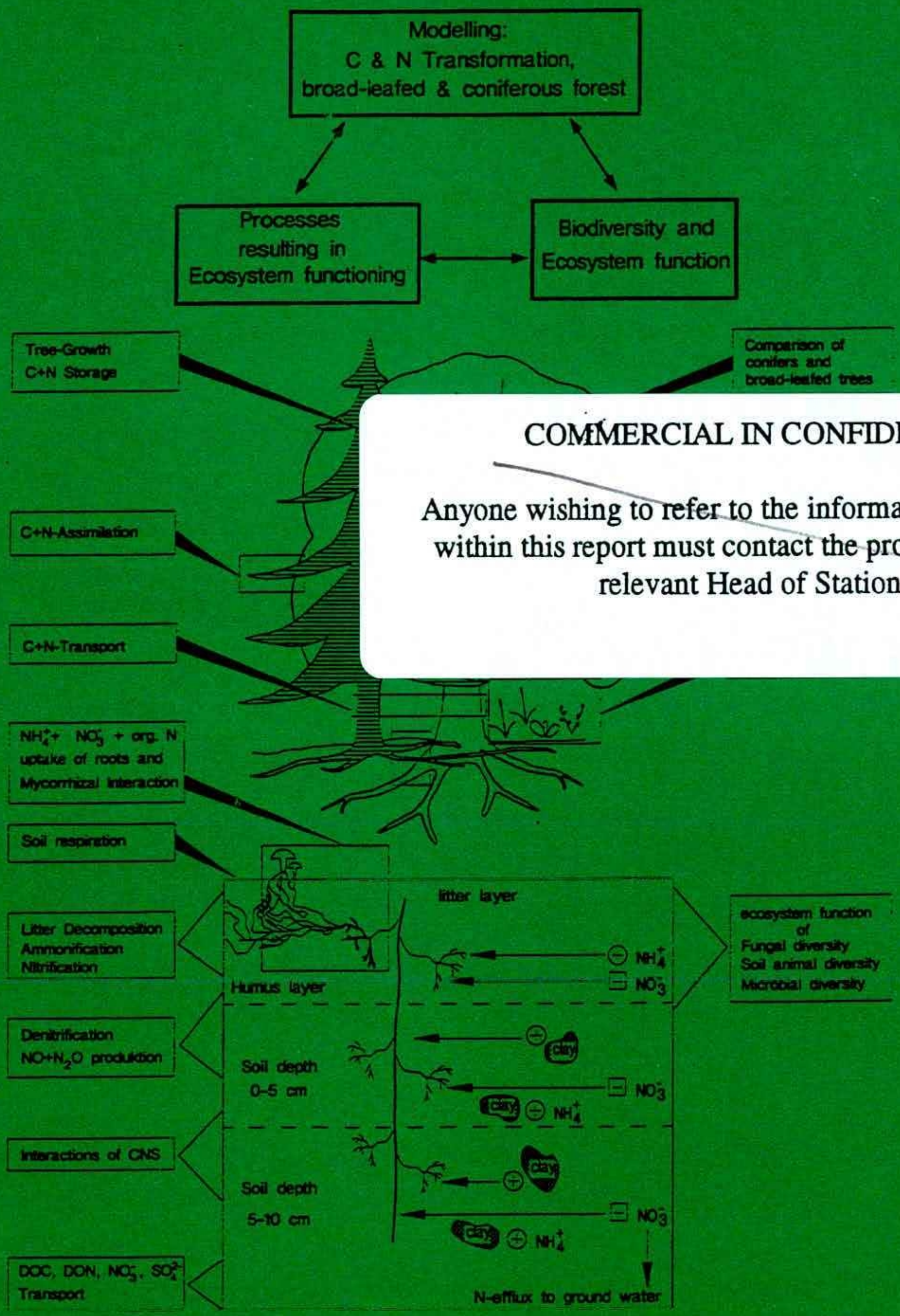
CANIF - Carbon and Nitrogen Cycling in Forest ecosystems

Annual Report
1.2.1997 - 31.1.1998

EEC contract No ENV4-CT95-0053
and
subcontract No ERB IC20 CT960024

E.-D. Schulze (coordinator)



