

## REFERENCES

- Asta, J., Erhardt, W., Ferretti, M., Fornasier, F., Kirschbaum, U., Nimis, P. L., Purvis, O. W., Pirintsos, S., Scheidegger, C., Haluwyn, C. V. and Wirth, V. (2002) *European Guideline For Mapping Lichen Diversity as an Indicator of Environmental Stress* [online]. Available: [www.thebls.org.uk/eumap.pdf](http://www.thebls.org.uk/eumap.pdf) (20 May 2004)
- Ayers, G. P., Ketwood, M. D., Gillett, R., Manins, P. C., Malfroy, H. and Bardsley, T. (1998) Validation of passive diffusion sampler for SO<sub>2</sub> and NO<sub>2</sub>. *Atmospheric Environment* 32 (20): 3587-3592.
- Batič, F. (2002) Bioindication of sulfur dioxide pollution with lichens. In: *Protocols in Lichenology: culturing, biochemistry, Ecophysiology and use in biomonitoring* (eds. Kranner, I., et al.). Springer-Verlag Berlin Heidelberg, Germany.
- Bower, J. S., Lampert, J. E., Stevenson, K. J., Atkins, D. H. F. and Law, D. V. (1991) A diffusion tube survey of NO<sub>2</sub> levels in urban areas of the U.K. *Atmospheric Environment* 25B (2): 255-265.
- Brawn, K. and J. G. Ogden, I. (1977) Lichen diversity and abundance as affected by traffic volume in an urban environment. *Urban Ecology* 2 (3): 235-244.
- Bush, T., Smith, S., Stevenson, K. and Moorcroft, S. (2001) Validation of nitrogen dioxide diffusion tube methodology in the UK. *Atmospheric Environment* 35: 289-296.
- Carmichael, G. R., Fermb, M., Thongboonchooa, N., Wooa, J.-H., Chanc, L. Y., Muranod, K., Viete, P. H., Mossbergf, C., Bala, R., Boonjawat, J., Upatum, P., Mohan, M., Adhikary, S. P., Shrestha, A. B., Pienaar, J. J., Brunke, E. B., Chen, T., Jie, T., Guoan, D., Peng, L. C., Dhiharto, S., Harjanto, H., Jose, A. M., Kimani, W., Kirouane, A., Lacaux, J., Richard, S., Barturen, O., Cerda, J. C., Athayde, A., Tavares, T., Cotrina, J. S. and Bilici, E. (2003) Measurements

of sulfur dioxide, ozone and ammonia concentrations in Asia, Africa and South America using passive samplers. *Atmospheric Environment* 37: 1293-1308.

Castello, M. and Skert, N. (2005) Evaluation of lichen diversity as an indicator of environmental quality in the North Adriatic sub Mediterranean region. *Science of the Total Environment* 336 (1-3): 201-214.

Chirasathaworn, N. (2005) Monitoring and analysis of acid deposition in Chiang Mai province in 2003-2004. M.S. Thesis. Environmental Science, Chiang Mai University, Chiang Mai.

Cislaghi, C. and Nimis, P. L. (1997) Lichens, air pollution and lung cancer. *Nature* 387: 463-464.

Conti, M. E. and Cecchetti, G. (2001) Biological monitoring: lichens as bioindicators for air pollution assessment- a review. *Environmental Pollution* 114: 471-492.

Cruz, L. P. S., Campos, V. P., Silva, A. M. C. and Tavares, T. M. (2004) A field evaluation of a SO<sub>2</sub> passive sampler in tropical industrial and urban air. *Atmospheric Environment* 38: 6425-6429.

Energy Information Administration (2003) Country Analysis Briefs; Thailand: Environmental Issues [online]. Available: [www.eia.doe.gov/emeu/cabs/thai\\_env.html](http://www.eia.doe.gov/emeu/cabs/thai_env.html) (15 June 2004)

Engardt, M. and Leong, C. P. (2001) Regional modeling of anthropogenic sulphur in Southeast Asia. *Atmospheric Environment* 35: 5935-5947.

Fields, R. F. (1988) Physiological responses of lichens to air pollutants fumigations. In: *Lichens, Bryophytes and Air Quality. Bibliotheca Lichenologica* (ed. Cramer, J.) pp. 175-200. der Gebr. Borntraeger Verlagsbuchhandlg, Berlin-Stuttgart.

