

Bibliography

A

- Adams, S. N., Honeysett, J.T., Tiller, K.G. and Norrish, K. 1969. Factors controlling the increase of cobalt in plants following the addition of a cobalt fertiliser. *Aust. J. Soil Res.* 7, 29-42.
- Amann, R.L., Ludwig, W. and Schleifer, K.H. 1995. Phylogenetic identification and *in situ* detection of individual microbial cells without cultivation. *Micro and Molecular Biol Reviews* 59, 143-169.
- Aubrey, K.V., 1956. Frequency distributions of elements in igneous rocks. *Geochimica et Cosmochimica Acta* 9, 83-89.
- Avrahami, S., Liesack, W. and Conrad, R. 2003. Effects of temperature and fertilizer on activity and community structure of soil ammonia oxidisers. *Environ Microbiol* 5, 691-705.
- Axelrood, P.E., Chow, M.L., Radomski, C.C., McDermott, J.M. and Davies, J. 2002. Molecular characterization of bacterial diversity from British Columbia forest soils subjected to disturbance. *Can J Microbiol* 48, 655–674.

B

- Bacon, J.R., Berrow, M.L. and Shand, C.A. 1992. Isotopic composition as an indicator of origin of lead accumulations in surface soils. *Intern. J. Environ. Anal. Chem.* 46, 71 – 76.
- Bak, J., Jensen, J., Larsen, M.M., Pritzl, G. and Scott-Fordsmand, J. 1997. A heavy metal monitoring-programme in Denmark. *Sci. Tot. Environ.* 207,179-186.
- Blackwood, C.B. and Paul, E.A. 2003. Eubacterial community structure and population size within the soil light fraction, rhizosphere, and heavy fraction of several agricultural systems. *Soil Biol Biochem* 35, 1245-1255.
- Boddington, C. L., and Dodd. J. C. 2000. The effect of agricultural practices on the development of indigenous arbuscular mycorrhizal fungi. I. Field studies in an Indonesian Ultisol. *Plant Soil* 218, 137-144.
- Bonkowski, M., Cheng, W., Griffiths, B., Alpehi, J. and Scheu, S. 2000. Microbial–faunal interactions in the rhizosphere and effects on plant growth. *Eur J Soil Biol* 36, 135–147.
- Borneman, J., Skroch, P.W., O’Sullivan, K.M., Palus, J.A., Rumjanek, N.G., Jansen, J.L., Nienhaus, J. and Triplett, E.W. 1996. Molecular microbial diversity of an agricultural soil in Wisconsin. *J Environ Micro* 62, 1935-1943.
- Borneman, J., and Triplett, E.W. 1997. Molecular microbial diversity in soils from eastern Amazonia: evidence for unusual microorganisms and microbial population shifts associated with deforestation. *J. Environ. Microbiol.* 63, 2647-2653.
- Bortels, H. 1930. Molybden als Katalysator bei der biologischen stiekstoffbindung. *Arch. Mikrobiol.* 1, 333-342.
- Bowen, J.M. 1982. *The Elemental Constituents of Soils. Environmental Chemistry, Vol. 2, The Royal Society of Chemistry, London, 204pp.*

- Box, G.E.P., and Cox, D.R., 1962. An analysis of transformations. *Journal of the Royal Statistical Society, Series B* 26(2), 211-252.
- Brogan, J.C. 1966. Organic carbon in Irish pasture soils. *Irish Journal of Agricultural Research* 5(2), 169 – 176.
- Bruns, M.A., Stephen, J.R., Kowalchuk, G.A., Prosser, J.I. and Paul, E.A. 1999. Comparative diversity of ammonia oxidizer 16S rRNA gene sequences in native, tilled, and successional soils. *Appl. Environ. Microbiol.* 65, 2994–3000.
- Buckley, D.H., and Schmidt, T. M. 2001. The structure of microbial communities in soil and the lasting impact of cultivation. *Microb. Ecol.* 42, 11-21.
- Buckley, D.H. and Schmidt, T.M 2003. Diversity and dynamics of microbial communities in soils from agro-ecosystems. *Environ Microbiol* 5, 441–452.
- Burgmann, H., Pesaro, M., Widmer, F. and Zeyer, J. 2001. A strategy for optimizing quality and quantity of DNA extracted from soil. *J Micro Methods* 45(1), 7-20.
- Burgess, T.M. and Webster, R. 1980. Optimal interpolation and isarithmic mapping of soil properties: II. Block Kriging. *Journal of Soil Science* 31, 333-341.
- Buyer, J.S., Roberts, D.P and Russek-Cohen, E. 2002. Soil and plant effects on microbial community. *Can J Microbiol* 48, 955–964.