Bayreuth, Germany
February, 1998

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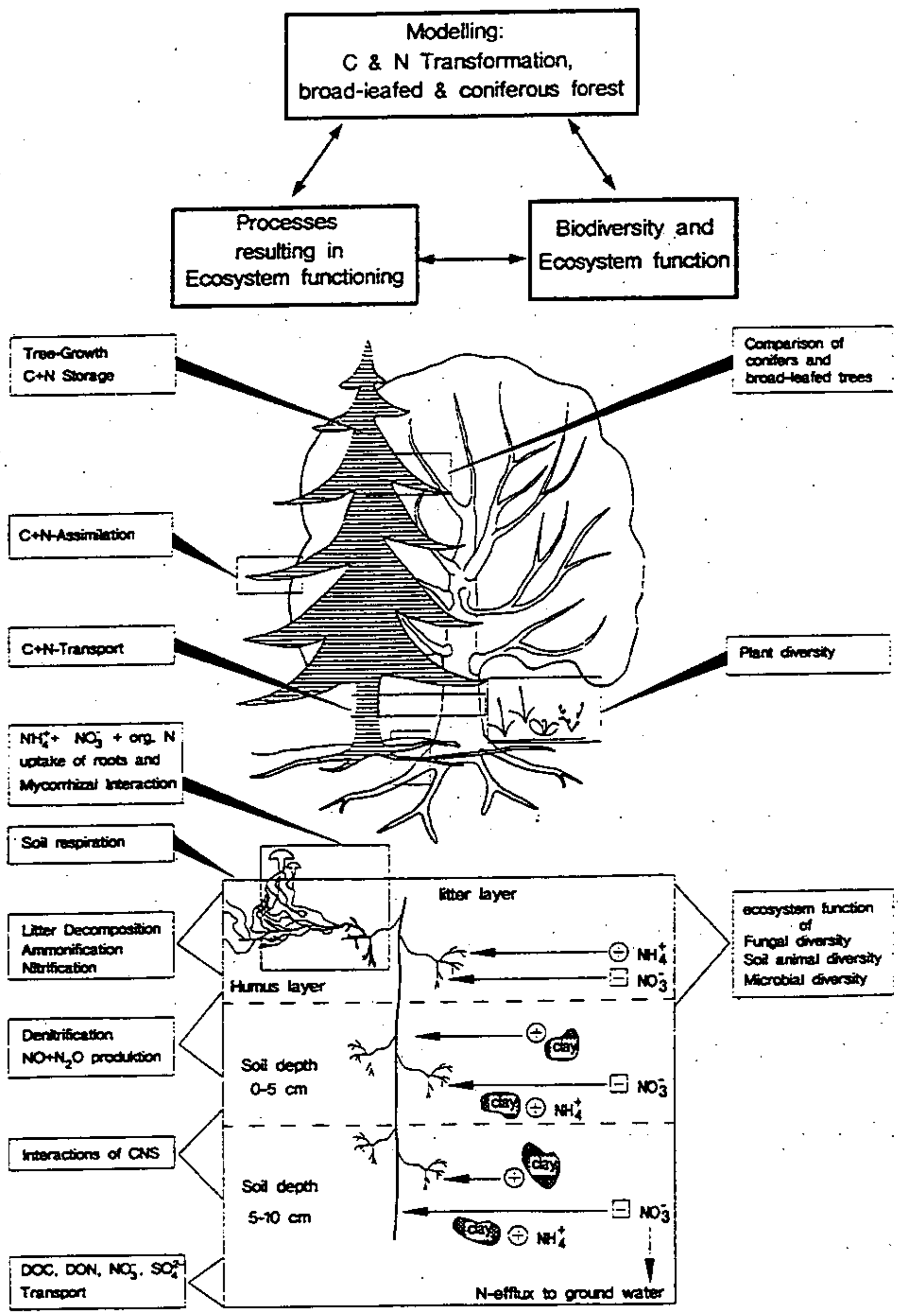

Bayreuth, Germany
February, 1998

PART A

ENVIRONMENT & CLIMATE RESEARCH PROGRAMME (1994-1998)
SUMMARY PROGRESS REPORT
(to be compiled by the coordinator)

1. Contract No: ENV4-CT95-0053

2. Title: CANIF; Carbon and nitrogen cycling in Forest ecosystems

3. Reporting period: 970201 - 980131

4. Scientific coordinator: Prof. Dr. E.-D.Schulze

5. Project participants:

1. UB (DE) University of Bayreuth, Germany
2. SU (SE) Swedish University of Agricultural Sciences
3. UT (IT) University of Tuscia, Italy
4. UH (DE) University of Hohenheim, Germany
5. IN (FR) INRA Nancy, France
6. US (GB) University of Sheffield, UK
7. SU (SE) Swedish University of Agricultural Sciences
8. UC (DK) University of Copenhagen, Denmark
9. UG (DE) University of Gießen, Germany
10. IT (GB) Institute of Terrestrial Ecology, UK
11. DI (DK) Danish Forest and Landscape Institute, Denmark
12. WU (NL) Wageningen Agricultural University, Netherlands
13. GS (CZ) Czech Geological Survey, Czech Republic

Part A

SUMMARY PROGRESS REPORT OF THE PROJECT

I. GENERAL OBJECTIVES (from technical Annex)

CANIF investigates effects of climate, and soil-borne and deposited nitrogen on C- and N-assimilation and turnover as well as on forest organism functions along a climatic transect through Europe extending from North Sweden to Central Italy.

(1) To contribute to the European and global research programmes envisaged by the EC Environment and Climate Work Programme (Framework IV, 1994-1998) and its Terrestrial Ecosystems Research Initiative (TERI) and by the IGBP-GCTE (Global Change and Terrestrial Ecosystems), which aim
- to better understand mechanisms driving pools and fluxes of carbon, water, nitrogen and other nutrients in forest ecosystems (TERI 3.2)
- to extrapolate this understanding to scenarios of land-use and climate change (TERI 3.2)
- to identify ways in which biological diversity regulates ecosystem function, structure and dynamics (TERI 4)

(2) To promote scientific co-operation, education, training and technology transfer within the EC by linking 12 European and 1 Eastern European research institution via a single major multidisciplinary project.

II. SPECIFIC OBJECTIVES FOR THE REPORTING PERIOD (from technical Annex)

(1) 15N pulse labeling with ammonium and nitrate will be a major tool in order to quantify fluxes of N-compounds through the ecosystem. Standard analytical methods (HPLC, GC, MS) were used by all participants based on joint protocols.

(2) Laboratory experiments under controlled conditions will support the interpretation of field observations.

III. SPECIFIC OBJECTIVES FOR THE NEXT REPORTING PERIOD (from Technical Annex)

(1) To quantify the abilities of species of different trophic levels (plants, fungi, soil animals, microbes) to use and to store different forms of C and N, and to investigate the efficiency of these assimilation processes and their contribution to open and close biogeochemical cycles (ecosystem function of biodiversity).

(2) To integrate and to model ecosystem fluxes of carbon and nitrogen, and to make predictions on the effect of atmospheric deposition, of climate and land-use changes on biogeochemical cycles in forests.

IV. MAIN ACTIVITIES UNDERTAKEN: METHODOLOGY, RESULTS, DISCUSSION, CONCLUSION

Joint activities
- a reporting workshop at Viterbo (datum?)
- a data analysis workshop at Paris (Datum?)
- group meetings took place for planning the ^{15}N experiments
- A large number of scientists have worked at all sites

Methodology:
CANIF is an ecosystem project. Thus, the transect running North Sweden to Central Italy is the main tool.
Each group works at all (or selected) sites of the transect.
Each group develops its own methodology of investigation, as explained by each partner (Part B)

Results:
In the following I point at major progresses which link various projects.