- Gair, A. J. and Penkett, S. A. (1995) The effects of wind speed and turbulence on the performance of distribution tube samplers. *Atmospheric Environment* 29 (18): 2529-2533.
- Gair, A. J., Penkett, S. A. and Oyola, P. (1991) Development of a simple passive technique for the determination of nitrogen dioxide in remote continental locations. *Atmospheric Environment* 25A (9): 1927-1939.
- Galun, M., Garty, J. and Ronen, R. (1984) Lichen as bioindicators of air pollution. *Webbia* 38: 371-383.
- Glasius, M., Carlsen, M. F., Hansen, T. S. and Lohse, C. (1999) Measurements of nitrogen dioxide on Funen using diffusion tubes. *Atmospheric Environment* 33: 1177-1185.
- Gombert, S., Asta, J. and Seaward, M. R. D. (2004) Assessment of lichen diversity by index of atmospheric purity (IAP), index of human impact (IHI) and other environmental factors in an urban area (Grenoble, southeast France). *Science of the Total Environment* 324 (1-3): 183-199.
- Górecki, T. and Namieśnik, J. (2002) Passive Sampling. *Trends in Analytical Chemistry* 21 (4): 276-291.
- Hale, M. E. (1979) *How to know the lichens*. Wm. C. Brown Company Publishers, Iowa, USA.
- Hansen, T. S., Kruse, M., Nissen, H. and Glasius, M. (2001) Measurement of nitrogen dioxide in Greenland using palmes diffusion tubes. *Journal of Environmental Monitoring* 3: 139-145.
- Hawksworth, D. L. and Rose, F. (1970) Qualitative scale for estimating sulphur dioxide air pollution In England and Wales using epiphytic lichens. *Nature* 227: 145-148.
- Hawksworth, L. D. and Rose, F. (1976) *Lichens as Pollution Monitors*. Edward Arnold (Publishers) Limited, London.

- Heal, M. R. and Cape, J. N. (1997) A numerical evaluation of chemical interferences in the measurement of ambient nitrogen dioxide by passive diffusion samplers. *Atmospheric Environment* 31 (13): 1911-1923.
- Heal, M. R., Kirby, C. and Cape, J. N. (2000) Systematic biases in measurement of urban nitrogen dioxide using diffusion samples. *Environmental Monitoring and Assessment* 62: 39-54.
- Heal, M. R., Donoghue, M. A. and Cape, J. N. (1999) Overestimation of urban nitrogen dioxide by passive diffusion tubes: a comparative exposure and model study. *Atmospheric Environment* 33: 513-524.
- Hien, P. D., Bac, V. T. and Thinh, N. T. H. (2004) PMF receptor modeling of fine and coarse PM<sub>10</sub> in air masses governing monsoon conditions in Hanoi, northern Vietnam. *Atmospheric Environment* 38: 189-201.
- Hutchinson, J., Maynard, D. and Geiser, L. (1996) *Air Quality and Lichens - A Literature Review Emphasizing the Pacific Northwest, USA*. [online]. Available: <http://www.fs.fed.us/r6/aq/lichen/almanac.htm#Mechanisms> (15 December 2004)
- Johnsen, I. and Søchting, U. (1976) Distribution of cryptogrammic epiphytes in a Danish city in relation to air pollution and bark properties. *The Bryologist* 79: 86-92.
- Kasper-Giebl, A. and Puxbaum, H. (1999) Deposition of particulate matter in diffusion tube samplers for the determination of NO<sub>2</sub> and SO<sub>2</sub>. *Atmospheric Environment* 33: 1323-1326.
- Kawaii, C. (2003) People's health living around the ceramic factory area in Lampang Province. M.S. Thesis. Public Health, Chiang Mai University
- Khaodee, W. (in press) Development of passive sampler for determination of nitrogen dioxide, sulfur dioxide and ozone in ambient air. M.S. Thesis. Chemistry, Chiang Mai University.

- Kong, F. X., Hu, W., Chao, S. Y., Sang, W. L. and Wang, L. S. (1999) Physiological responses of the lichen *Xanthoparmelia mexicana* to oxidative stress of SO<sub>2</sub>. *Environmental and Experimental Botany* 42 (3): 201-209.
- Krochmal, D. and Kalina, A. (1997a) Measurements of nitrogen dioxide and sulphur dioxide concentrations in urban and rural areas of Poland using a passive sampling method. *Environmental pollution* 96 (3): 401-407.
- Krochmal, D. and Kalina, A. (1997b) A method of nitrogen dioxide and sulphur dioxide determination in ambient air by use of passive samplers and ion chromatography. *Atmospheric Environment* 31 (20): 3473-3479.
- Krupa, S. (2001) *Theory and principles of passive sampling of gaseous air pollutants*. Abstracts, International Symposium, Passive sampling of gaseous air pollutants in ecological effects research, California
- Krupa, S. V. and Legge, A. H. (2000) Passive sampling of ambient, gaseous air pollutants: an assessment from an ecological perspective. *Environmental Pollution* 107: 31-45.
- Lampang Meteorological Station (2005) Meteorological data 1994-2004.
- LeBlanc, F., Rao, D. N. and Comeau, G. (1972) The epiphytic vegetation of *Populus balsamifera* and its significance as an air pollution indicator in Sudbury, Ontario. *Canadian Journal of Botany* 50: 519-528.
- Loppi, S., Giordani, P., Brunialti, G., Isocrono, D. and Piervittori, R. (2002a) Identifying deviations from naturality of lichen diversity for bioindicator purpose. In: *Monitoring with Lichens-Monitoring Lichens* (eds. Nimis, P. L., et al.). Kluwer Academic Publishers, Netherlands.
- Loppi, S., Ivanov, D. and Boccardi, R. (2002b) Biodiversity of epiphytic lichens and air pollution in the town of Siena (Central Italy). *Environmental pollution* 116: 123-128.

