AIR QUALITY MONITORING WITH THE LICHEN BIODIVERSITY INDEX (LBI) IN THE DISTRICT OF FAENZA (ITALY)

MONITORING DE LA QUALITÉ DE L'AIR AU MOYEN DE L'INDICE DE BIODIVERSITÉ LICHÉNIQUE (IBL) SUR LE TERRITOIRE DE LA COMMUNE DE FAENZA (ITALIE)

MONITORAGGIO DELLA QUALITÀ DELL'ARIA MEDIANTE L'INDICE DI BIODIOVERSITÀ LICHENICA (IBL) NEL TERRITORIO DEL COMUNE DI FAENZA (ITALIA)

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Abstract

The Lichen Biodiversity Index (LBI) is a method for monitoring air pollution. This method employs lichens living on lime trees because they are sensitive to NOx and SOx, and it considers the variations in their communities. This study was performed in 16 stations located in the suburbs of Faenza city town and the result shows a more than acceptable air quality although in some stations the air was affected by the polluting effects of the vehicle traffic.
Keywords: *bioindicator; lichens; air pollution; biodiversity*

Résumé

L'indice de Biodiversité des Lichens (IBL) est une méthode de monitoring de la pollution atmosphérique. Cette méthode se base sur l'étude de lichens épiphytes qui colonisent les tilleuls et qui sont sensibles à NOx et SOx, Elle consiste à observer les variations de leurs communautés. Cette étude, réalisée sur 16 stations des alentours de FAENZA, a révélé une qualité de l'air plus qu'acceptable bien que certaines stations subissent la pollution liée au trafic routier.
Mots-clés: *bioindicateur; lichens; pollution atmosphérique; biodiversité*

Riassunto

L'indice di Biodiversità Lichenica (IBL) è un metodo di monitoraggio dell'inquinamento atmosferico. Questo metodo utilizza i licheni epifiti che colonizzano alberi di tiglio, poiché sono organismi sensibili a NOx e SOx, e osserva le variazioni delle comunità. Questo studio si è svolto in 16 stazioni della periferia di Faenza e ha dato come risultato una qualità dell'aria più che accettabile nonostante che qualche stazione risenta degli effetti inquinanti del traffico veicolare.
Parole chiave: *bioindicatori; licheni; inquinamento dell'aria; biodiversità*

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Discussion

The Lichen Biodiversity Index (LBI) method to monitor the air quality has been applied in an investigation about the town of Faenza (Fig. 1). This method has been published in May 2001 by ANPA, with the title "IBL – Indice di Biodiversità Lichenica", freely downloadable from the web and adapted to educational and popular purposes; it is based on sensitivity of lichens respect to some products from combustion of fossil fuels, like NOx and Sox; in adverse conditions, it can be observed a variation inside the community (Table 1).

