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# Australiani SOI CIUD

#### Welcome

The main articles in this issue are:

- Soils are Alive: on-line book about soil biology for anyone interested in the living aspects of soil
- Scientific research summaries

#### FEATURED WEBSITES

#### www.soilquality.org.au

This website provides a range of pdf articles, presentations, fact sheets and various web calculators related to soil properties (chemical, physical and biological) of Western Australian soils.

The website has recently added a new "traffic light" system that provides an overview of soil-related issues on a local and regional basis.

The application of critical values to each soil quality indicator allows for simple interpretation of a dataset, and implies the need for management action or not. Recent funding from the Grains Research and Development Corporation will allow national expansion of the website to include datasets from across Australia.

#### www.soilhealthknowledge.com. au

This Australian Government website is designed for farmers and industry where soil health knowledge and tools for assessing soil condition is needed.

The website provides access to information about many aspects of soil properties and includes interesting case studies related to management practices.

For further information about the Australian Soil Club, contact: Professor Lyn Abbott School of Earth and Environment The University of Western Australia Crawley, WA 6009 Australia Email: Lynette.Abbott@uwa.edu.au

### **Soil Health Self-Assessment Tool**

Visit http://www.soil.org.au/ to complete the Questionnaire.

This soil management questionnaire is built on the Farming for the Future: Self-assessment Tool (SAT) Bulletin 4694 developed by the Department of Agriculture and Food, Western Australia (October 2006). The SAT tool is available at http://www.agric.wa.gov.au/objtwr/imported\_assets/content/fm/bulletin2006\_f4f\_sat.pdf

The Farming for the Future: Self-assessment Tool (SAT) includes a list of recommended practices associated with sustainable primary production. The questionnaire based on the SAT Tool was in part funded by the Australian Government's Caring for our Country program through the project 'A broadacre approach to certification of sustainable farm practice'.

The emphasis of questionnaire concerns on-farm agricultural management practices that relate to balancing the physical, chemical and biological components of soil fertility for improving soil conditions and soil health.

The website **www.soilhealth.com** serves as a reference guide for landowners, researchers, consultants and any others interested in soil and land. It aims to provide introductory information about soil biological processes, organic matter, soil organisms, and the soil management practices that affect them.

### Soils are Alive

The on-line book **Soils are Alive** is now available for viewing on the website **www.soilhealth.com** 

The sections covered in the book are:

- PART 1: WHAT IS IN SOIL AND WHAT DOES IT DO?
- PART 2: HOW DO SOIL ORGANISMS AFFECT SOIL?
- PART 3: HOW DO SOIL ORGANISMS AFFECT PLANTS?
- PART 4: WHAT AFFECTS SOIL ORGANISMS?
- PART 5: HOW DO SOIL ORGANISMS INTERACT WITH EACH OTHER?
- PART 6: WHAT ARE THE OPTIONS FOR MANAGING SOIL ORGANISMS?
- PART 7: HOW IS KNOWLEDGE OF SOIL ORGANISMS RELEVANT TO SUSTAINABLE LAND MANAGEMENT?

# www.soil.org.au

# Can earthworms alter soil carbon sinks?

Research reported here is by Filley and others, and is from a commentary provided by K Sanderson in Nature News online 28th August 2007

Performed in Maryland USA, this study showed that earthworms in tulip poplar forest preferred certain types of leaf litter, with a resulting change in soil chemistry. Earthworms preferred to eat the biopolymer cutin present in leaves instead of lignin present in stems in litter. Cutin is a waxy material.

In North America, introduced earthworm species are spreading. The authors of this study speculate that this process may impact on the amount of carbon in soil, in particular through increased release of  $CO_2$ .

A later study by Addison (2009) provides detail about the spread of European species of earthworm in Canada. At the end of the last ice age, there were only 8 native species of earthworm present in Canada, all with limited geographical range. Now there are an additional 19 species are present in Canada, and several of these additional species occur widely.

Previously, studies in forest soils in Minnesota and New York State, USA, indicated that invasive earthworms substantially reduce soil carbon storage. The hypothesis underlying this effect is that global warming is likely to increase winter temperatures, thereby expanding the suitability of many soils in North America for introduced earthworms.

