

Biological Diversity and Ecosystem Function in Soil

Soil Biodiversity

NERC Thematic Programme



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First *in situ* $^{13}\text{CO}_2$ pulse experiments: SID blows gas at the grass



A transect of pulse chambers running down the Rigg Foot slope

In late August the stable isotope delivery laboratory (SID) was installed alongside the verdant Sourhope plots, under the curious gaze of the largest herd of angora goats in Europe. Unperturbed, a hearty troupe of hose-charmers released 3 km of gas lines onto the mountainside, hooked-up the on-line CO_2 analysis system and installed a dozen isotope pulse-chambers into the pilot study area. The mobile generator chugged dutifully into action.

We wanted to determine the fate and turnover of

plant derived C in a number of soil-plant organic matter pools and soil/plant respired CO_2 using an *in situ* $^{13}\text{CO}_2$ pulse. On this maiden experiment SID pumped fresh Scots air through a hi-flow 'scrub and mix' system that removed ambient CO_2 and instantaneously replaced it with ^{13}C labelled CO_2 . A pulse of 50 atom % ^{13}C labelled CO_2 at 360 ppm was then directed to all 12 chambers at a rate of 2-5 litres minute⁻¹. Approximately 200,000 litres of air were ruthlessly displaced in 48 hours.



Dr Patricia Bruneau (Sterling University) and Dr Maria Briones (Vigo University, Spain) investigating the soil profile

Macrofauna, soil and plant matter were sampled 4 times over a period of 6 weeks after the initial tracer pulse. Collaborative research teams worked in parallel on aspects of C flux through mycorrhizae (David Johnson, Sheffield) and soil microbial biomass fractions (Amy Treonis, MLURI). One aspect of the study involved an evaluation of the effects of shoot herbivory on short-term soil C turnover. Unfortunately for the goats herbivory was simulated by manual cutting and clippings were removed for isotope analyses at the NERC Stable Isotope Facility (ITE-Merlewood).

So, now we chase the hare.....

Nick Ostle, ITE Merlewood.

Website: <http://www.nmw.ac.uk/soilbio>

RECENT AWARDS

The following small grant awards have been given by the programme.

- 2642** Dr A Meharg University of Aberdeen (with Dr Mark Toal, CEH Monks Wood) £35k
Title: Towards a quantitative analysis of food-web structure and function at the ecosystem scale
- 2645** Dr H Black CEH Merlewood, Grange-over-Sands £35k
Title: Diversity and functional activity of *Enchytraeidae* in an upland pasture

STATISTICAL ADVISER APPOINTMENT

Applicants were interviewed in London on July 19th. The panel recommended the appointment of Biomathematics & Statistics Scotland (BioSS). Its lead adviser is David Elston, head of the Environmental Modelling Unit based at the Macaulay Land Use Research Institute in Aberdeen. He will be able to call on other experts in BioSS for specialist advice on particular methodologies.

Statistical advice will be allocated within a fixed

quota to PIs and other researchers within the Programme, although PIs will be able to make a case for additional time if required. Award holders will be asked to demonstrate the source of the statistical advice they have used in the course of their work. Requests for advice should be made to the Programme Office. The Data and Modelling Subcommittee will oversee activities and direct policy.

A short report from the ISOTOPES MASTERCLASS - July 1999

The first of the Masterclasses linked to the Programme, the Application of Isotopic Techniques in Soil Ecology, was held at ITE Merlewood 30 June to 2 July. 18 attendees, representing 11 of the



Mark Bradford, participant on the Isotopes Masterclass held at ITE Merlewood.

projects within the Programme and the linked US project survived an intensive 3 days that included a programme of lectures and practicals. The panel of tutors comprised Prof. Howard Griffiths and Prof. Nick Owens (University of Newcastle), Dr Richard Evershed (NERC Isotope Geochemistry



Tania Streeter and Amy Treonis working in the practical workshop

Unit, University of Bristol), Dr Andy McDonald (IACR Rothamsted), Dr Declan Barraclough (EA), and Dr Phil Ineson and Chris Quarmby (ITE Merlewood). Prof Mike Hornung, Programme Science Co-ordinator, acted as ring master. The practicals revealed the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signatures of participants hair, showed litter preferences of Collembola and demonstrated a rapid method for screening for methanotrophs. Results from the first of these studies revealed that some course members consume a very strange diet. In addition to providing training to those attending, the course helped develop links between the groups involved in the Soil Biodiversity Programme and spawn new ideas for collaborative work.

It is hoped that the next Masterclass will be held in Spring 2000 and will focus on aspects of bioinformatics, with the emphasis on the taxonomy of soil invertebrates.

Mike Hornung, ITE Merlewood



Sam Sheppard, Martin Krsek and Rob Griffiths talk to Alision Greenup.

ANNUAL AWARD HOLDERS MEETING

Grange-over-Sands, 9th to 11th November 1999

Over eighty people attended the annual meeting at the Grange Hotel. Sessions were structured to bring related projects together, with contributions from the facilities attached to the Programme, the site manager, Ecotron team leader, consultant statistician and the modelling initiative team. Colleagues were squeezed into the main meeting room, so there was no problem in encouraging contact.

A large proportion of the PhD students and PDRAs attended, giving them the chance to meet up early in their work. Kerry Flanagan of Unilever Research lead an evening discussion on career prospects. Alastair Fitter of the University of York and Mike Hornung of CEH, giving the university and research scientist's points of view. While there were common threads for individual success, the goals of the organisations were quite different.