C

- Carlson, C., Critto, A., Marcomini, A., and Nathanail, P. 2001. Risk based characterisation of contaminated industrial site using multivariate and geostatistical tools. *Environmental Pollution* 111, 417-427.
- Chesworth, W. 1991. Geochemistry of micronutrients. In *Micronutrients in Agriculture*, 2nd ed. Soil Sci. Soc. Amer. 4, 1-30.
- Clark, I., and Harper, W.V. 2000. *Practical Geostatistics 2000*. Ecosse North America Llc, Columbus Ohio, USA. 342pp.
- Commission of the European Communities 2002. Towards a thematic strategy on soil protection, COM (2002) 179.
- Commission of the European Communities 2003. Regulation amending the conditions for authorisation of a number of additives in feedstuffs belonging to the group of trace elements. Regulation No. 1334/2003.
- Coulter, B.S. 2004. Nutrient and trace element advice for grassland, tillage, vegetable and fruit crops. Teagasc, 96pp.
- Coulter, B.S., McDonald, E., MacNaoidhe, F.S., Parle, P.J., Blagden, P.A., Fleming, G.A. and Gately, T.F. 1999. Nutrient and trace element status in grassland and tillage soils. Teagasc, 46pp.
- Crecchio, C., Gelsomino, A., Ambrosoli, R., Minati, J.L. and Ruggiero, P. 2004. Functional and molecular responses of soil microbial communities under differing soil management practices. *Soil Biol Biochem* 36, 1873-1883.
- Cressie, N., 1993. *Statistics for spatial data*, revised ed. John Wiley and Sons, New York. 900 pp.

Cruickshank, J.G. 1997. Soils and Environment: Northern Ireland. Department of Agriculture, Belfast. 213pp.

D

- Dahllöf, I. 2002. Molecular community analysis of microbial diversity. *Current Opinions Biotech.* 13, 213-217.
- Dalmastri, C., Chiarini, L., Cantale, C., Bevivino, A. and Tabacchioni, S. 1999. Soil type and maize cultivar affect the genetic diversity of maize root-associated *Burkholderia cepacia* populations. *Microbiol Ecol* 38, 273–284.
- Daly, K. and Fealy, R. 2007. Digital Soil Information System for Ireland (2005-S-DS-22). <http://www.epa.ie/EnvironmentalResearch/ReportsOutputs/>
- Daniel, R. 2004. The soil metagenome - a rich resource for the discovery of novel natural products. *Curr Opin Biotechnol* 15, 199-204.
- De Boer, W. and Laanbroek, H.J. 1989. Ureolytic nitrification at low pH by *Nitrosopira* species. *Arch Microbiol* 152, 178-181.
- De Liphay, J.R., Enzinger, C., Johnsen, K., Aamand, J. and Sorensen, S.J. 2004. Impact of DNA extraction method on bacterial community composition measured by denaturing gradient gel electrophoresis. *Soil Biol Biochem* 36(10), 1607-1614.
- DeLong, E.F., Franks, D.G., Allredge, A.D.L. 1993. Phylogenetic diversity of aggregate-attached vs. free-living marine bacterial assemblages. *Limnol Oceanog* 38, 924-934.
- Demaneche, S., Jocteur-Monrozier, L., Quiquampoix, H. and Simonet, P. 2001. Evaluation of biological and physical protection against nuclease degradation of clay-bound plasmid DNA. *J Environ Micro* 67(1), 293-299.
- Department of Agriculture and Food 2006. Fact Sheet on Irish Agriculture. Economics and Planning Division. <http://www.agriculture.gov.ie>.
- Department of the Environment, 1991. Statutory Instrument No. 183 of 1991. European Communities (Use of Sewage Sludge in Agriculture) Regulations. The Stationery Office, Dublin, 14 pp.
- Dobermann, A., Goovaerts, P., Neue, H.U., 1997. Scale-dependent correlations among soil properties in two tropical lowland rice fields. *Soil Sci. Soc. Am. J.* 61, 1483-1496.
- Drinkwater, L.E., Wagoner, P. and Sarrantonio, M. 1998. Legume-based cropping systems have reduced carbon and nitrogen losses. *Nature* 396, 262– 265.
- Dunbar, J., Ticknor, L.O. and Kuske, C.R. 2001. Phylogenetic specificity and reproducibility and new method for analysis of terminal restriction fragment profiles of 16S rRNA genes from bacterial communities. *J Environ Microbiol* 67, 190–197.

E

Eardly, D.F., Carton, M.W., Gallagher, J.M., Patching, J.W. 2001. Bacterial

- abundance and activity in deep-sea marine sediments from the Eastern North Atlantic. *Prog Oceanog* 50, 245-259.
- EEC, 1986. On the Protection of the Environment, and in particular of the Soil when Sewage Sludge is used in Agriculture, 86/278/EEC.
- Emo, G.T. 1986. Some considerations regarding the styles of mineralization at Harberton Bridge, County Kildare. In *Geology and Genesis of Mineral deposits in Ireland*. Eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F. Irish Assoc. for Econ. Geol., Dublin.
- Environmental Protection Agency 2002. Towards setting environmental quality objectives for soil: developing a soil protection strategy for Ireland, EPA, Wexford, Ireland.
- ESRI, 2003. *Using ArcGIS Geostatistical Analyst*. ESRI, 380 New York Street, Redlands, CA 92373-8100, USA.
- EU Thematic Strategy on Soil protection. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. COM(2006)231 final, Brussels.