#### References:

Filley TR, Boutton TW, Liao JD, Jastrow JD & Gamblin DE (2008) Chemical changes to non-aggregated particulate soil organic matter following grassland-to-woodland transition in a subtropical savanna. *Journal of Geophysical Research, Biogeosciences*. 113, Co3009, doi:10:1029.2007/JG000564

Addison JA (2009) Distribution and impacts fo invasive earthworms in Canadian forest ecosystems. *Biological Invasions* 11: 59-79



Visit the Soil Health website at www.soilhealth.com

### **Charles Darwin and Earthworms**

You probably know that 2009 was the bicentenary of the birth of Charles Darwin. Although famous for formulating the mechanism of evolution of species (natural selection), Darwin also contributed to numerous other parts of biological knowledge. One of these was dispelling the popular idea of the 1800's that earthworms are pests of the soil.

Darwin overturned this incorrect idea and demonstrated the beneficial role of earthworms in turning over the soil and mixing its components. He showed their role in improving soil fertility. He was very interested in agriculture and spent many hours discussing this topic with his relatives who farmed land nearby. He watched carefully the activities of earthworms in incorporating layers of burnt lime into soil by the activities of earthworms. The earthworms brought soil to the surface and gradually buried the burnt lime that had been applied at the surface. The burnt lime gradually sank below the soil surface in an undisturbed visible band.

Darwin published the results of his seminal investigations in the last book he wrote which was called: **The Formation of Vegetable** *Mould, through the Action of Worms, with Observations on their Habits.* The book was published one year before he died in 1882.

Darwin's 'earthworm' book has been reprinted many times, although seldom as a facsimile.

Darwin's book is still worth reading today, although it should be remembered that he worked mainly with the species of earthworm found in his backyard at Down House, in Kent, south of London. The book can be found on the internet.

#### Reference:

Darwin, C. (1881) Formation of Vegetable Mould through the Action of Worms with Observations. Publisher: John Murray, London

# Impact of land use on soil chemical and physical properties

Research on this topic was conducted by Golchin and Asgari and published in the Australian Journal of Soil Research, 46: 27036 (2008)

This study examined the conversation of forest grassland soils to agricultural soils in NE Iran, and how this transformation affected various chemical and physical properties of the surface soil, Paired sites, matched for slope, parent material and physical aspect, were used.

As expected, organic carbon and nitrogen concentrations decreased with cultivation. This reflected the reduced return of plant residues (leaf litter). Bulk density and dispersible clays increased in the cultivated soils, indicating lower structural stability. The link between chemical and physical components is that carbon (as organic matter) stabilises soil aggregates against slaking and reduces clay dispersion through binding soil particles.

Retention of soil carbon at high levels is therefore indispensible to the sustainable management of agricultural soils. The authors suggest that farmyard manure or green manure used with conservation tillage practices should help minimize breakdown of soil aggregates and excessive disturbance of soils.

#### Reference:

Golchin A & Asgari H (2008) Impact of land use on soil chemical and physical properties. *Australian Journal of Soil Research* 46: 27-36.

# Soil carbon, uncertainty, and predicting the future CO<sub>2</sub> levels in the atmosphere

Research on this topic was conducted by Trumbore & Czimczik and published in Science, 321: 1455-6 (2008)

This brief 'perspectives' paper discusses how quickly the large amount of carbon stored in soil as organic matter (SOM) will respond to global warming. Consideration of this topic is hindered by an inadequate understanding of the processes that destabilize SOM following disturbance. Rates of decomposition of litter are influenced by chemical content of litter, the types of soil animals and microbes present, and climate. In contrast, over geological time, carbon accumulates slowly with weathering of rock.

The influence of temperature on decomposition rates of litter cannot at present be separated clearly from the direct influence of temperature on soil fauna and microbes, the composition of these ecological communities, the rate of abscission of leaves, as well as changes in fire frequency, intensity and timing.