Programme Chairman Michael Usher looked at the way forward beyond the present funding phase. He indicated that funding will be available to



Award holders from IFE, (right to left) Bland Finlay, Geneveva Esteban, Ruth Hindle and Jose Olmo.

anyone, but that the steering Committee may suggest areas where applications would be most welcomed. Kay Fox of Unilever then directed PI's thoughts to ways in which the work of the Programme could extend into the user community. Breakout meetings were held on sampling, background data and molecular techniques. A lot of very valuable discussion resulted and the participants look forward to next year's meeting, to be held on 8th and 9th Nov in the English midlands, possibly at Warwick.

Richard Scott, Programme Manager

THE USA SOIL BIODIVERSITY PROGRAMME REPORTS

We have concentrated on analysing the samples we brought in from Konza in May. Peter Mullin has tentatively identified 241 morphospecies of nematodes from the collection site so far. Considering the samples came from six plant species and a small area, that's a remarkable number of species. Dorota Porazinska and Pilar Tillberg carried out the enumeration and identification of nematodes at the trophic group level.

Steve Blecker has carried out the following analyses on subsamples of soil. Microbial biomass extractions and analysis for C and N. C and N mineralization study over a 28 day incubation period, measuring respired CO₂ at intervals throughout the study and N at the beginning and end of the study. Loss-On-Ignition to estimate organic matter. Dry combustion with an elemental analyzer to determine C and N. Texture analysis using the hydrometer method.

Nicole DeCrappeo has carried out preliminary sampling for entomopathogenic nematodes on 1, 4, and 20 year burned plots from Konza. Isolation of nematodes from these samples is in progress.

Mark St. John attended the "Acarology Summer Program" at Ohio State University in August to learn more about mite life histories, systematics and identification. He is presently working on sorting mites and Collembola to major taxonomic groups

and producing slides for species identifications.

Heather Reed and Tim Seastedt are leading the study of diversity effects on decomposition. A year ago five plots were set up in systems of relatively high plant diversity and another five in low plant diversity systems. Surface foliage litter showed significantly greater decomposition on higher diverse plots. Rain out shelters had no significant effect on decomposition, however, a significant interaction was found between "drought" and level of diversity for wood dowel decomposition.

Bill Hunt writes about the modeling progress: My strategy has been to update our (1987) detrital food web model (Biol. Fert. Soils 3:57-68) by

- converting from an N budget to a dynamic model by including equations for plant growth, trophic transfers, and mineralization
- including both C and N cycling with variable C/N ratios, and
- using optimization to estimate parameters necessary to fit the model to data.

Then we used the model to examine the concepts of keystone species (rather, keystone functional groups) and redundancy. Most groups were non-keystone, and several were redundant.

Andy Parsons, NREL, Colorado State University

COLLABORATION AROUND THE GLOBE

I had the opportunity in early October of visiting the University of Jyväskylä, Finland, and meeting Professor Veikko Huhta, Dr Jari Haimi and Dr Heikki Setälä. The soils biodiversity work is focused on forest ecosystems, vitally important in Finland both economically and for nature conservation.

One new study that we discussed is focused on the community structure in the soil of birch stands within the forest biome. All of these stands have been planted, some on clear-felled areas of coniferous forest and others on abandoned agricultural fields. The main focus of the research is on the functional relationships of the soil biota. I also saw some preliminary microcosm results that have addressed the age-old question of why there are so many species in the soil and whether they all matter. Measuring CO₂ production in relation to the number of fungal species present, there was an increase from 1-3 species, and then no further

increase as more species were added, up to a total of nearly 50. Similarly, looking at the number of microarthropod species, there was an increase in the rate of decomposition until there were a few species (in the range 6-10) and then no significant increase as more were added up to over 40. What does this tell us about species richness in the soil and the requirement for only a handful of species if organic matter decomposition and cycling of nutrients are to achieve their maximal rates? These are certainly some interesting preliminary studies.

The contact for anyone interested is the Department of Biological and Environmental Science, University of Jyväskylä, Box 35, FIN-40351 Jyväskylä. Heikka Setälä has already analysed the enchytraeid worms in the Sourhope soil, finding the densest population of about 200,000 m⁻² that he has ever encountered. It looks as if the Sourhope soil is going to pose some interesting international comparisons.

Michael B Usher, Scottish Natural Heritage

DATA MANAGEMENT POLICY

A data policy has been drawn up which incorporates the requirements of the NERC for data management and access for its Thematic Programmes. Baseline data on soils, vegetation and meteorological variables from the Sourhope field site have been made openly available on the WWW, subject to conditions of use. Access to other datasets may require authorisation by data originators and release under licence.



Mark Toal and Bill Hunt at the Award Holders Meeting

FINAL BID CALL IN 2001

Steering Committee has decided to make the call for the second main round of funding in early 2001, to allow for a tranche of two year awards beginning in January 2002 to December 2003. The Programme will have over £1million remaining to disburse. It is not anticipated that any further PhD studentships will be funded, but it is hoped that PhDs and existing PDRAs may progress their careers within the Programme.

DATES FOR THE DIARY

SETAC World Congress - 21-25 May 2000, Brighton, UK.

"Global Environmental Issues in the 21st Century: Problems, Causes and Solutions"

3RD AWARD HOLDERS MEETING

8th and 9th November 2000

Venue to be confirmed (Midlands area)

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