F

- Farrelly, V., Rainey, F.A. and Stackebrandt, E. 1995. Effect of genome size and rrn copy number on PCR amplification of 16S rRNA genes from a mixture of bacterial species. *Appl Environ Microbiol* 61, 2798–2801.
- Felske, A., Akkermans, A.D.L. and De Vos, W.M. 1998. Quantification of 16S rRNAs in Complex Bacterial Communities by Multiple Competitive Reverse Transcription-PCR in Temperature Gradient Gel Electrophoresis Fingerprints. *J Environ Micro* 64, 581-587.
- Ferris, M.J. and Ward, M. 1997. Seasonal distributions of dominant 16S rRNA-defined populations in a hot spring microbial mat examined by denaturing gradient gel electrophoresis. *Appl Environ Microbiol* 63, 1375– 1381.
- Finch, T. and Rogers, P.A.M. 1978. Distribution of cobalt and molybdenum in soils in the eastern midlands of Ireland. *Irish Journal of Agricultural Research* 17, 107 – 113.
- Finlay, B.J., Esteban, G.F., Olmo, J.L. and Tyler, P.A. 1999. Global distribution of free-living microbial species. *Ecography* 22, 138-144.
- Fleming, G.A. 1962. Some factors affecting the uptake of selenium by plants. *Irish J. Agric. Res.* 1, 131-138.
- Fleming, G.A. 1978. *Trace Elements in Irish Soils with Special Reference to Cobalt and Selenium*. PhD Thesis, NUI, 339pp.
- Fleming, G. 1982. Trace element investigations in Ireland: a half century of research in soils, plant nutrition and soil-plant-animal interrelationships. *Journal of Life Sciences of the Royal Dublin Society* 4, 9 – 25.

- Fleming, G.A. 1983. Aspects of the soil chemistry of cobalt. In: *The Significance of Trace Elements in Solving Petrogenetic Problems and Controversies*, ed. S.S. Augustithis, Theophrastus Publications, Athens 731 - 743.
- Fleming, G.A. and Parle, P.J. 1977. Heavy metals in soils, herbage and vegetables from an industrialised area west of Dublin city. *Irish Journal of Agricultural Research* 16, 35-48.
- Fleming, G.A. and Parle, P.J. 1987. Trace Elements in Irish Soils – Content and Distribution. *Proceedings of the Symposium on Trace Elements in Soils Crops and Animals*, Teagasc, Johnstown Castle, March pp 1 – 30.
- Fleming, G.A. and Walsh, T. 1957. Selenium occurrence in certain Irish soils and its toxic effects on animals. *Proc. Roy. Ir. Acad.* 58B, 151-166.
- Fream, W. 1890. The herbage of pastures. *J. Royal Agric. Soc.* 1 (Ser. 3), 384-392.
- Fromin, N., Hamelin, J., Tarnawski, S., Roesti, P., Jourdain-Miserez, K., Forestier, N., Teyssier-Cuvelle, S., Gillet, F., Aragzo, M. and Rossi, P. 2002. Statistical analysis of denaturing gradient electrophoresis fingerprinting patterns. *Environ Microbiol* 4(11), 634-643.
- Frostegard, A., Courtois, S., Ramišse, V., Clerc, S., Bernillon, D., Le Gall, F., Jeannin, P., Nesme, X. and Simonet, P. 1999. Quantification of bias related to the extraction of DNA directly from soils. *J Environ Micro* 65(12) 5409-5420.
- Fuhrman, J.A., Comeau, D.E., Hagstrom, A. and Chan, A.M. 1988. Extraction from natural planktonic microorganisms of DNA suitable for molecular biological studies. *J Environ Micro* 54(6), 1426-1429.

G

- Gabor, E.M., de Vries, E.J. and Janssen, D.B. 2003. Efficient recovery of Environ DNA for expression cloning by indirect extraction methods. *FEMS Micro Ecol* 44 (2) 153-163.
- Gamma Design Software. 2004. *GS+: Geostatistics for the Environmental Sciences*. Gamma Design Software, Plainwell, Michigan USA.
- Garbeva, P., van Veen, J.A. and van Elsas, J.D. 2004. Microbial diversity in soil: selection of microbial populations by plant and soil type and implications for disease suppressiveness. *Annu Rev Phytopathol* 42, 243–270.
- Gardiner, M.J., and Radford, T., 1980. *Soil Associations of Ireland and Their Land Use Potential – Explanatory Bulletin to Soil Map of Ireland 1980*. The Agricultural Institute, Dublin. 142pp
- Gelsomino, A.A., Keijzer-Wolters, C., Cacco, G. and van Elsas J.D. 1999. Assessment of bacterial community structure in soil by polymerase chain reaction and denaturing gradient gel electrophoresis. *J Microbiol Meth* 38, 1–15.
- Girvan, M.S., Bullimore, J., Pretty, J.N., Osborn, A.M. and Ball, A.S. 2003. Soil type is the primary determinant of the composition of the total and active bacterial communities in arable soils. *J. Environ Microbiol* 69, 1800–1809.

- Gomes, N.C., Heuer, H., Schönfeld J., Costa, R., Mendonca-Hagler Land Smalla, K. 2001. Bacterial diversity of the rhizosphere of maize *Zea mays* grown in tropical soil studied by temperature gradient gel electrophoresis. *Plant Soil* 232, 167–180.
- Goovaerts, P., 1997. *Geostatistics for Natural Resources Evaluation*. Oxford University Press: New York. 483pp.
- Goovaerts, P., 1999. Geostatistics in soil science: state-of-the-art and perspectives. *Geoderma* 89, 1-45.
- Grayston, S.J., Vaughan, D. and Jones, D. 1996. Rhizosphere carbon flow in trees, in comparison with annual plants: the importance of root exudation and its impact on microbial activity and nutrient availability. *J Soil Ecol* 5, 29–56.
- Grayston, S.J., Wang, S., Campbell, C.D. and Edwards, A.C. 1997. Selective influence of plant species on microbial diversity in the rhizosphere. *Soil Biol Biochem* 30, 369-378.
- Grayston, S.J., Wang, S., Campbell, C.D. and Edwards, A.C. 1998. Selective influence of plant species on microbial diversity in the rhizosphere. *Soil Biol Biochem* 30, 369–378.
- Grayston, S.J., Campbell, C.D. and Bardgett, R.D. 2004. Assessing shifts in microbial community structure across a range of grasslands of differing management intensity using CLPP, PLFA and community DNA techniques. *J Soil Ecol* 25, 63–84.
- Griffiths, R.I., Whiteley, A.S., O'Donnell, A.G. and Bailey, M.J. 2000. Rapid method for coextraction of DNA and RNA from natural Environments for analysis of ribosomal DNA- and rRNA-based microbial community composition. *J Environ Micro* 66(12) 5488-5491.