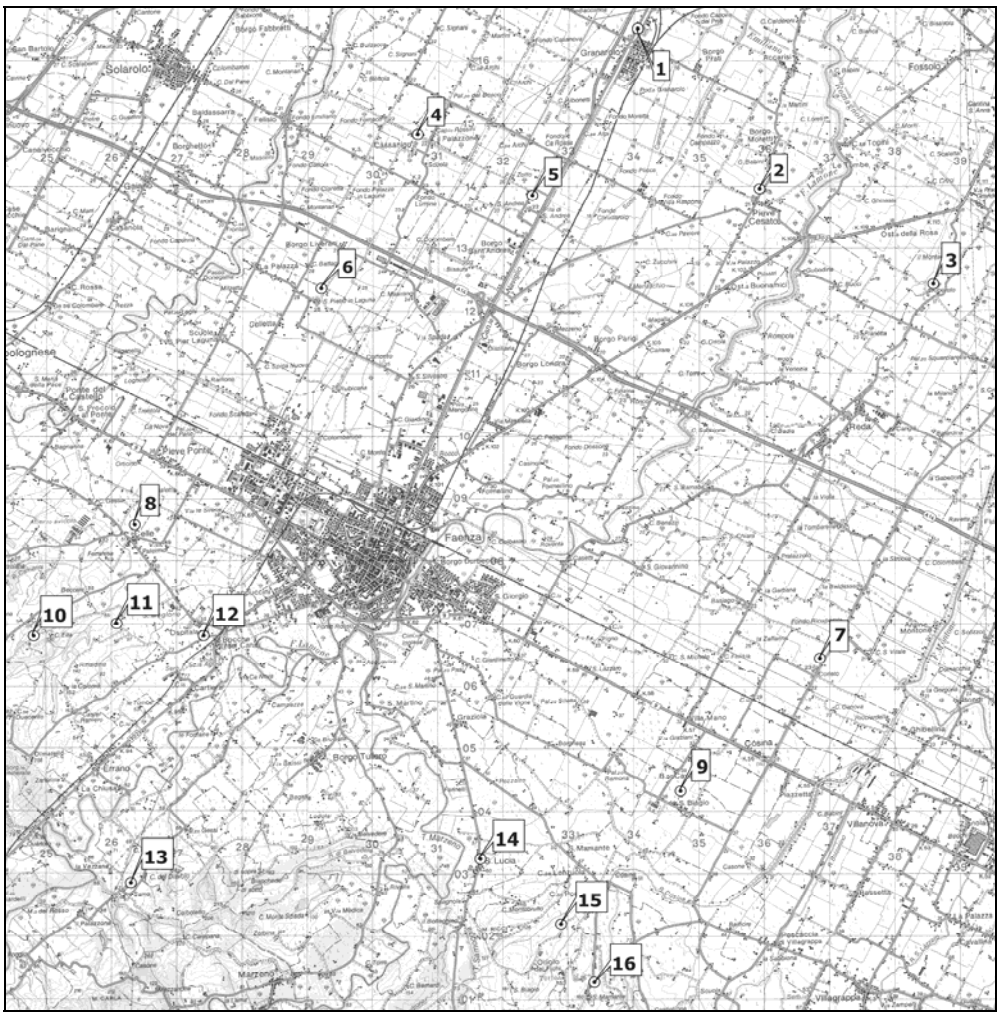

Figure 1 – *Map of Faenza town and surroundings. In shaded grey squares, numbers of station are indicated. Map not to scale.*

Table 1 – *Lichens species found. Numbers of station refer to Table 2.*

STATIONS ⇒	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
LICHENS SPECIES																
Amandinea punctata	✓			✓	✓	✓	✓		✓							
Artonia radiata			✓													
Candelaria concolor	✓	✓	✓	✓	✓				✓	✓	✓					
Candelariella reflexa/ xantostigma			✓	✓	✓				✓	✓	✓			✓		
Evernia prunastri				✓							✓					
Hyperphyscia adglutinata	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lecanora carpinea		✓														
Lecanora chlarotera		✓				✓			✓		✓	✓		✓		
Lecanora hagenii		✓			✓							✓	✓			
Lecidella elaeochroma	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Parmelia caperata				✓						✓	✓	✓	✓			
Parmelia subaurifera											✓					
Parmelia subrudecta											✓					
Parmelia solcata													✓	✓		
Parmelia liliacea											✓		✓			✓
Phaeophyscia orbicularis	✓	✓	✓	✓	✓		✓	✓	✓				✓		✓	✓
Physcia adscendens	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Physcia biziana										✓	✓	✓	✓	✓	✓	✓
Physcia tenella				✓	✓											
Physconia distorta													✓			
Physconia grisea			✓	✓		✓			✓		✓			✓		✓
Xanthoria fallax																
Xanthoria parietina	✓	✓	✓		✓		✓		✓		✓		✓	✓	✓	✓

This is the first of this type of interventions in this area; this work could be the first of a series of periodical monitorings, like, for instance, every five years. We tried to choose stations (Table 2) having:

- well distribution in the whole territory, excepted downtown because it will be considered in the next studies;
- three lime trees (Tilia sp.pl.) where possible, or at least two.

The first seven stations (1-7) are located in the plan to the north of Via Emilia (Fig. 1); other nine (8-16) are located on the hill belt to the south of Via Emilia. In some cases the tree choice was very restricted because the trees were not much homogeneous and often in bad conditions: big inner hollows, wounds by bill-posting, steep slope. Moreover, almost all monitored trees showed dry or yellow

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leaves edges because of the draught, probably a usual condition in summer after a long dry period. As this method suggests, we had to exclude trees standing where cars stop with the engine on (traffic-lights, crowded car-parks) unless the work aims at monitoring local limited situations. Here we chose to use 16 stations in a comparatively small territory, therefore also local situations are considered in IBL mean values, even if quite different from those of other trees. In Fig. 2 are shown the monitoring results. IBL values refer to Table 3 about the air quality.
As shown in the graph (Fig. 2), the air quality in Faenza area is more than acceptable, but some stations (though far from the town) show IBL values similar to the ones from the town (yellow columnes).

