

## *Printzina lagenifera* coll. (Trentepohliales, Chlorophyta) epiphyllous in a boreal forest

Harri Harmaja

Finnish Museum of Natural History, P.O. Box 7, FI-00014 University of Helsinki, Finland (e-mail: harri.harmaja@helsinki.fi)

Received 2 Aug. 2010, revised version received 21 Sep. 2010, accepted 1 Oct. 2010

Harmaja, H. 2011: *Printzina lagenifera* coll. (Trentepohliales, Chlorophyta) epiphyllous in a boreal forest. — *Ann. Bot. Fennici* 48: 129–132.

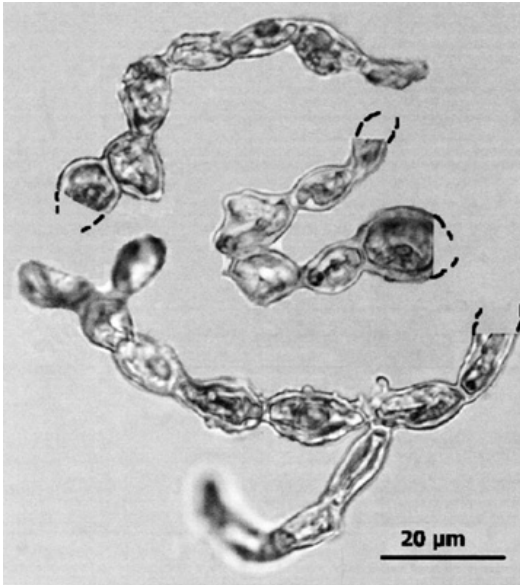
The green alga *Printzina* (*Trentepohlia*) *lagenifera* was found in southern Finland in the sori of the leaves of the indigenous fern *Polypodium vulgare*. The find is noteworthy because *P. lagenifera* occurred epiphyllous in a boreal, natural habitat. The subcosmopolitan *P. lagenifera* is a collective species; it was described from a hothouse in Germany. Two earlier finds from Finland are likewise from hothouses. The present alga is hardly conspecific with these lignicolous hothouse algae that most probably are introductions from the tropics. Another green alga, the common *Desmococcus olivaceus* (Chaetophorales) is reported to occur in Finland on the upper surfaces of the leaves of *Polypodium vulgare*.

During my recent studies on the fern genus *Polypodium* (Polypodiaceae) in the Nordic countries, green filaments were observed in the sori of the leaves of the previous season in three specimens of *P. vulgare*, the only Finnish species of the genus. The specimens were collected by me on three occasions in a southern Finnish site. The epiphyllous organism was discernible under the dissecting microscope as its colouration deviated from the olivaceous, brown or black colour of its background. The shady microniche, the sorus ‘microsilva’, on the leaf undersides would suggest that the threads might belong to the Cyanobacteria; if supposed that the threads belonged to the Chlorophyta, some representatives of the non-aquatic order Trentepohliales appeared closest. However, the cell contents of the organism were devoid of the orange, red or yellow tinges that should mark the presence of carotenoid pigments, a diagnostic character of that algal order.

The problem was solved as, on the basis of my description and photograph, Prof. Fabio Rindi (Università Politecnica delle Marche, Italy) kindly identified the organism as belonging to the collective species *Printzina lagenifera* (syn. *Trentepohlia lagenifera*; Chlorophyta, Ulvophyceae, Trentepohliales). For information about the species, see e.g. Rindi *et al.* (2006, 2009). Prof. Rindi also noted that when they grow in deep shade, species of *Trentepohlia* and *Printzina* may superficially be difficult to identify as they do not accumulate the typical large amounts of carotenoids.

No more finds of this alga were detected through fairly extensive screening of *P. vulgare* in my own collections and in the herbarium material in the Botanical Museum (H) of the Finnish Museum of Natural History.

Macroscopic notes were made in dried herbarium material of the host under the dissecting



**Fig. 1.** *Printzina lagenifera* coll.: three separate filaments from one sorus of a dried *Polypodium vulgare* leaf in water mount (Finland, Lohja, Torhola, 5.IX.2007 Harmaja).

microscope with magnifications of 25× and 50×. The microscopic description was made under the light microscope in water mounts from this dry material.