Main progress took place in the understanding of the nutrient supply from soils (microbiota) to uptake of roots. Tryggve Persson (SU-SE) has measured nitrification at most sites and he developed molecular probes for ammonium oxidizers. This work is supported by Sten Struwe (DI-DK) who now can measure saprophytic decomposition, and by Volker Wolters (UG-DE) who qualifies the activity in the soil fauna. While the variation in the soil fauna is explained by the water content, the microbial activity is determined by the pH. Following decomposition, and even before organic N is being mineralized, a significant proportion of organic N is lost to groundwater (Björn Andersen UC-DK). To our surprise, losses on organic nitrogen (DON) do not correlate with losses in dissolved organic carbon (DON). There are several isotope dilution studies on the way (UB-DE, SU-SE, and UI-IT) which will further quantify the mineralization process.

For the first time, Tony Harrison (IT-GB) is able to quantify the overall turnover of organic matter, and to determine the age of organic matter. The mean age of litter is 7 years in Fagus and 16 years in Picea, the difference can in part be accounted for ba the difference in needle age versus deciduous leaves. In the 0 to 5 cm mineral soil the age of humus increases to 110 years in Fagus and 165 years in Picea, and becomes more that 300 years in deeper horizons. Persson (SU-SE) will supply a quantification of the humus pools so we can calculate fluxes in future.

There are several projects focussing on the fate of mineralized N during plant uptake. The most outstanding result comes from Peter Högberg (SU-SE) who for the first time demonstrates with double labelled amino acids the uptake of amino acids by roots by passing mineralization. To our surprise grasses were more effective than woody plants in using amino acids. This result is supported by Eckart George (UH-DE) who could show that mycorrhizal hyphae are just as effective in N-uptake as roots, independent of the N-form and only dependent on the concentration. This is even further explored by David Read (US-GB) who determines the amino acid transporter in mycorrhizae (Vmax 2.4 to 25 nmol $mg^{-1}h^{-1}$, km 0.020 to 0.350 mM). The progress made about uptake of N in roots and mycorrhizae is an outstanding example that the cooperation by groups of different expertise lead to totally new insight.

The allocation of N and C was studied in detail by Guiseppe Scarascia-Mugnozza (UT-IT), Detlef Schulze (UB-DE) and by Etienne Dambrine (IN-FR). about 2/3 of the nitrogen and carbon enter into above-ground parts, 1/3 is used for roots. The above ground part is further supported by uptake of NOx into needles and leaves. Since stomata are more open in leaves than in needles, and since the nitrate activity is higher in angiosperms than in conifers, 16 % of the N-requirement for growth of new needles originated from atmospheric uptake in spruce; this fraction increase to 60% in Fagus. This result is supported by the quantification of the S-cycle (UB-DE). In fact, the Czech water shed study supports these numbers for S at a watershed scale.

As joint result, CANIF produces a CD ROM database for modelling activities. Frank Berendse (WU-NL) has developed a coupled model for N and C-cycles. The above information is fed into this model. It is quite clear that the transfer of analytical data into the model is not as fast as we anticipated, but we are making progress. The data-base is getting complete, and 1st test runs of the model took place. So we can be confident that we will be able to generalize the result at the end of this project by model-experiments.

V. Joint publications

- The preparation of a CD-ROM database is in progress

- A joint summary of all results in form of a book is planned for 1998/1999.

VI. Changes in status

Prof. Dr. E-D.Schulze became director of the new Max-Planck-Institute of Biogeochemistry at Jena. The CANIF Project continues to be administered by the University of Bayreuth. Schulze is still teaching at Bayreuth.

VII. Is the project on schedule?
yes

Part B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting Period: 970201-980131

Partner: 01 (UB)DE University of Bayreuth

Principle Investigator: Prof. Dr. E.-D.Schulze

Scientific staff: Dr. G. Gebauer, Dr. G. Bauer, M. Hein

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I. OBJECTIVES FOR THE REPORTING PERIOD

Pulse labelling of the spruce and the beech stand with ^{15}N-ammonium and nitrate at the Bayreuth site

II. OBJECTIVES FOR THE NEXT PERIOD

- Continue isotope dilution studies in soils

- Analyzed the data of the pulse labelling study

III. Are there any particular problems? Is your part of the project on schedule?

- The number of samples in the pulse labelling was much greater than expected (> 15000). Thus more time is needed for analyses.

- The isotope dilution study proved more complicated than expected due to the natural large heterogeneity of forest soils. In addition the detection of isotope levels in the organic matrix proved to be very complicated.

The project is on schedule.

IV. MAIN RESULTS OBTAINED: METHODOLOGY, RESULTS, DISCUSSION, CONCLUSION

Methodology: Spruce and beech forest were treated by pulse labelling with ^{15}N ammonium and nitrate. In addition an isotope dilution study was performed in the litter and the organic layer of spruce forest.

Results:

- Spruce and beech show similar atom fractions of labelled ammonium and nitrate. Differences in uptake are calculated on the assumption that the label was diluted according the ratio of concentrations of ammonium/nitrate in soil solution. Based on this assumption ammonium uptake exceed nitrate uptake.

- Acid soils exhibit a rapid nitrate turnover

- 16% and 60% of nitrogen required for growth of new foliage in Picea and Fagus respectively may originate from uptake of NOx from the atmosphere.

- Gaseous uptake of SO_2 contributes 20 to 25% to the organic S in Fagus and Picea.