- Loppi, S. and Pirintsos, S. A. (2000) Effect of dust on epiphytic lichen vegetation in the Mediterranean area (Italy and Greece). *Israel Journal of Plant Sciences* 48 (2): 91-95.
- Manahan, S. E. (1999) *Environmental Chemistry*. 7th edition, Lewish publishers, New York [online]. Available: <http://www.environetbase.com> (6 February 2005)
- Ministry of Energy (2002) Thailand Energy Situation; Annual Report. Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand [online]. Available: <http://203.150.24.8/dede/statpage/ENERGY2002/ENT25.pdf> (11 June 2004)
- Ministry of Public Health (1998-2002) Statistic of Illnesses. Health Information Division, Department of Health, Ministry of Public Health, Thailand [online]. Available: <http://203.157.19.191/Pla3-3.html> (5 June 2004)
- Na Ma, J. (2004) Dynamics of residential land use: A case study of Lampang urban area. M.S. Thesis, Geography, Chiang Mai University, Chiang Mai.
- Nimis, P. L. and Purvis, O. W. (2002) Monitoring Lichens as Indictors of Pollution. In: *Monitoring with Lichens-Monitoring Lichens* (eds. Nimis, P. L., et al.). Kluwer Academic Publishers, Netherlands.
- Nimis, P. L. and Purvis, O. W. (2002) Monitoring lichens as indicators of pollution. In: *Monitoring with Lichens-Monitoring Lichens* (eds. Nimis, P. L., et al.). Kluwer Academic Publishers, Netherlands.
- Nimis, P. L., Castello, M. and Perotti, M. (1990) Lichen as biomonitor of sulphur dioxide pollution in La Spezia (Northern Italy). *Lichenologist* 22 (3): 333-344.
- Perkauskas, D. and Mikelinskiene, A. (1998) Evaluation of SO<sub>2</sub>, and NO<sub>2</sub>, concentration levels in Vilnius (Lithuania) using passive diffusion samplers. *Environmental Pollution* 102: 249-252.

- Pinho, P., Augusto, S., Branquinho, C., Bio, A., Pereira, M. J., Soares, A. and Catarino, F. (2004) Mapping lichen diversity as a first step for air quality assessment. *Journal of Atmospheric Chemistry* 49: 377-389.
- Plaisance, H., Sagnier, I., Saison, J. Y., Galloo, J. C. and Guillermo, R. (2002) Performances and application of a passive sampling method for the simultaneous determination of nitrogen dioxide and sulfur dioxide in ambient air. *Environmental Monitoring and Assessment* 79: 301-315.
- Poikolainen, J., Kuusinen, M., Mikkola, K. and Lindgren, M. (1998) Mapping of the epiphytic lichens on conifers in Finland in the years 1985-1986 and 1995. *Chemosphere* 36: 1073-1078.
- Pollution Control Department (2005) Regional air quality. Division of Air Quality and Noise Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment, Thailand
- Purvis, O. W., Coppins, B. J., Hawksworth, D. L., James, P. W. and Moore, D. M. (1992) *The Lichen Flora of Great Britain and Ireland*. The British Lichen Society, London.
- Richardson, D. H. S. (1992) *Pollution monitoring with lichens*. Richmond Publishing Co. Ltd., England.
- Royal Thai Survey Department (1997) Map of Chang wat Lampang
- Saipunkaew, W., Wolseley, P., Chimonides, J. and Boonpragob, K. (in press) Epiphytic macro-lichens as indicators of environmental alteration in Upper Northern Thailand. *Environmental Pollution*.
- Saipunkeaw, W. (1994) Lichens as bioindicators for air pollution monitoring in Doi Suuthep mountain and Chiang Mai city. M.S. Thesis. Environmental Risk Assessment for Tropical Ecosystems, Chiang Mai University.