H

- Hammond, R.F. 1978. *The Peatland Map of Ireland*. An Foras Taluntais, Dublin.
- Head, I.M., Hiorns, W.D., Embley, T.M., McCarthy, A.J. and Saunders, J.R. 1993. The phylogeny of autotrophic ammonia-oxidizing bacteria as determined by analysis of 16S ribosomal RNA gene sequences. *J. Gen.Microbiol.* 139, 1147–1153.
- Herlihy, M., McCarthy, J. and Brennan, D. 2006. Divergent Relationships of Phosphorous Soil Tests in Temperate Grassland Soils. *Commun. Soil Sci. Pla.* 37:693-705.
- Hill, G.T., Mitkowski, N.A., Aldrich-Wolfe, L., Emele, L.R., Jurkonie, D.D., Ficke, A., Maldonado-Ramirez, S., Lynch, S.T. and Nelson, E.B. 2000. Methods for assessing the composition and diversity of soil microbial communities. *J Soil Ecol* 15(1), 25-36.
- Hitzman, M.W., O'Connor, P., Shearley, E., Schaffalitzky, C., Beaty, D.W., Allan, J.R. and Thompson, T. 1992. Discovery and geology of the Lisheen Zn-Pb-Ag prospect, Rathdowney Trend, Ireland. In *The Irish Minerals Industry 1980-*

1990. Eds. Bowden, A.A., Earls, G., O'Connor, P.G. and Pyne, J.F. Irish Assoc. for Econ. Geol., Dublin.

Hornek, R., Pommerening-Roöser, A., Koops, H-P., Farnleitner, A.H., Kreuzinger, N. Kirschner, A., and Mach, P.L. 2006. Primers containing universal bases reduce multiple amoA gene specific DGGE band patterns when analysing the diversity of beta-ammonia oxidizers in the environment. *Journal of Microbiological Methods* 66, 147–155.

I

Ibekwe, A.M., Kennedy, A.C., Frohne, P.S., Papiernik, S.K., Yang, C-H. and Crowley, D.E. 2002 Microbial diversity along a transect of agronomic zones. *FEMS Microbiol Ecol* 39, 183–191.

Innes, L., Hobbs, P.J. and Bardgett, R.D. 2004. The impacts of individual plant species on rhizosphere microbial communities in soils of different fertility. *Biol Fertil Soil* 40, 7–13.

Isaaks, E.H., Srivastava, R.M., 1989. *Applied Geostatistics*. Oxford University Press: Oxford. 561pp.

J

Jobson, J.D., 1991. *Applied Multivariate Data Analysis*. Vol. I: Regression and Experimental Design. Springer-Verlag: New York.

Johnson, M.J., Lee, K.Y. and Scow, K.M. 2003. DNA fingerprinting reveals links among agricultural crops, soil properties and the composition of soil microbial communities.. *Geoderma* 114, 279-303.

Jordan, C., Higgins, A. and Hamill, A. and Cruickshank, J.G. 2002. *The Soil Geochemical Atlas of Northern Ireland*. Department of Agriculture and Rural Development, Belfast.

K

Kisand, V. and Wikner, J. 2003. Combining culture-dependent and -independent methodologies for estimation of richness of estuarine bacterioplankton consuming riverine dissolved organic matter. *J Environ Micro* 69(6), 3607-3616.

Koops, H-P., Böttcher, B., Möller, U.C., Pommerening-Röser, and Stehr, G. 1990. Description of a new species of *Nitrosococcus*. *Arch. Microbiol.* 154, 244–248.

Kovach, W.L. 1999. MVSP – A MultiVariate Statistical Package for Windows, ver. 3.1. Kovach Computing Services, Pentraeth, Wales, U.K.

Kozdroj, J. and Van Elsas, J.D. 2000. Response of the bacterial community to root exudates in soil polluted with heavy metal assessed by molecular and cultural approaches. *Soil Biol Biochem* 32, 1405-1417

Kuske, C.R., Barns, S.M. and Busch, J.D. 1997. Diverse uncultivated bacterial groups from soils of the arid southwestern United States that are present in many geographic regions. *J. Environ. Microbiol.* 63, 3614-3621.

Kuske, C.R., Banton, K.L., Adorada, D.L., Stark, P.C., Hill, K.K. and Jackson, P.J., 1998. Small-scale DNA sample preparation method for field PCR detection of microbial cells and spores in soil. *Appl Environ Microbiol* 64, 2463-2472.