V. List of publications arising from the project:

Bruckner G, Katz C, Schulze E-D, Eiden R (1997) Die Bedeutung der Deposition für die oberirdische Stickstoffaufnahme. UFZ-Bericht 5/1997:56-59 ISSN 0948-9452

Schmidt G, May C, Buchmann N, Gebauer G, Schulze E-D (1997) Aufnahme von Ammonium und Nitrat bei Waldbäumen. UFZ-Bericht 5/1997:50-51 ISSN 0948-9452

Bauer G, Schulze E-D, Mund M (1997) Nutrient status of the evergreen conifer Picea abies and the deciduous heartwood Fagus sylvatica along a European transect. Tree Physiology 17:777-786

Köstner B, Schupp R, Schulze E-D, Rennenberg H (1995) Sulfur transport in the xylem sap of spruce (Picea abies L. Karst.) and its significance for the trees sulfur budget. Tree Physiology 18:1-9

Signature of Partner:

Date: E.D. Schulze

PART B

DETAILED REPORT OF INDIVIDUAL PARTNERS

Reporting period: 970201-980131

Partner: Dept. of Forest Ecology, SUAS (now SLU), Sweden

Principal Investigator: Prof. Peter Högberg

Scientific Staff: Dr. Alf Ekblad Dr. Reiner Giesler, Dr. Maud Quist, Msc. Mona Högberg

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Fax: +46 90 786 7750 E-mail: Peter.Hogberg@sek.slu.se

I. OBJECTIVES FOR THE REPORTING PERIOD:

We did a N-15 labelling study along the natural N-supply gradient at Betsele (Giesler et al. 1998). We studied the turnover of inorganic N pools to see how fast they are turned over. This material is now processed in the laboratory. We also completed our study, which started in the field in 1996, of organic N source uptake by plants; this work (Näsholm et al. 1998) has now been accepted by *Nature*. We also did some further development on the substrate-induced respiration method, and studied the potential to separate root respiration from microbial respiration in the soil.

II. OBJECTIVES FOR THE NEXT PERIOD:

To determine turnover of the pools of amino acids, ammonium and nitrate in soils of contrasting C:N ratios by the use of N-15 pool dilution. To use C-13 tracer methods to separate root respiration from microbial respiration in the field.

III. Are there any particular problems? Is your part of the project on schedule?

There are no particular problems, and we are running on schedule.

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS*

We showed, for the first time, uptake of organic N in the field by the trees *Pinus sylvestris* and *Picea abies*, the dwarf shrub *Vaccinium myrtillus* and the grass *Deschampsia flexuosa*, implying that the plants, irrespective of their different types of mycorrhiza, by-pass mineralization. A trace of amino acid, glycine, labelled with C-13 and N-15, was injected into the mor-layer of an old successional boreal forest. Ratios of C-13:N-15 in the soluble N pool of roots showed that at least 91, 64 and 42% of the absorbed glycine was taken up intact by the dwarf shrub, the grass and the trees, respectively. Rates of glycine uptake were similar to those of ammonium. Our data show that organic N is important for these contrasting plants even when competing with each other and non-symbiotic microorganisms.

V. List of Publications arising from the project:

Taylor AFS, Högbom L, Högberg M, Lyon TEJ, Näsholm T, Högberg P 1997 Natural N-15 abundance in fruit bodies of ectomycorrhizal fungi from boreal forests. *New Phytologist* 136, 713-720.
Högberg P 1997 N-15 natural abundance in soil-plant systems. *Tansley Review* No. 95. *New Phytologist* 137, 179-203.
Giesler R, Högberg M, Högberg P 1998 Soil chemistry and plants in the Fenno-scandian boreal forest as exemplified by a local gradient. *Ecology* 79, 119-137.
Näsholm T, Ekblad A, Nordin A, Giesler R, Högberg M, Högberg P 1998 Boreal forest plants take up organic nitrogen. *Nature*, in press.
Ekblad A, Högberg P 0000 C4-sucrose induced soil respiration - a way to separate root respiration from microbial respiration in a C3-plant ecosystem. Manucsript.

Signature of Partner: Peter Högberg

Date: 980213

Annual Report - CANIF

Period: 1.2.97 - 31.1.98
Partner: 03

Principle Investigators: Prof. Dr. Giuseppe Scarascia-Mugnozza (gscaras@unitus.it)
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Mr. Giuseppe Napoli
Mr. Roberto Bimbi
Mr. Tullio Oro
Mr. Renato Zompanti
Mr. Massimiliano Haijni
Dr. Francesca Cotrufo (University of Napoli II)
Dr. Guia Cecchini (University of Firenze)
Prof. Dr. Guido Sanesi (University of Firenze)

Sites: Collelongo, beech forest (41°52' N, 13°38' E, 1550 m a.s.l.)
Monte di Mezzo, spruce plantation (41°49' N, 14°12' E, 900 m a.s.l.)

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I. Objectives '97

1. Biomass production:
   - to study litter production above- (leaves and needles) and below-ground (fine root turnover) in beech and spruce sites of the Central Appennines;
   - to monitor tree growth by means of dendrometer at both sites, with larger sampling in the beech forest.
2. Plant nutrient budget and cycling:
   - to study nitrogen uptake and partitioning in montane-Mediterranean forest ecosystems (beech and spruce) by means of ^{15}N labelling experiments;
   - to investigate nitrogen distribution in plant compartments by means of classical analytical techniques. Special emphasis will be addressed to study vertical profiles of leaf nutrients.
3. Soil respiration:
   - According to the general objective of the group for the project, monitoring of soil respiration will be continued at beech and spruce sites. Measurements will be performed every 15-30 days.
     Soil respiration will be also measured in different soil/litter conditions and, for the beech site, in areas where different silvicultural practice have been applied. At the beech site, in co-operation with the EC project EUROFLUX soil respiration will

be estimated at a larger scale by means of eddy flux measurements (test and daily campaigns).