- Saipunkaew, W., Wolseley, P. and Chimonides, P. J. (2005) Epiphytic lichens as indicators of environmental health in the vicinity of Chiang Mai city, Thailand. *The Lichenologist* 37 (4): 345-356.
- Santis, F. D., Fino, A., Tiwari, S., Vazzana, C. and Allegrini, I. (2000) A performance evaluation of the open tube diffusion sampler (palmes sampler) for monitoring nitrogen dioxide. In: *Air Pollution VIII* [online]. Available: <http://library.witpress.com/pdfs/abstracts/AIR00/AIR00042AU.pdf>(6 February 2005)
- Shakya, K. (2004) Passive sampling of nitrogen dioxide and sulfur dioxide in ambient air. M.S. Thesis. Environmental Science, Chiang Mai University.
- Showman, R. E. (1997) *Lichen Biomonitoring for air pollution at selected Ohio State forests* [online]. Available: [www.ohiodnr.com/forestry/health/lichen/lichen\\_study.htm](http://www.ohiodnr.com/forestry/health/lichen/lichen_study.htm) (26 March 2005)
- Sipman, H. (2003) *Lichen determination keys- common Malesian lichen genera - Key to the lichen genera of Bogor, Cibodas and Singapore* [online]. Available: <http://www.bgbm.org/Sipman/keys/Javagenera.htm> (15 June 2004)
- Sommerfeldt, M. and John, V. (2001) Evaluation of a method for the reassessment of air quality by lichen mapping in the city of izmir, Turkey. *Turkey Journal of Botany* 25: 45-55.
- Spiro, T. G. and Stigliani, W. M. (1996) *Chemistry of the Environment*. 2<sup>nd</sup> edition. Prentice-Hall, Inc., NJ, USA.
- Staxäng, B. (1969) Acidification of bark of some deciduous trees. *Oikos* 20: 224-230.
- Stevenson, K., Bush, T. and Mooney, D. (2001) Five years of nitrogen dioxide measurement with diffusion tube samplers at over 1000 sites in the UK. *Atmospheric Environment* 35: 281-287.

- Subsri, P. (2002) Lichens as bioindicators for air pollution monitoring in urban and suburban of Chiang Mai city in 2001. M.S. Thesis. Biology, Chiang Mai University.
- Subsri, P. and Saipunkaew, W. (2002) Mango tree bark as bioindicator for air pollution monitoring in Chiang Mai city. *Chiang Mai Journal of Science* 29 (3): 183 -188.
- Swinscow, T. D. V. and Krog, H. (1988) *Macrolichens of East Africa*. British Museum (Natural History), London.
- Thai Meteorological Department (2005) Climate of Thailand [online]. Available: <http://www.tmd.go.th> (11 June 2004)
- The World Bank Group (2002) Thailand: Thailand Environmental Monitor 2002. [online]. Available: [www.worldbank.org./0,contentMDK:20206650~pagePK:141137~piPK:217854~theSitePK:333296,00.html](http://www.worldbank.org./0,contentMDK:20206650~pagePK:141137~piPK:217854~theSitePK:333296,00.html) (15 June 2004)
- Thrower, S. L. (1980) Air pollution and lichens in Hong Kong. *Lichenologist* 12 (3): 305-311.
- Ukpebor, E. E., Ahonkhai, S. I. and Heydtmann, H. (2004) NO<sub>2</sub> measurement with a passive sampler: assessment of the sensitivity of two types of palmes diffusion tubes for NO<sub>2</sub>. *Internal Journal of Environmental Studies* 61 (1): 67-71.
- van Dobben, H. F., Wolterbeek, H. T., Wamelink, G. W. W. and Ter Braak, C. J. F. (2001) Relationship between epiphytic lichens, trace elements and gaseous atmospheric pollutants. *Environmental Pollution* 112: 163-169.
- van Haluwyn, C. and van Herk, C. M. (2002) Bioindication: The community approach. In: *Monitoring with Lichens-Monitoring Lichens* (eds. Nimis, P. L., et al.). Kluwer Academic Publishers, Netherlands.
- Varshney, C. K. and Singh, A. P. (2003) Passive samplers for NO<sub>x</sub> monitoring: A critical review. *The Environmentalist* 23: 127-136.

- VDI (1995) *VDI 3799, Part 1: Measurement and evaluation of phytotoxic effects of ambient air pollutions (immissions) with lichens mapping of lichens for assessment of air quality*. Verein Deutscher Ingenieure, Düsseldorf.

Vokou, D., Pirintzos, S. A. and Loppi, S. (1999) Lichens as bioindicators of temporal variations in air quality around Thessaloniki, northern Greece. *Ecological Research* 14 (2): 89-96.

Wolseley, P. and Aguirre-Hudson, B. (1997) *Lichen of Tropical Forest in Thailand: A field key to characteristic epiphytic species in northern Thailand*. Botany Department, Natural History Museum, London.