L

LaMontagne, M.G., Michel, F.C., Holden, P.A. and Reddy, C.A. 2002. Evaluation of extraction and purification methods for obtaining PCR-amplifiable DNA from compost for microbial community analysis. *J Micro Meth* 49(3), 255-264.

LECO Corporation 2003 Organic Application Note: Total/Organic Carbon and Nitrogen in soils. LECO Corporation, MI, USA.

Lee, S.Y., Bollinger, J., Bezdicek, D., and Ogram, A.. 1996. Estimation of the abundance of an uncultured soil bacterial strain by a competitive quantitative PCR method. *J. Environ. Microbiol.* 62, 3787-3793.

Leff, L.G., Dana, J.R., McArthur, J.V. and Shimets, L.J. 1995. Comparison of methods of DNA extraction from stream sediments. *J Environ Micro* 61(3), 1141-1143.

Liesack, W., and Stackebrandt, E.. 1992. Occurrence of novel groups of the domain Bacteria as revealed by analysis of genetic material isolated from an Australian terrestrial Environment. *J. Bacteriol.* 174, 5072-5078.

Liljeroth, E., van Veen, J.A. and Miller, H.J. 1990. Assimilate translocation to the rhizosphere of two wheat lines and subsequent utilization by rhizosphere microorganisms at two soil nitrogen concentrations. *Soil Biol Biochem* 22, 1015-1021.

Liu, W., Marsh, T.L., Cheng, H. and Forney, L.J. 1997. Characterization of microbial diversity by determining terminal restriction fragment length polymorphisms of genes encoding 16S rRNA. *J Environ Microbiol* 63, 4516-4522.

Lockeretz, W., Shearer, G., and Kohl, D.H. 1981. Organic farming in the corn belt. *Science* 211, 540-547.

Lorenz, M.G. and Wackernagel, W. 1987. Adsorption of dna to sand and variable degradation rates of adsorbed DNA. *J Environ Micro* 53(12) 2948-2952.

Luna, G.M., Dell'Anno, A., Danovaro, R. 2005. DNA extraction procedure: a critical issue for bacterial assessment in marine sediments. *Environ Microbiol* 8(2), 308-320.

M

Maloney, P.E., van Bruggen, A.H.C. and Hu, S. 1997. Bacterial community structure in relation to the carbon Environments in lettuce and tomato rhizospheres and in bulk soil. *Microbiol Ecol* 34, 109-117.

Marschner, P., Yang, C-H., Lieberei, R. and Crowley, D.E. 2001. Soil and plant specific effects on bacterial community composition in the rhizosphere. *Soil Biol Biochem* 33, 1437-1445.

McCaig, A.E., Embley, T.M. and Prosser, J.I. 1994. Molecular analysis of enrichment

- cultures of marine ammonia oxidizers. *FEMS Microbiol. Lett.* 120, 363–368.
- McCaig, A.E., Glover, L.A. and Prosser, J.I. 1999. Molecular analysis of bacterial community structure and diversity in unimproved and improved upland grass pastures. *J Environ Micro* 65, 1721-1730.
- McConnell, B and Gately, S. 2006. Bedrock Geological Map of Ireland, Geological Survey of Ireland, Dublin.
- McDougald, D., Rice, S. A., Weichart, D., and Kjelleberg, S. 1998. Nonculturability: adaptation or debilitation. *FEMS Microbiol. Ecol.* 25, 1-9.
- McGrath, D. 1995. Organic micropollutant and trace element pollution of Irish soils. *Sci. Tot. Environ.* 164, 125-133.
- McGrath, D. 1996. Application of single and sequential procedures to polluted and unpolluted soils. *Sci. Tot. Environ.* 178, 37-44.
- McGrath, D. and McCormack, R.J. 1999. The significance of heavy metal and organic micropollutants in soils. Teagasc End of Project Report, Dublin.
- McGrath, D., Poole, D.B.R., Fleming, G.A. and Sinnott, J. 1982. Soil ingestion by grazing sheep. *Irish J. Agric. Res.* 21, 135-145.
- McGrath, D., Zhang, C.S., Carton, O.T., 2004. Geostatistical analyses and hazard assessment on soil lead in Silvermines area, Ireland. *Environmental Pollution* 127(2), 239-248.
- McGrath, S.P. and Loveland, P.J. 1992. The Soil Geochemical Atlas of England and Wales. Blackie Academic and Professional, Glasgow.
- McKenzie, R.M. 1967. The sorption of cobalt by manganese minerals in soils. *Aust. J. Res.* 8, 97-106.
- Menking, D.E., Emanuel, P.A., Valdes, J.J. and Kracke, S.K. 1999. Rapid cleanup of bacterial DNA from field samples. *Res Conser Recycl* 27(1-2), 179-186.
- Miethling, R., Wieland, G., Backhaus, H. and Tebbe, C.C. 2000. Variation of microbial rhizosphere communities in response to crop species, soil origin, and inoculation with *Sinorhizobium meliloti* L33. *Microbiol Ecol* 40, 43–56.
- Mobarry, B.K., Wagner, M., Urbain, V., Rittmann, B.E. and Stahl, D.A. 1996. Phylogenetic probes for analyzing abundance and spatial organization of nitrifying bacteria. *Appl. Environ. Microbiol.* 62, 2156–2162.
- More, M.I., Herrick, J.B., Silva, M.C., Ghiorse, W.C. and Madsen, E.L. 1994. Quantitative cell-lysis of indigenous microorganisms and rapid extraction of microbial dna from sediment. *J Environ Micro* 60(5), 1572-1580.
- Muyzer, G., de Waal, E. and Uitterlinden, A. 1993. Profiling of complex microbial populations by DGGE of PCR amplified genes coding for 16S rRNA. *J Environ Micro* 59, 695-700.