4. Soil processes:
   - Together with Prof. Guido Sanesi from Florence and Dr. Björn R. Andersen from DFLRI (Denmark) soil solution will be collected by means of gravity and suction-cup lysimeters. Microlysimeters will be also installed adjacent to suction lysimeters, in order to assess their performance and comparability. Soil water will be then analysed for the major chemicals and for DOC and DON. Due to their limited space requirement, microlysimeters will be installed at various location within the beech forest, in order to sample spatial variability of soil solution. Soil processes will be mainly investigated in the beech site.
5. Decomposition processes
   - Together with Dr. Francesca Cotrufo leaf and twig litter decomposition will be studied. Leaf and twig samples will be collected and analysed after 0.5 and 1 year from their incubation in mesh bags (leaf litter) and nylon lines (twigs). The experiment is running in 4 different beech forests (Denmark, France, Germany, Italy) and a first comparison will be possible.
6. Isotopes studies
   - Plant material will be analysed for carbon ($^{12}C/^{13}C$) and deuterium/ hydrogen abundances (D/H). D/H values of plant material (leaves, branches and roots) will be compared to those of rain and of water extracted from different soil depth to investigate the rooting depth of the different forest tree species and to evaluate competitive interactions in water utilisation among trees of each forest stand.
     Analysis of leaf carbon isotopic ratio ($^{12}C/^{13}C$) of different tree species (beech/spruce) and, within a species, of different leaf layers in the canopy will be utilised to infer intrinsic water use efficiency.

II. Objectives '98

1. Biomass production:
   - to continue to monitor tree growth by means of dendrometer at both sites, with larger sampling in the beech forest.
2. Plant nutrient budget and cycling:
   - to study nitrogen absorption as ammonium vs. nitrate in conifer and broadleaf forests (beech and spruce) by means of ^{15}N enrichment experiments, in contrasting seasons of the year;
   - to investigate nitrogen distribution in plant compartments by means of classical analytical techniques.
3. Soil respiration:
   - Soil respiration measurements will be continued at beech and spruce sites.. At the beech site, in co-operation with the EC project EUROFLUX soil respiration will be estimated at a larger scale by means of eddy flux measurements (test and daily campaigns).
4. Soil processes:
   - Together with Prof. Guido Sanesi from Florence and Dr. Björn R. Andersen from DFLRI (Denmark) soil solution will be collected by means of gravity and suction-cup lysimeters. Microlysimeters will be also installed adjacent to suction lysimeters, in order to assess their performance and comparability. Soil water will be then analysed for the major chemicals and for DOC and DON. Due to their limited space requirement, microlysimeters will be installed at various location

within the beech forest, in order to sample spatial variability of soil solution. Soil processes will be mainly investigated in the beech site.

5. Decomposition processes
   - Together with Dr. Francesca Cotrufo leaf and twig litter decomposition will continue to be monitored. Leaf and twig samples will be collected and analysed after 1.5 and 2 year from their incubation in mesh bags (leaf litter) and nylon lines (twigs). The experiment is running in 4 different beech forests (Denmark, France, Germany, Italy) and conclusive results will be available at the end of the period. In the next year of work, second year mass loss data, coupled with data on chemical composition of the decomposing litter, will provide useful information towards the complete understanding of C and N cycling in these European beech forests.
6. Isotopes studies
   - Plant material will be analysed for carbon ($^{12}C/^{13}C$) and deuterium/ hydrogen abundances (D/H). D/H values of plant material (leaves, branches and roots) will be compared to those of rain and of water extracted from different soil depth to investigate the rooting depth of the different forest tree species and to evaluate competitive interactions in water utilisation among trees of each forest stand.
     Analysis of leaf carbon isotopic ratio ($^{12}C/^{13}C$) of different tree species (beech/spruce) and, within a species, of different leaf layers in the canopy will be utilised to infer intrinsic water use efficiency.

III. Problems and deviations from plans

Overall, within 1997, there were not major deviations from the stated workplan except for the stable isotope analyses because a new mass spectrometer Delta S Finnigan was only recently acquired and a stable isotope lab has been implemented during the year. The lab facilities were thoroughly tested and presently analyses are being carried on.

IV. Results

1. Biomass production:
- During 1997, the area covered by the spruce plantation at Monte di Mezzo (41°45' N, 14°53' E) has been carefully estimated by means of topographic technique. The plantation is established over 1.76 ha, a larger surface than previously considered after information received by the local Forest Service. The new estimate leaded to the revision of site structural, biomass and production data.
- The stand, planted 40 years ago at a high density, at the moment has 1197 tree ha^{-1} with a relevant mean height (21.3 m) and diameter at breast height (20.2 cm). Total basal area is 38.43 m^2 ha^{-1} and total biomass (above+belowground) sums to 222.9 t ha^{-1}. Stem contributes to 60% of total biomass (131.25 t ha^{-1}), while root biomass contribution to total biomass is 26% (57.6 t ha^{-1}). The biomass allocated to needle is significant, arriving to 16.84 t ha^{-1} (7.5% of the total). Mean annual increment of total biomass is 10.6 t ha^{-1} yr^{-1}, and that of root reaches 2.1 t ha^{-1} yr^{-1}, while the stem production is 4.5 t ha^{-1} yr^{-1}.

2. Plant nutrient budget and cycling:
   - A detailed nutrient analyses of biomass components of the study forests was carried out and results are being evaluated.
     Concerning the leaf component of beech forest, analyses at performed on samples collected at the season's peak shows a high N content (2.5 cg g^{-1}), a relatively low P content (0.15 cg g^{-1}) and high values for K, Mg and Ca.

