Klebsormidium algae on bark in NW-Germany

In the federal state North Rhine-Westphalia (NRW, Germany), the composition of the corticolous lichen and bryophyte species spectrum has changed dramatically within the last two decades: In the early 1990s, pollution-sensitive lichens and bryophytes started to recapture formerly heavy-industrialized areas (e. g. "lichen deserts" in the Ruhr-District), mainly due to declining sulphur dioxide levels. Meanwhile, nitrophytic species largely dominate over acidophytic ones as a result of high levels of eutrophicating airborne nitrogen compounds (e. g. NOx and ammonia). Furthermore, it is suspected that the spread of some 'southern' lichen species is brought forward by climate change (manuscript in preparation). Another, yet poorly documented phenomenon is the appearance of filamentous green algae on bark of roadside trees. Since the mid 1990s, during epiphyte mapping studies, dense felt-like coats formed by filamentous algae have frequently been observed on roadside trees in the big cities of the Ruhr District and along the Rhine valley (FRAHM 1999; STAPPER & FRANZEN-REUTER 2004). They are member(s) of the Klebsormidiaceae. Using the key of ETTL & GÄRTNER (1995), all samples collected so far were identified as *Klebsormidium crenulatum* (KÜTZING) LOKHORST. It can, however, not be excluded that also other species of the genus are involved, e.g. *K. flaccidum* or others.

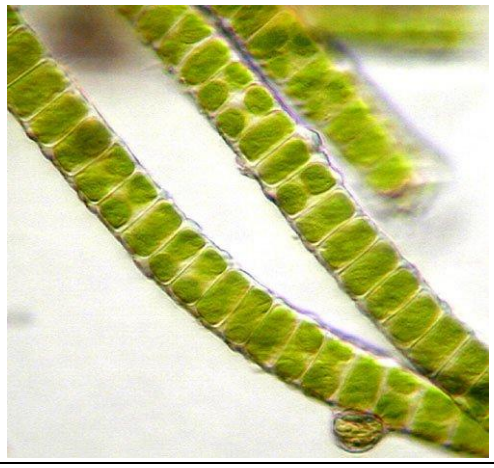
From the character of the locations, mostly sites with high frequencies of nitrophytic epiphytic lichens and bryophytes, FRAHM (1999) concluded that epiphytic *Klebsormidium* algae are advanced by eutrophicating immissions. In a later mapping study (STAPPER & FRANZEN-REUTER 2004) they were recorded at two thirds of all sampling units in NRW, and data analysis showed that frequency and algal coverage of the phorophyte is positively correlated with transport emissions. Similar observations were made in Düsseldorf (STAPPER & KRICKE 2004) and other German cities and also in France (e.g. Nimes and Avignon; unpublished observations in 2005). In NRW, even fast growing foliose lichens like *Parmelia sulcata* or *Physcia tenella* may become overgrown rapidly. Sometimes, 50 % and more of a trunk's surface is covered by dense mats of algal filaments, in particular at stations with strong traffic influence in highly populated regions. When mapping bryophytes and lichens, normally, only the coverage (in %) and the type ("coccal" or "filamentous") are noted – if algae are considered at all. The latter seems, however, to be advisable.

'Traffic influence' chemically means a complex mixture of different gaseous and particulate components with different physiological effects on lichens and other sensitive organisms. Studies with externally applied substances (FRANZEN-REUTER 2005) show that ammonia which is, according to CAPE et al. (2004), produced in three-way catalysts, and its derivatives are rapidly metabolized by lichens and may therefore be regarded as very powerful compounds of traffic emissions. Nitrogen oxides, however, appear to have a lower impact on lichens as generally believed. It is, however, still unclear if this also applies to epiphytic algae. In the Ruhr-District, nitrogen compounds have, no doubt, favored epiphytic lichen reinvasion. Above certain levels, however, nitrogen compounds are toxic to lichens. In addition to this, algae may directly influence epiphytic lichen (and bryophyte) flora by outperforming and overgrowing or growth inhibitory action.

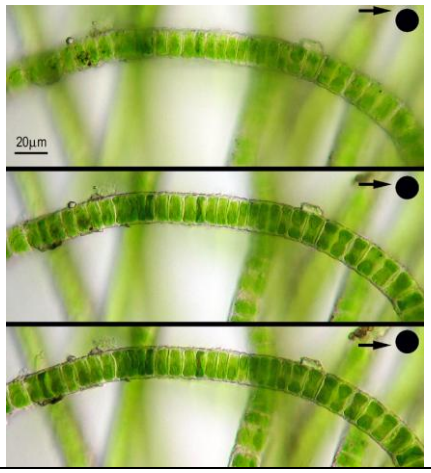
This paper is based on web site prepared by the author in 2006. For further reading the papers by FREYSTEIN *et al.* (2008) or RINDI et al. (2008) are recommended.

The following images should give an impression of how algal films on bark formed by *Klebsormidium* look like.

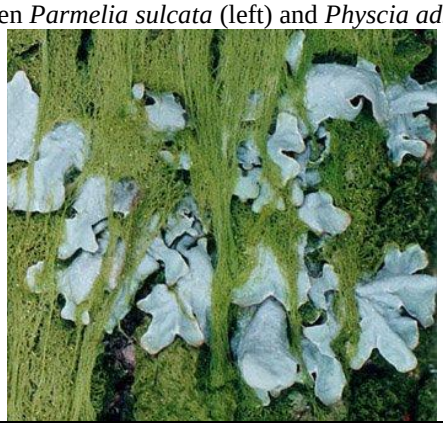
Microscopic aspect of material collected in NRW and determined as *Klebsormidium crenulatum.*



Microscopic aspect of material collected 2005 in Nimes (France). It was found on roadside trees along the Boulevard Gambetta which is the northern part of the ring road around the old town. Here, like in German towns, *K. crenulatum* lives together with *Phaeophyscia orbicularis, Xanthoria* sp., and *Orthotrichum diaphanum*. - Images of the same specimen at different focus levels.



Foliose lichen *Parmelia sulcata* (left) and *Physcia adscendens* (right) covered by filamentous algae.



Klebsormidium crenulatum on *Acer platanoides* in Düsseldorf, 2003.

Dense mats of filamentous algae on maple *(Acer platanoides)* in Dortmund. This image was obtained from material growing at 1.7m above the ground.

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