N

- Nannipieri, P., Ascher, J., Ceccherini, M.T., Landi, L., Pietramellara, G. and Renella, G. 2003. Microbial diversity and soil functions. *Eur J Soil Sci* 54, 655–670.

NASA, 2006. Shuttle Radar Topography Mission (SRTM): The Mission to Map the World. <http://www2.jpl.nasa.gov/srtm/index.html>; ftp website: <ftp://e0srp01u.ecs.nasa.gov/> (last date accessed: June 21, 2006).

Nielsen, M.N. and Winding, A. 2002. Microorganisms as indicators of soil health. National Environmental Research Institute, Denmark. Technical Report No. 388.

Norris, T.B., Wraith, J.M., Castenholz, R.W. and McDermott, T.R. 2002. Soil microbial community structure across a thermal gradient following a geothermal heating event. *J Environ Microbiol* 68, 6300–6309.

Nunan, N., Wu, K.J., Young, I.M., Crawford, J.W. and Ritz, K. 2003. Spatial distribution of bacterial communities and their relationships with the micro-architecture of soil. *FEMS Micro Ecol* 44(2) 203-215.

O

O'Donnell, A.G. and Gorres, H.E. 1999. 16S rDNA methods in soil Micro. *C Opin Biotech* 10(3) 225-229.

Ogram, A. 2000. Soil molecular microbial ecology at age 20: methodological challenges for the future. *Soil Biol Biochem* 32, 1499-1504.

O'Neill, P. 1990. Arsenic. In *Heavy Metals in Soils*. ed. B. Alloway, Blackie 83-99.

Ordnance Survey of Ireland 1962 Geological Map of Ireland, Dublin.

O'Riordan, E.G., Dodd, V.A., Tunney, H. and Fleming, G.A. 1986. The chemical composition of Irish sewage sludges. *Irish J.Agric. Res.* 25, 239-249.

Osborn, A.M., Moore, E.R.B. and Timmis, K.N. 2000. An evaluation of terminal-restriction fragment length polymorphism (T-RFLP) analysis for the study of microbial community structure and dynamics. *Environ Microbiol* 2, 39–50.

PQ

Pannatier, Y., 1996. *VARIOWIN: Software for Spatial Data Analysis in 2D*. Springer, New York, 91 pp.

Parle, P.J., Culleton, N. and Coulter, B.S. 1998. *Trace Elements in Irish Grassland*. Teagasc, 47pp.

Paterson, E., Towers, W., Bacon, J.R. and Jones, M. 2002. Background levels of contaminants in Scottish soils. Scottish Environment Protection Agency.

Peech, M. and English, L. 1944. Rapid microchemical soil tests. *Soil Science* 57, 16.

Peters, S., Koschinsky, S., Schwieger, F. and Tebbe, C.C. 2000. Succession of Microbial Communities during Hot Composting as Detected by PCR-Single-Strand-Conformation Polymorphism-Based Genetic Profiles of Small-Subunit rRNA Genes. *J Environ Micro* 66, 930-936.

Prosser, J.I. 1989. Autotrophic nitrification in bacteria. *Adv. Microb. Physiol.* 30, 125–181.

R

- Reaves, G.A. and Berrow, M.L. 1984. Total lead concentrations in Scottish soils. *Geoderma*, 32, 1 – 8.
- Reganold, J.P., Palmer A.S., Lockhart, J.S. and Macgregor, A.N. 1993. Soil quality and financial performance of biodynamic and conventional farms in New Zealand. *Science* 260, 344–349.
- Reilly, T. 1986. A review of vein mineralization in SW County Cork, Ireland. In *Geology and Genesis of Mineral deposits in Ireland*. Eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F. Irish Assoc. for Econ. Geol., Dublin.
- Reimann, C., and Filzmoser, P., 2000. Normal and lognormal data distribution in geochemistry: death of a myth. Consequences for the statistical treatment of geochemical and environmental data. *Environmental Geology* 39(9), 1001-1014.
- Robe, P., Nalin, R., Capellano, C., Vogel, T.M. and Simonet, P. 2003. Extraction of DNA from soil. *European J of Soil Biol* 39,183-190.
- Roberts, A.H.C., Longhurst, R.X.D. and Brown, M.W. 1994. Cadmium status of soils, plants and grazing animals in New-Zealand. *New Zealand J. Agric. Res.* 37, 119-129.
- Rölleke, S., Muyzer, G., Wawer, C., Wanner, G. and Lubitz W. 1996. Identification of bacteria in a biodegraded wall painting by denaturing gradient gel electrophoresis of PCR-amplified gene fragments coding for 16S rRNA. *J Environ Micro* 62, 2059-2065.
- Roose-Amsaleg, C.L., Garnier-Sillam, E. and Harry, M. 2001. Extraction and purification of microbial DNA from soil and sediment samples. *J Soil Ecol* 18(1), 47-60.
- Rovira, A.D. 1959. Root excretion in relation to the rhizosphere effect – IV Influence of plant species, age of plant, light, temperature, and calcium nutrition on exudation. *Plant Soil* 11, 53–64.