The authors advocate cross-disciplinary studies of soil that integrate experimental research by soil physicists, chemists, and biologists. The desired outcome is improved conceptual and mathematical models that work at the scale of the both the root and landscape. Reference:

eference:

Trumbore SE & Czimczik CI (2008) Soil carbon, uncertainty, and predicting future CO<sub>2</sub> levels in the atmosphere. *Science* 321: 1455-1456

#### **19th World Congress of Soil Science** will be held in Brisbane, 1st to 6th August 2010

Details of this Congress are available on the official WCSS website: www.19wcss.org.au

The congress is presented by the International Union of Soil Sciences, and is held every 4 years. As explained on this website, it presents a global forum for soil science researchers, academics, and professionals to meet and discuss issues of importance to all aspects of soil, land and water.

The conference theme is Soil Solutions for a Changing World.

# www.soil.org.au

# Biodiversity and the functioning of ecosystems

It has often been debated whether each species present in an ecosystem is essential for effective functioning of that ecosystem. The extreme view is that redundancy is common, and that the loss of some species should not have any prominent effect on the working of an ecosystem. According to this this viewpoint, a process influenced by a deleted (locally extinct) species is taken over by another species.

A paper published in Nature 448: 188-190 (2007) (authored by A Hector & R Bagchi) has challenged this view, based on experiments conducted in pasture in Europe in a study called Project BIODEPTH. This study examined 7 ecosystem processes or properties: (i) wood decomposition, (ii) light at ground level, (iii) belowground biomass, (iv) unconsumed soil N, (v) above-ground N pool, (vi) cotton decomposition, and (vii) above-ground biomass.

The study found, after a complex statistical analysis, that the 7 ecosystem processes were not affected by exactly the same species. Because different species affect different processes, maintaining 'mutifunctional' ecosystems requires greater diversity than was previously suggested by studies that examined single ecosystem processes in isolation.

These findings lend support to a popular viewpoint known as the 'insurance' hypothesis. This hypothesis states that.... "biodiversity has an insurance value through buffering processes at the ecosystem-level in a way similar to a diverse investment portfolio, in which financial risk is spread and average performance is improved in the long (instead of short) term."

The practical message from this study is that it is prudent for a land manager to retain as many species as possible. As most species in farmland will occur in the soil, therefore, the quality of the soil is paramount in maintaining biodiversity.

Reference:

Hector A & Bagchi R (2007) Biodiversity and ecosystem multifunctionality. *Nature* 448: 188-190

## Putting a monetary value on the contribution of soil biodiversity to society

Recent estimates of the economic value of ecological services provided by soil biota have been summarized by Brussard and his colleagues.

The potential value globally is about \$US 1,500, 000, 000, 000 (i.e. \$ US 1.5 trillion). This immense quantity includes:

recycling of organic wastes
 (~\$US 760 billion),
bio-remediation of polluted soils and water
 (~\$US 121 billion),
 and
 nitrogen fixation by micro-organisms
 (~\$US 90 billion).

These monetary values may have seemed unimaginable in 2007. However, the current global financial crisis has familiarized all of us with billions and trillions (in \$US) as part of the various economic stimulus programs that have been put into place by governments around the world.

Reference:

Brussaard L, dr Ruiter PC and Brown GG. (2007) Soil biodiversity for agricultural sustainability. Agriculture, *Ecosystems and Environment* 121: 233-244.

### If you are a land manager, you are invited to complete the questionnaire about soil health on the website www.soil.org.au

This self assessment tool was developed using the NATURAL RESOURCES & PRODUCTION SUSTAINABILITY CRITERIA and sub-criteria linked to soil fertility component of the Farming for the Future Self-Assessment Tool, developed by the Department of Agriculture and Food, Western Australia. http://www.agric.wa.gov.au/objtwr/imported\_assets/content/fm/bulletin2006\_f4f\_sat.pdf

A) Biodiversity and landscape features: Native vegetation and wildlife protection and enhancement, soil and land management, fertility management and sodic soil management.B) Water management: (surface water, groundwater, acidity, salinity).

ASC Mission Statement To provide information about soil that is relevant to all land users.