### Description of the present find of *Printzina lagenifera*

Under a dissecting microscope, after at least partial removal of the sporangia of the host plant, the filaments on *P. lagenifera* are observable as scattered, tiny, bright green threads that are more or less appressed to the sorus bottom. Under the light microscope, the filaments (Fig. 1) are mostly simple but rarely with 1–2 short branches, ca. 60–100 µm long and 2.5–10 µm thick, curved, uniseriate, moniliform, strongly constricted at cross walls; no sheath is observable. Cells are ca. 9–14 in number, 8–15 µm long, fusiform, ellipsoid or subglobose, often somewhat irregular in shape; walls appear thickened, being smooth or with few, variably sized warts or papillae; contents are abundant, heterogeneous, mostly olivaceous green but blue-green in places (uncertain observations included deviating globose, both

lateral and terminal, cells that might have been gametangia or young zoosporangia).

The filaments occurred, a few together, in several sori of the leaves of the previous season of *Polypodium vulgare*. They appeared to be — between the sporangium stalks — loosely attached to the specialized, platform-like sorus bottoms (receptacles) which are permanently sticky, i.e. with stored moisture. The host was collected on three occasions in September, from two separate stands that are situated within a radius of 20 m. Some of the sori infected were not perfectly developed.

Other algae were not present in the sori (or on the blade underside generally). No fungal hyphae were observed in connection with the filaments of *P. lagenifera*, either.

The habitat of the host was a low, shady limestone rock outcrop in rich woods not far from lakeshore, by the mouth of a voluminous limestone cave. Besides some interesting mosses and lichens of the rock substrate, the woods surrounding this well known cave, dominated by *Corylus avellana*, *Tilia cordata*, *Ulmus glabra* and *U. laevis*, house many calcicolous and calciphilous macrofungi as well as uncommon insect species.

**SPECIMENS EXAMINED.** — **Finland.** Varsinais-Suomi, Lohja, Torhola, rich woods by the cave, in several sori in one green leaf of the previous season of *Polypodium vulgare* on limestone, Finnish uniform grid 6686:3326, 5.IX.2007 Harmaja (H); the same place, in a different stand of the host, in several sori in three green or yellow leaves, 26.IX.2007 Harmaja (H); the same place, the latter stand, in several sori of one fairly withered, partly brown, partly yellow leaf, 1.IX.2010 Harmaja (H).

### Discussion

Representatives of the Chlorophyta (especially some Trentepohliales) are well-known to occur foliicolous or even parasitic on angiosperm leaves, especially in tropical rainforest (López-Bautista *et al.* 2006). In temperate and boreal regions, aerial green algae are present on variable substrata. An interesting substrate is the hairiness of the upper surfaces of the fruit bodies of many polypores, such as *Cerrena unicolor*; the nutritional relationship between the alga and the fungus is yet somewhat unclear. Moreover,

in NW Europe, e.g., epiphyllous green algae may be abundant especially on spruce needles. This now well-known phenomenon markedly increased during the latter half of the 1900s (Søchting 1997). The increased air pollution, especially through deposition of nitrogen oxides from the atmosphere, is generally supposed to be the main reason for this. *Desmococcus olivaceus* (Chlorophyceae, Chaetophorales) is possibly the most abundant of these green algal species (see e.g. Søchting 1997, as *D. viridis*).

*Printzina lagenifera*, in its current wide concept, is a subcosmopolitan species. However, its main occurrence is in tropical and subtropical areas where the species is a common epiphyll (Rindi *et al.* 2009). Curiously, it is even found — among other green algae — in the fur hairs of the neotropical mammalian sloth (Suutari *et al.* 2010). Especially northwards, the substrate is — often human-influenced — tree bark, stone surface or even concrete (e.g., Nakano 1988, Rindi *et al.* 2009). In the north, *P. lagenifera* is perhaps mainly reported from hothouses; actually the species was described on the basis of a most probably introduced occurrence on bark in a hothouse in Germany (see Rindi *et al.* 2009). Moreover, the species is a lichen photobiont, especially in the order Graphidales (see e.g. Nakano 1988).

*Printzina lagenifera* is already known also from Finland (Anonymous 1883, as *Trentepohlia lagenifera*). However, the finds are very occasional. The collections of the Botanical Museum (H) of the Finnish Museum of Natural History include five specimens, four of which correspond to the published record: they were collected in 1880 and 1881 by E. Hisinger in Inkoo, Fagervik, S Finland. The fifth specimen is from the Botanical Garden of the Finnish Museum of Natural History in Helsinki, collected in 1914 by V. Seppälä and identified by R. Collander. All the specimens originated from hothouses where the alga grew on exotic wooden surfaces. The algal growth in these specimens is now apparent as pale greenish covering to the naked eye. I did not examine the specimens further. The occurrences are clearly introduced.