S

- Saitou, N. and Nei, M. 1987. The neighbor-joining method: a new method for reconstructing phylogenetic trees. *Mol Biol Evol* 4, 406–425.
- Sandaa, R-A., Enger, Ø. and Torsvik, V. 1998. Rapid method for fluorometric quantification of DNA in soil. *Soil Biol Biochem* 30, 265-268
- Schloss, P.D. and Handelsman, J. 2003. Biotechnological prospects from metagenomics. *Current Opinion in Biotechnology* 14, 303-310.
- Schwartz, K. and Foltz, C.M. 1957. Selenium as an integral part of Factor 3 against dietary necrotic liver degeneration. *J. Am. Chem. Soc.* 79: 3292-3293.
- Scow, K.M., Bruns, M.A., Graham, K., Bossio, D. and Schwartz, E. 1998. Development of indices of microbial community structure for soil quality assessment. *Soil Quality in the California Environment*, Zabel, A. and Sposito,

- G., eds, pp. 110–123. Kearny Foundation of Soil Science Annual Report of Research Projects 1997–1998.
- Smit, E., Leeftang, P. and Wernars, K. 1997. Detection of shifts in microbial community structure and diversity in soil caused by copper contamination using amplified ribosomal DNA restriction analysis. *FEMS Micro Ecol* 23(3), 249–261.
- Smit, E., Leeftang, P., Gommans, S., van den Broek, J., van Mil, S. and Wernars, K. 2001. Diversity and seasonal fluctuations of the dominant members of the bacterial soil community in a wheat field as determined by cultivation and molecular methods. *J Environ Microbiol* 67, 2284–2291.
- Statutory Instrument No. 378 of 2006. European Communities (Good Agricultural Practice for Protection of Waters) Regulations. The Stationery Office, Dublin, 49pp.
- Stein, A., Brouwer, J., Bouma, J., 1997. Methods for comparing spatial variability patterns of millet yield and soil data. *Soil Sci. Soc. Am. J.* 61, 861–870.
- Steinnes, E., Hvatum, O. Ø., Bølviken, and Varskog, P. 2005. Atmospheric Pollutants and Trace Gases. Atmospheric Supply of Trace Elements Studied by Peat Samples from Ombrotrophic Bogs. *Journal of Environmental Quality* 34, 192 – 197.
- Stephen JR., McCaig A.E., Smith Z., Prosser J.I. and Embley. T.M. 1996. Molecular diversity of soil and marine 16S rDNA sequences related to β -subgroup ammonia-oxidizing bacteria. *Appl. Environ. Microbiol.* 62:4147–4154.
- Stephen, J.R., Kowalchuk, G.A., Bruns, M-A.V., McCaig, A.E., Phillips, C.J., Embley, T.M. and Prosser, J.I. 1998. Analysis of β -subgroup proteobacterial ammonia oxidiser populations in soil by denaturing gradient gel electrophoresis and hierarchical phylogenetic profiling. *Appl Environ Microbiol* 65, 95–100.
- Suzuki, M., Rappe, M.S. and Giovannoni, S.J. 1998. Kinetic bias in estimates of coastal picoplankton community structure obtained by measurements of small-subunit rRNA gene PCR amplicon length heterogeneity. *Appl Environ Microbiol* 64, 4522–4529.
- Suzuki, M.T. and Giovannoni, S.J. 1996. Bias caused by template annealing in the amplification of mixtures of 16S rRNA genes by PCR. *Appl Environ Microbiol* 62, 625–630.
- Swofford, D.L. 1996. PAUP*: Phylogenetic analysis using parsimony (* and other methods). Version 4.0. Sinauer Associates, Sunderland, Massachusetts, 1998.
- Synge, F.M. 1979. Quaternary glaciation in Ireland. In: *Prospecting in areas of glaciated terrain*, Ed. Jones, M.J. I.M.M. London.

T

- Tack, F.M.G., Verloo, M.G., Vanmechalen, L. and Van Ranst, E. 1997. Baseline concentration levels of trace elements as a function of clay and organic carbon contents in soils in Flanders (Belgium). *Sci. Tot. Environ.* 201, 113–123.

- Talbot, V. and Max, M.D. 1984. Application of various geophysical exploration techniques to Cu and Mo mineralisation in Galway granite. *Trans. Inst. Min. Metall.* 93B, 779-788.
- Talbot, V. and Ryan, P. 1988a. High molybdenum land values in Ireland: possible implications. *Sci. Total Environ.* 76, 217-228.
- Talbot, V. and Ryan, P. 1988b. Hydromorphic dispersion of Cu and Mo over mineralized granodiorite in a high rainfall area in Ireland: geochemical interpretation and case history. *J. Geochem. Explor.* 30, 209-220.
- ter Braak, C. J. F. and Verdonschot, P. F. M. 1995. Canonical correspondence analysis and related multivariate methods in aquatic ecology. *Aquatic Sciences*, 57, 255-289.
- Thompson, J.D., Gibson, T.J., Plewniak, F., Jeanmougin, F. and Higgins, D.G. 1997. The ClustalX windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Research* 24, 4876-4882.
- Tiedje, J.M., Asuming-Brempong, S., Nüsslein, K., Marsh, T.L. and Flynn S.J. 1999. Opening the black box of soil microbial diversity. *J Soil Ecol* 13, 109-122.
- Tobias, F.J., Bech, J. and Sanchez Algarra 1997. Establishment of the background levels of some trace elements in soils of NE Spain with probability plots. *Sci. Tot. Environ.* 206, 255-265.
- Torsvik, V.L. 1980. Isolation of bacterial DNA from soil. *Soil Biol Biochem* 12, 15-21.
- Torsvik, V. and Øvreås, L. 2002. Microbial diversity and function in soil: from genes to ecosystems. *Curr Opin Microbiol* 5, 240-245.
- Torsvik, V., Sørheim, R., and Goksøyr, J. 1996. Total bacterial diversity in soil and sediment communities—a review. *J. Ind. Microbiol.* 17, 170-178.