- Seasonal course of leaf nitrogen shows a decreasing trend for percentage content (cg g^{-1}) from May (3-4 cg g^{-1}) to end of September (1.7 cg g^{-1}). The greater content of May could be related to the mobilization of nutrients from buds to freshly opened leaves, while in September, nutrient resorption from senescing leaves has certainly an important role. Vertical profiles of N content on a dry leaf mass basis are not evident, with slight and not-significant differences among layers.
- On the contrary, there are strong differences among layers when N content is calculated on a leaf area basis and as mean leaf pool. At the season peak, N content (g m^{-2}) shows a very strong vertical profile going from 2.34±0.30 g m^{-2} at the top of the beech canopy (21 m) to 0.69±0.01 g m^{-2} for leaves at 3 m from the ground. The profiles were evident at all sampling date, going from mid May to end of September.
- Vertical profiles were also evident when N content was calculated as mean leaf pool. The calculation was done multiplying N content on an area basis by the mean leaf area of leaves of the different layers. Values were then converted to molar content. At the season peak, leaf pools varied from 155.6±26.9 μmol $leaf^{-1}$ at the top of canopy to 69.7±0.41 μmol $leaf^{-1}$ for the lower canopy layer sampled (3 m).

3. Soil respiration:
   - Measurements of soil respiration were performed also in 1997, at both sites. 14 measurement dates were performed at the beech (Feb-Dec) and 6 in the spruce plantation (May-Dec).

     At the spruce site, soil CO_2 emission ranged between 2.0 and 6.0 μmol m^{-2} s^{-1}, peaking in August, while at the beech site the soil respiration was characterized by very low winter values (0.5-1 μmolCO_2 m^{-2} s^{-1}) and summer peaks of 4.1 μmolCO_2 m^{-2} s^{-1}. This year, in the beech forest, respiration was strongly suppressed during August (1.7 μmolCO_2 m^{-2} s^{-1}) due to a drought period. Respiration rates recovered again to 3.5 μmolCO_2 m^{-2} s^{-1} after the early September rainfalls.

     At both sites, soil respiration were fitted following the relationship reported by Hanson and colleagues (1993), that uses both soil temperature and water content (eq. 1):

$$R_{soil} = Rb \cdot Q^{\frac{Tsoil}{10}} \cdot \frac{(1-Cf)}{100} \qquad (1)$$

     where Tsoil is the soil temperature, WS is the soil water content and Cf is the soil coarse fraction, while Q and Rb are parameters, with Rb defined by equation 2:

$$Rb = \frac{(K \cdot WS \cdot R\max)}{((K \cdot WS) + R\max)} \qquad (2)$$

   - In general, model performance was very poor when used with all single data points, proving not to be useful to simulate respiration heterogeneity within the same sampling date. This was particularly true for the natural beech site, where soil heterogeneity is particularly evident. When data were pooled and averages by sampling date, the model was able to fit measured data of 1995-1997 at the beech site and 1996 to 1997 in the spruce site. Again, the fitting was more reliable at the spruce site (r^2=0.95, K=0.06, Rmax=1.87, Q=3.70, Cf=0.05) than at the beech site (r^2=0.34, K=0.15, Rmax=10.6, Q=2.04, Cf=0.4), where the interaction of soil temperature with soil water content is particularly important. Probably, within the spruce plantation, the clayish, compact and uniform soil of agricultural origin and the even-aged structure of the stand limit the variability of soil respiration.

4. Soil processes

- Soil solution samples from vacuum mini-lysimeters and from gravimetric lysimeters have been regularly collected approximately every 15 days, stored and will be sent to the lab of the Danish contractor for analyses.

5. Decomposition processes
   - Within the framework of the CANIF project, a field decomposition experiment, on leaf and twig litters, was established in Autumn 1996, and it is running since then, at the four beech sites of the CANIF project: Collelongo, Italy; Aubure, France; Schacht, Germany; Hilleröd, Denmark. Aim of the study was to answer to the following hypothesis: i) decomposition of each litter type, at one site, is dependent on its chemical composition (i.e. C-to-N ratio), this relation may differ for different litter types (i.e. leaf litter vs. twig litter); ii) mass loss rate of a standard litter differs when litter is incubated at different sites, and it is controlled by climate variables (e.g. evapotranspiration). Different N deposition along the transect may explain the residual. These relationship may differ for different litter types. The study, therefore, consists of two experiments: i) incubation at a standard site (Collelongo) of the leaf and twig litters derived from the four beech sites; ii) incubation of the standard leaf and twig litter (derived from Collelongo) at the four beech sites.
   - Leaf and twig litters were collected in Autumn 96 as they fell, from all the four beech sites, air dried and a sub-sample was posted to the Italian site, where the leaf litter bags and the twig-lines were prepared. At the time of bag and twig-line preparation, litter water content was determined. In late Autumn 1996 litter bags and twig-lines, with the standard litter were placed in the field at Aubure, Schacht and Hilleröd, while litter bags and twig-lines, with litters derived from all the four sites, were placed in the field at Collelongo. The decomposition experiment will last 24 months and, during this period, 6 samplings will occur. Once collected, 7 bags and the twig-line are air dried and shipped to Italy, where they are processed for the determination of mass loss. After weighing, dried litters are milled and stored separately for later C and N concentration analysis.
   - Provisional data, referring to the first year incubation, are presented here. Overall, after the first year, interesting results seem to be emerging, with the standard litter incubated at the Italian site showing slower decomposition rates (mass-loss, % of initial weight, 17.8±0.86), than those incubated in the other most northern European sites (D: 19.5±2.4; G: 22.1±0.6; F: 26.6±0.7). This was particularly true for the early summer months. At the Italian site, the local leaf litter was the one that decomposed faster (percentage mass loss: 17.8±0.86), with respect to the litter originating from the other countries (D: 11.2±0.6; G: 9.1±1.1; F: 8.1±1.2). As expected, first year wood decomposition rates were lower than those measured for leaf litter decomposition, but it was a surprising result that in few occasions, wood samples increased their weights during the early stages of decomposition, possibly due to the ingrowth of fungal hyphae. Contrary to leaf litter, when incubated at Collelongo, twigs from other countries decomposed faster and similarly among them (D, F, G, average mass loss: 12.9±3.1) than local samples (2.8±1.4). Twig litter of the other sites decomposed faster than standard litter also when incubated at the Northern sites.