Table 2 – *Stations, monitoring days, grid references, number of trees observed in each station and Biodiversity Index risulted.*

Reference number	Station	Time	UTM grid reference (Latitude, Longitude)	Number of trees	IBL
1	Granarolo	08/10/2006	4916289 N, 733985 E	3	**47**
2	Pieve Cesato	08/10/2006	4913732N, 735851 E	3	**53**
3	Albereto	08/15/2006	4912205 N, 738515 E	3	**40**
4	Cassanigo	08/08/2006	4914595 N, 730612 E	3	**37**
5	Sant'Andrea	08/10/2006	4913621 N, 732368 E	2	**49**
6	San Pier Laguna	08/08/2006	4912131 N, 729133 E	3	**19**
7	Pieve di Corleto	09/15/2006	4906225 N, 736776 E	2	**46**
8	Celle	09/28/2006	4908356 N, 726270 E	3	**28**
9	San Biagio	09/15/2006	4904100 N, 734640 E	3	**36**
10	Pergola (in the vicinity)	09/15/2006	4906588 N, 724720 E	3	**34**
11	Villa Ragazzina	09/28/2006	4906787 N, 725994 E	3	**53**
12	Villa Rotonda	09/29/2006	4906590 N, 727326 E	3	**24**
13	Pieve di Sarna	09/29/2006	4902647 N, 726212 E	3	**40**
14	Santa Lucia	09/29/2006	4903016 N, 731572 E	3	**35**
15	Via Salita di Oriolo	09/29/2006	4901978 N, 732808 E	2	**45**
16	San Mamante	10/01/2006	4901053 N, 733320 E	3	**38**

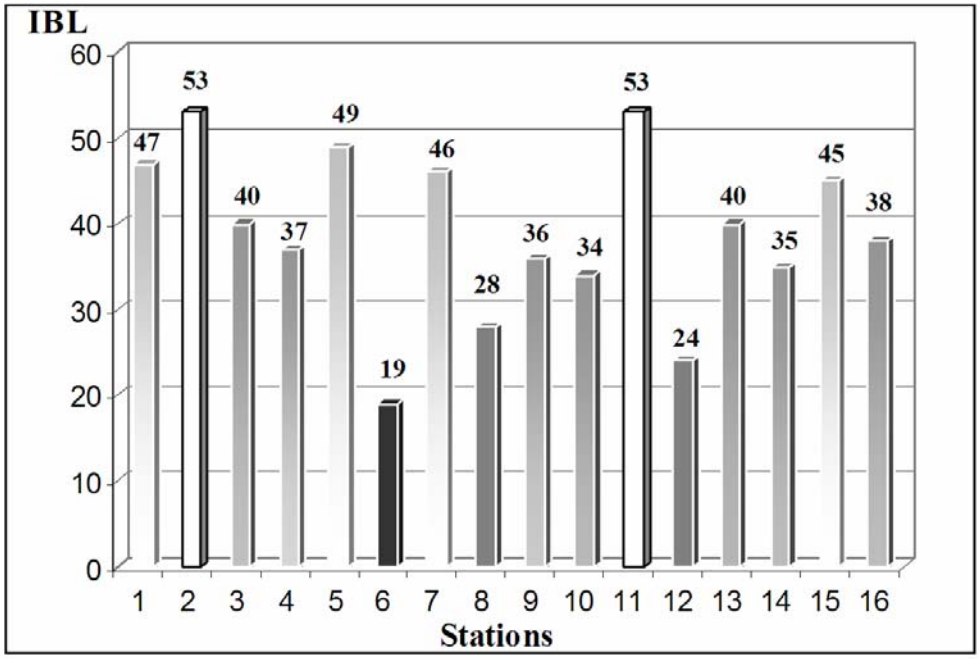
Table 3 – *Legend about Biodiversity Index and Reference Classes of air quality.*

Colors	IBL	Reference classes
	0	Very high alteration (lichen desert)
	1 - 10	High alteration
	11 - 20	Middle alteration
	21 - 30	Low alteration/low naturality
	31 - 40	Middle naturality
	41 - 50	High naturality
	> 50	Very high naturality

The stations having the worst air quality are in S. Pier Laguna and Celle. About S. Pier Laguna station, the low value obtained probably is due to the presence of the

A14 motorway lying close to it; such a bad influence is not detected in Pieve di Corleto station, although it lies between the motorway and Via Emilia as well. The reason for this difference is likely due to the presence of fields cultivated with intensive method (lichens are very sensitive to fungicides that kill pathogenic fungi) or to a vegetation between this station and the motorway too poor for absorbing pollution coming from the road. To understand this situation we should study better the geographic distribution of plants, the use of soil and prevailing winds. The same applies to Celle station, as far from Via Emilia as S. Biagio station but being one IBL quality class under. Clear enough is the situation of Villa Rotonda station, having low naturality IBL values probably because it is very close to Via Firenze and the parking area of its crowded restaurant.

Figure 2 – *Graph about Biodiversity Index and frequency for every station. As numbers refer to Table 2 as shades of grey to Table 3.*



So the quality of the air is affected by the polluting effects of the vehicle traffic coming from the nearby roads and the parking area of the restaurant, where the station is located. Again the vehicle traffic is responsible for the poor quality of the air, although in this area is not as bad as in other similar enviromental conditions.

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