U

- Ulrich, A. and Becker, R. 2006. Soil parent material is a key determinant of the bacterial community structure in arable soils. *FEMS Micro Ecol* 56(3) 430-443.
- United States Department of Agriculture 1960. Soil Classification – A Comprehensive System (7th Approximation). Soil Survey Staff, Soil Conservation Service, USDA, Washington 25, DC.
- Ure, A.M. and Berrow, M. L. 1982. The elemental constituents of soils. In *Environmental Chemistry*. Vol. 2. Pub. R.S.C., London 188-191.
- Utåker, J.B., Bakken, L., Jiang, Q.Q. and Nes, I.F. 1995. Phylogenetic analysis of seven new isolates of ammonia-oxidising bacteria based on 16S rRNA gene sequences. *Syst. Appl. Microbiol.* 18, 549 – 559.

V

- Vinogradov, A.P. 1959. The geochemistry of rare and dispersed chemical elements in soils. 2nd Ed., Consultants Bureau, New York, 209 pp.

Vistelius, A.B., 1960. The skew frequency distributions and the fundamental law of the geochemical processes: *Journal of Geology* 68, 1-22.

W

Walkley, A. and Black, I.A. 1934. An examination of the Degtjareff method for determining soil organic matter, and proposed modification of the chromic acid titration method. *Soil Science* 37, 29 – 38.

Walsh, T. and Fleming G.A. 1952. Selenium levels in rocks, soils and herbage from a high selenium locality in Ireland. *Trans. Intern. Soc. Soil Sci. Comm.* 11. and 1V, Dublin 2, 178-183.

Walsh, T., Fleming, G.A., Kavanagh, T. J. and Ryan, P. 1952. The cobalt status of Irish soils and pasture in relation to pining in sheep and cattle. *J.Dept. Agric. (Ireland)* 52, 1-62.

Walsh, T., Fleming, G.A., O'Connor, R. and Sweeney, A. 1951. Selenium toxicity associated with an Irish Soil Series. *Nature* 168, 881.

Webster, G, Embley, T.M. and Prosser, J.I. 2002. Grassland Management Regimens Reduce Small-Scale Heterogeneity and Species Diversity of β -Proteobacterial Ammonia Oxidizer Populations Applied and Environmental Microbiology, 68(1), 20–30.

Webster, R., 1994. The development of Pedometrics. *Geoderma* 62, 1-15.

Webster, R. and Oliver, M.A. 2001. *Geostatistics for Environmental Scientists*. John Wiley & Sons: Chichester, 271pp.

Wedepohl, F.H. 1979. *Handbook of Geochemistry*. 2. 3/25. Pub. Springer-Verlag, Berlin.

Westover, K.M., Kennedy, A.C. and Kelley, S.E. 1997. Patterns of rhizosphere microbial community structure associated with co-occurring plant species. *J Ecol* 85, 863–873.

World Reference Base for Soil Resources 2006. A framework for international classification, correlation and communication. *World Soil Resources Report* 105, ISSN 0532-0488.

Wright, A.F. and Bailey, J.S. 2001. Organic carbon, total carbon and total nitrogen determination in soils of variable calcium carbonate contents using a LECO CN-2000 dry combustion analyser. *Commun. Soil Sci. Plant Anal.* 32(19&20), 3243 – 3258.

XYZ

Zhang, C.S., and Zhang, S. 1996. A robust-symmetric mean: A new way of mean calculation for environmental data. *GeoJournal* 40(1-2), 209-212.

Zhang, C.S., and Selinus, O., 1998. Statistics and GIS in environmental geochemistry: some problems and solutions. *Journal of Geochemical Exploration* 64: 339-354.

- Zhang, C.S., Selinus, O. & Wong, P. 2000. Spatial structures of cobalt, lead, and zinc contents in tills in southeastern Sweden. *GFF (Transactions of the Geological Society in Stockholm)*, Vol. 122 (Pt. 2, June), pp. 213-217.
- Zhang, C.S., Manheim, F.T., Hinde, J., and Grossman, J.N. 2005. Statistical characterization of a large geochemical database and effect of sample size. *Applied Geochemistry* 20, 1857–1874.
- Zhang, C.S., 2006. Using multivariate analyses and GIS to identify pollutants and their spatial patterns in urban soils in Galway, Ireland. *Environmental Pollution* 142(3):501-511.
- Zhou, J., Burns, M.A. and Tiedje, J.M. 1996. DNA recovery from soils of diverse composition. *Appl Environ Microbiol* 62, 316-322
- Zhou, J., Xia, B., Huang, H., Palumbo, A.V. and Tiedje, J.M. 2004. Microbial diversity and heterogeneity in sandy subsurface soils. *J Environ Microbiol* 70, 1723–1734.