     Data have yet to be analysed for statistics and possible relations to environmental factors have yet to be investigated. Therefore, we remand interpretation of the results to the end of the experiment, when also results from the chemical analyses of the decomposing litters will be available.

6. Isotopes studies

- A preliminary ^{15}N labelling study has been conducted and samples are being analysed at our stable isotope facility; $^{12}C/^{13}C$ isotopic abundance was analysed on tree, air and understory samples collected in the beech forest.

V. Publications and Communications in Workshops

Masci A., Napoli G., Dore S., Matteucci G. Scarascia Mugnozza G. (1998). Produzione di biomassa epigea e radicale in una faggeta e in un rimboschimento di abete rosso dell'Appennino abruzzese. *In*: Borghetti M., Viola F., Scarascia Mugnozza G. (edit). *La ricerca italiana in selvicoltura ed ecologia forestale. Atti del I Convegno della S.I.S.E.F.*, Padova, 4-6 Giugno 1997 (in press).

Matteucci G. Dore S., Masci A., Scarascia Mugnozza G. (1997). The CANIF EU project: activities and results of the research performed in Italy in a beech forest and a spruce plantation. Poster presented at the *Int. Workshop "Greenhouse gases and their role in climate change: the status of Research in Europe"*, held at Orvieto, Italy, 10-13 Novembre 1997.

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1.2.1997 - 31.1.1998

Partner: University of Hohenheim, Institute of Plant Nutrition

Principal Investigator: Dr. Eckhard George

Scientific staff: Christoph Stober

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I. OBJECTIVES FOR THE REPORTING PERIOD:

1) To investigate the relations between nitrogen (N) uptake by, and transport of photosynthetic carbon (C) to different root zones.
2) To determine the contribution of ectomycorrhizal hyphae to the N uptake of trees and the corresponding carbon supply from the trees to the hyphae, and to measure respiration rates.
3) To analyse non-structural carbohydrates in different root parts in order to assess the current energy status of the root tissue as a measure of the corresponding carbon investment in the root system (together with other groups).
4) To quantify soil respiration rates and to estimate the proportion of root respiration (including mycorrhizal respiration).

II. OBJECTIVES FOR THE NEXT PERIOD:

See I (final measurements, report)

III. Are there any particular problems ? Is your part of the project on schedule ?

No. Yes.

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS* (use other pages as necessary but preferably no more than 2)

Enclosed.

V. List of Publications arising from the project (include copies):

—

Signature of Partner:

Universität Hohenheim
INSTITUT FÜR
PFLANZENERNÄHRUNG (330)
70593 Stuttgart

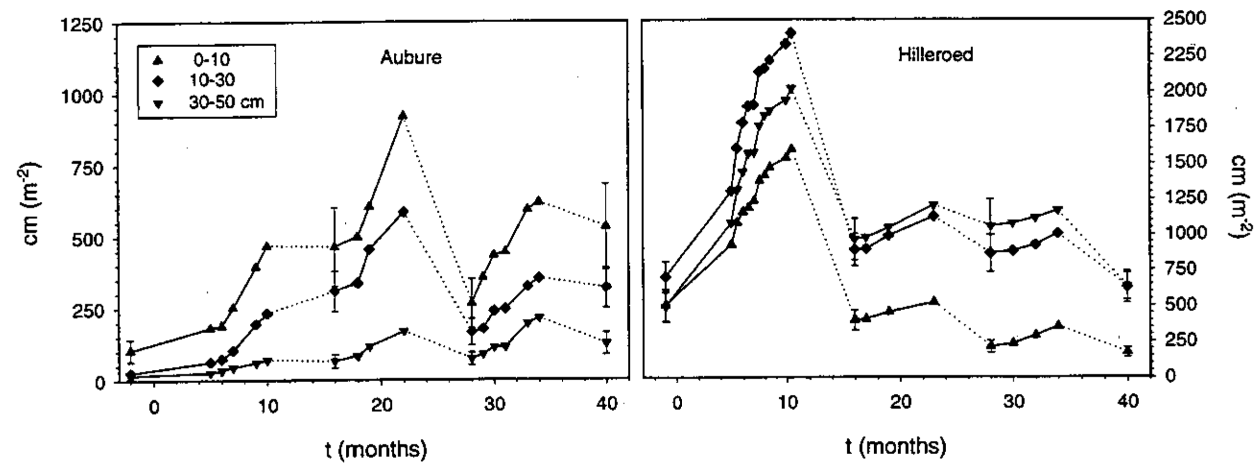
Date: 12. 02. 1998

IV. Main results obtained:

Root growth

Recordings of root growth at root windows were finished in May 1997 and covered a period of observation of three years. Root growth dynamics differed markedly between sites. Fig. 1 shows, as an example, fine root growth dynamics on two beech sites (Aubure, Vosges mountains, and Hilleroed, Denmark).

Fig. 1: Fine root length density at surface of root windows (beginning of season) and growth increment (during vegetation period) of beech at Aubure and Hilleroed (installation: summer 1993; n=20 [Aubure]/32 [Hilleroed]; means and standard errors).

