards tips. Newfoundland. C. conspicua

5. Growing mainly in BorealArctic areas. Branching partly trichotomous or dichotomous. Podetia usually pale gray, strongly blackened at base; ultimate tips loosely and roughly fibrose. Usually in bogs. Arcticboreal, south to Washington and Montana in the west, and to Great Lakes and Appalachian regions in the east. C. stygia

5. Occurring south to Florida. Branching dichotomous. C. sandstedei (des Abb.) Ahti

6. Branching predominantly dichotomous. Pycnidial jelly red. 7. Branches straight or curved in all directions; main stems often indistinct; apices erect or less deflexed; densely branched.

Thallus P+ red (fumarprotocetraric acid). Eastern U. S., south to Florida. C. subtenuis (including f. cinerea)

6. Branching predominantly trichotomous or tetrachotomous. Pycnidial jelly colorless.

7. Crown densely branched and often unilaterally deflexed, conspicuously brown; main stem robust, yellowishgray. Mostly western. (C. arbuscula spp. arbuscula)

7. Crown sparsely branched, erect or slightly deflexed, conspicuously browned; main stem slender to robust, usually very yellow. C. arbuscula ssp. berengiana

1b. Thallus P.

1. Thallus K+ yellow (atranorin). Branching primarily dichotomous. Containing perlatic acid. 2
1. Thallus K (without atranorin). Branching often trichotomous or tetrachotomous. With or without perlatic acid. 4
2. Thallus forming compact heads. Branching isotomic. Thallus whitish or pale yellowish, K+ yellow, KC (or KC+, with usnic acid, in f. icterica). Florida. C. evansii
2. Thallus looser, not forming compact heads. Branching anisotomic, primarily dichotomous. Northeastern. 3
3. Thallus gray. C. terraenovae f. cinerascens
3. Thallus yellowish. C. terraenovae
4. Thallus forming compact heads. Branching isotomic, primarily tetrachotomous or polytomous, with 36 branches around central open axil, and often forming sympodia. Pycnidial jelly red. Outer medulla loose, thick. With accessory perlatic and pseudonorrangiformic acids and substances A and B. C. stellaris (typical chemotype)
4. Thallus not forming compact heads. Branching anisotomic. 5
5. Branching predominantly trichotomous or sometimes dichotomous; main branches distinct. With perlatic acid. Branching often dense; apical branches multilaterally deflexed, gray to yellowish. (C. portentosa ssp. portentosa)
5. Branching predominantly tetrachotomous (on welldeveloped podetia). Without perlatic acid. 6
6. Main stems robust, dark green, often wrinkled at base; outer medulla very compact. With pseudonorrangiformic acid and substance A. Temperate. C. submitis
6. Main stems slender to fairly robust, usually lighter in color, smooth; outer medulla less compact. Without pseudonorrangiformic acid. BorealArctic. 7
7. Crown rather sparsely branched; tips erect or multilaterally deflexed, not strongly browned; main stem usually slender and pale bluishgray; branches pale whitishgreen, usually slender. C. mitis
7. Crown densely branched; tips strongly deflexed, often unilaterally, strongly browned; main stems generally robust and

yellowish gray; branches yellowishgreen, usually coarse.

..... C. arbuscula unnamed subspecies

II. Growing in Western N. America

IIa. Thallus P+ yellow, orange, or red.

1. Thallus P+ yellow, with psoromic acid. ... C. stellaris ("f. aberrans")

1. Thallus P+ redorange, with fumarprotocetraric acid. 2

2. Thallus K+ yellow, containing atranorin. 3

2. Thallus K, without atranorin. 5

3. Pycnidial jelly colorless. Branching mainly tetrachotomous, whorled. Podetia usually strongly bluish gray, not blackening at base (except for occasional patches). Widespread, N to arctic, S to Florida. Usually not in bogs. C. rangiferina (incl. ssp. grisea)

3. Pycnidial jelly red. Branching at least partly dichotomous or trichotomous. 4

4. Growing mainly in BorealArctic areas. Branching partly trichotomous or dichotomous. Podetia usually pale gray, strongly blackened at base; ultimate tips loosely and roughly fibrose. Usually in bogs. Arcticboreal, south to Washington and Montana. C. stygia

4. Pacific NW. Branching dichotomous. C. ciliata v. ciliata

5. Branching predominantly dichotomous. Pycnidial jelly red. Branches curved to one side; main stem distinct; apices clearly deflexed; rather sparsely branched. Pacific NW. C. ciliata v. tenuis

5. Branching predominantly trichotomous or tetrachotomous. Pycnidial jelly colorless. Crown sparsely branched, erect or slightly deflexed, conspicuously browned; main stem slender to robust, usually very yellow. Western Arcticboreal. C. arbuscula ssp. berengiana

IIb. Thallus P, K; branching often tri or tetrachotomous

1. Thallus forming compact heads. Branching isotomic, predominantly dichotomous, sometimes trichotomous. Pycnidial jelly colorless. Outer medulla very loose, thin. Containing perlatoric acid. Coastal

Alaska. C. pseudevansii

1. Thallus not forming compact heads. Branching anisotomic, predominantly trichotomous or tetrachotomous. 2

2. Branching predominantly trichotomous or sometimes dichotomous; main branches distinct. With perlatoric acid. Branching often sparse; apical branches unilaterally deflexed, greenish to yellow. Coastal, Alaska to California..... C. portentosa ssp. pacifica

2. Branching predominantly tetrachotomous (on welldeveloped podetia). Without perlatoric acid. Main stems slender to fairly robust, usually lighter in color, smooth; outer medulla less compact. BorealArctic, not restricted to the coast. 3

3. Crown rather sparsely branched; tips erect or multilaterally deflexed, not strongly browned; main stem usually slender and pale bluishgray; branches pale whitishgreen, usually slender. C. mitis

3. Crown densely branched; tips strongly deflexed, often unilaterally, strongly browned; main stems generally robust and yellowish gray; branches yellowishgreen, usually coarse. C. arbuscula unnamed subspecies

Literature

Ahti, T. 1961. Taxonomic studies on reindeer lichens (Cladonia, subgenus Cladina). Ann. Bot. Soc. Zool. Bot. Fennicae Vanamo 32(1): 1160.

Ahti, T. 1984. The status of Cladina as a genus segregated from Cladonia. Beih. 79 f. Nova Hedwigia: 2559. [with other references]

Ahti, T. 1986. New species of reindeer lichens (Cladina). Ann. Bot. Fennici 23: 221227.

Ahti, T. & S. Hyvnen. 1985. Cladina stygia, a common, overlooked species of reindeer lichen. Ann. Bot. Fennici 22: 223229.

Hale, M. E. 1979. How to Know the Lichens. Wm. C. Brown Co., Dubuque.

Thomson, J. W. 1967. The Lichen Genus Cladonia in North America. U. of Toronto Press, Toronto.

Thomson, J. W. 1984. American Arctic Lichens. I. The Macrolichens. U. of Columbia Press, New York.

Rogers, 19 . Genera of Australian Lichens. Galloway, D. 1985. Flora of New Zealand Lichens.