Thus, the present find is notable as *P. lagenifera* is occurring (i) free-living, (ii) in a natural habitat, (iii) as epiphyllous, (iv) on an indig-

enous vascular plant, and (v) in the hemiboreal bioclimatic zone (Ahti *et al.* 1968). *Trentepohlia bialowiesensis*, a species that may be included in *P. lagenifera* coll., was described as growing on the bark of *Picea abies* and *Pinus sylvestris* in a temperate region (Białowieża National Park, Poland; Mrozińska 1990).

It is not yet possible to judge whether the occurrence of *P. lagenifera* on *P. vulgare* is occasional or of significant nature. *Printzina lagenifera* might even be a parasite as the microniche inhabited by it, the receptacle in the sorus, is (i) sheltered, not within reach of normal rain water flow to feed the algal population with nutrients, and (ii) a hub of water and nutrient transportation in the host leaf.

Judging from its wide distribution and variable ecology, *P. lagenifera* could be judged to be heterogeneous. In fact, its polyphyly was proved in a recent phylogenetic analysis (Rindi *et al.* 2009). The Lohja alga with its exceptional ecological niche may well represent an undescribed, (almost) cryptic species.

In the course of the present study, when checking *Polypodium vulgare* leaves from Finland for epiphylls, I observed that, in more or less shady habitats, *Desmococcus olivaceus* is not rare on the upper (never lower) blade surfaces of leaves of the previous season. The *Desmococcus* colonies were mostly scanty and restricted to the lateral furrows that border the midrib; rarely true algal crust was observed in wide areas over the blade proper. Very scarce occurrence of *D. olivaceus* was even present at the blade base of the first collection of *P. lagenifera* reported above.

Neither epiphyllous algae nor cyanobacteria were probably reported on *P. vulgare* before, at least from Finland (the present algal occurrence should not be confused with occasional released *Lepraria* soredia that, according to my observations, may be entangled in the sporangia of the sori; anyway, the photobiont of these soredia is different and represents some species of *Trebouxia s. lato*). However, such fern epiphylls are probably not rare in the tropics: e.g., Bentley (1987: fig. 2) reported the presence of nitrogen-fixing microorganisms on the leaves of “*Polypodium* sp.” in a tropical rainforest (judging from the text, they most probably were cyanobacteria).

## Acknowledgements

Prof. Fabio Rindi (Università Politecnica delle Marche, Italy) most kindly identified the alga of the present contribution on the basis of a description and photograph sent by the author to him, and communication with him also yielded other useful information.

## References

- Ahti, T., Hämet-Ahti, L. & Jalas, J. 1968: Vegetation zones and their sections in northwestern Europe. — *Ann. Bot. Fennici* 5: 169–211.
- Anonymous 1883: Meddelanden från Sällskapet förhandlingar. — *Medd. Soc. F. Fl. Fennica* 9: 122–174.
- Bentley, B. L. 1987: Nitrogen fixation by epiphylls in a tropical rainforest. — *Ann. Missouri Bot. Garden* 74: 234–241.
- López-Bautista, J. M., Rindi, F. & Guiry, M. D. 2006: Molecular systematics of the subaerial green algal order Trentepohliales: an assessment based on morphological and molecular data. — *Int. J. System. Evol. Microbiol.* 56: 1709–1715.
- Mrozińska, T. 1990: Two new taxa of *Trentepohlia* (Trentepohliales) and a noteworthy species *Tetracystis sarcinialis* Schwarz (Chlorococcales) from Białowieża National Park. — *Nova Hedwigia* 50: 233–237.
- Nakano, T. 1988: Phycobionts of some Japanese species of the Graphidaceae. — *Lichenologist* 20: 353–360.
- Rindi, F., Guiry, M. D. & López-Bautista, J. M. 2006: New records of Trentepohliales (Ulvophyceae, Chlorophyta) from Africa. — *Nova Hedwigia* 83: 431–449.
- Rindi, F., Lam, D. W. & López-Bautista, J. M. 2009: Phylogenetic relationships and species circumscription in *Trentepohlia* and *Printzina* (Trentepohliales, Chlorophyta). — *Mol. Phyl. Evol.* 52: 329–339.
- Søchting, U. 1997: Epiphyllic cover on spruce needles in Denmark. — *Ann. Bot. Fennici* 34: 157–164.
- Suutari, M., Majaneva, M., Fewer, D. P., Voirin, B., Aiello, A., Friedl, T., Chiarello, A. G. & Blomster, J. 2010: Molecular evidence for a diverse green algal community growing in the hair of sloths and a specific association with *Trichophilus welckeri* (Chlorophyta, Ulvophyceae). — *BMC Evol. Biol.* 10: 86.