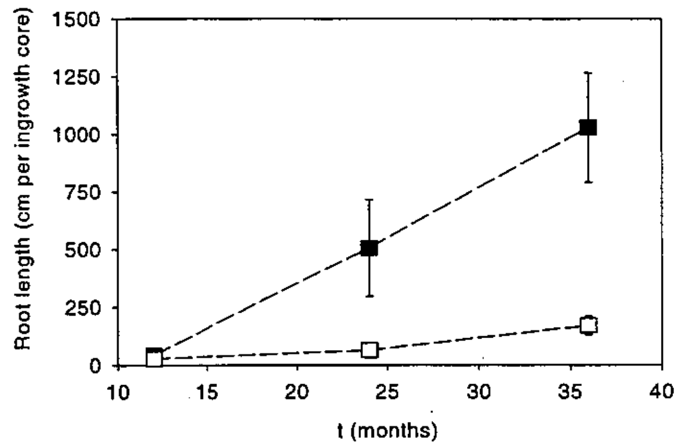


General observations made:

- Fast growth of extension roots in the first season (effect of installation), esp. in Norway spruce
- From second season, constant level of extension root length density at first registration, but differences between seasons in growth increments and turnover rates
- First root growth in season starts prior to shoot growth
- Development of fine roots starts later than that of extension roots
- No effect of installation on fine roots, no constant level of fine root length densities at beginning of season
- Fine root : extension root length ratio - Norway spruce ~ 1
  beech > 1

The effect of local high N supply was tested by two ingrowth core experiments of different duration and sampling intervals. Only at Aheden, northern Sweden, we found a strong positive response of root length increments in ingrowth cores supplied with N compared with the control (Norway spruce, Fig. 2). No significant responses were observed at the other sites (both tree species). Comparison of root dry matter in +N treatment versus control showed the same result. We conclude that increase in growth of tree roots inside N supplied patches indicates a N limited situation for the individual tree (and in consequence for the site).

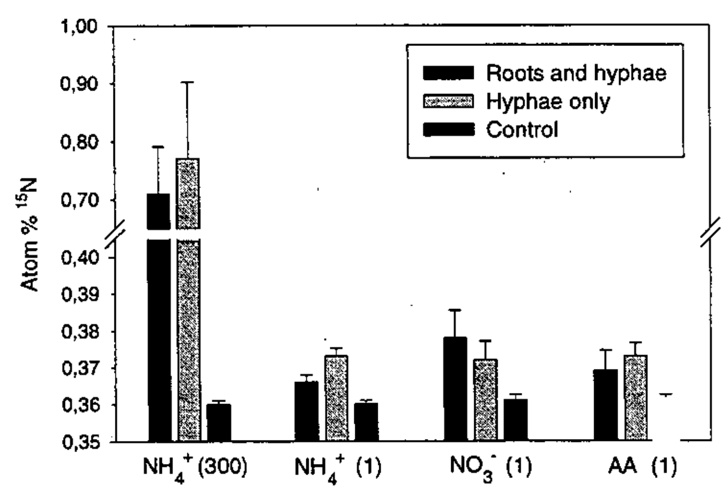
Fig 2: Root length of living fine roots within ingrowth cores in Norway spruce at Aheden, northern Sweden, 12, 24, and 36 months after installation (closed symbols = +N treatment, open symbols = control without N; $V_{ingrowth\ core} = 2011\ cm^3$; means and standard errors)



N uptake by ectomycorrhiza

In a mesh bag experiment, the potential of ectomycorrhizal hyphae to take up nitrogen supplied in different forms and concentrations was tested. The experimental design was described earlier (see annual report 1997). According to our findings in previous experiments, hyphal uptake and translocation of ^{15}N from soil compartments to aboveground young plant tissue was as efficient as root uptake (Fig. 3). ^{15}N enrichment in the aboveground plant parts was related to the level of N supply to the soil compartments but not to the N form. Thus, hyphae can not only take up ammonium, but also can utilize nitrate and amino acids as N sources.

Fig. 3: ^{15}N enrichment in buds of 3-5 year-old beech at Aubure, 6 weeks after ^{15}N supply to soil compartments accessible to roots and hyphae, or to hyphae only (control = site-specific natural abundance of ^{15}N; means and standard errors)



C allocation

Within the same experiment, a simple technique for ^{13}C-labeling of small trees under field conditions was developed. Analysis of different plant parts showed enrichment of ^{13}C in all plant fractions. Moreover, respired ^{13}C was also measured on the soil surface (together with the group of Prof. Högberg, Umeå). Thus, the method proved to be practicable for getting estimates of C partitioning in young trees. In the following months, analysis and calculations will be completed.

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: **February 1997 to February 1998**

Partner: **05 IN (FR)**

Principal Investigator: **Dr. Francis MARTIN**

Scientific staff: **Dr. M. COLIN-BELGRAND, B. ZELLER & Dr. F. MARTIN**

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I. OBJECTIVES FOR THE REPORTING PERIOD

All sites:

(1) Analysis of ^{15}N-litter decomposition and quantitation of the size and turnover of the different soil and plant N fractions at the selected CANIF sites.

Aubure site:

(2) Study of the leaching, accumulation and release of N in decomposing ^{15}N-labelled beech litter deposited on the site during the previous years.

(3) Identification of genotypes of ectomycorrhizal fungi by molecular diagnostics.

II. OBJECTIVES FOR THE NEXT PERIOD

All sites:

(1) Samples collected on the different sites will be analyzed. Data collected on the different sites will be compiled and analyzed for publication.

Aubure site:

(1) Samples of ^{15}N-litter, and soil and plant compartments collected during fall 1997 will be analyzed and data compiled for publication.

(2) Fruiting bodies of the different genets of the ectomycorrhizal fungus *Laccaria amethystina* collected during fall 1997 will be typed by inter-repeat PCR. Data collected over the last three years will be analyzed for publication.

III.Are there any particular problems? Is your part of the project on schedule?

No problem to mention
Work schedule and milestones of the project for the year 1997 have been achieved.

IV. MAIN RESULTS OBTAINED

All sites

(1) Application of ^{15}N-labelled beech litter to study its decomposition rate, and size and turnover of soil N fractions at selected CANIF sites

Major aims of the present study included: 1) tracing uptake and release of N from litter and 2) identifying patterns of N dynamics taking place during litter decomposition in the main above- and below-ground compartments of the beech ecosystem. A detailed ^{15}N budget has been performed after application of ^{15}N-labelled litter. Three sites (Steigerwald, Germany; Collelongo, Italy; Aubure, France) were selected amongst the CANIF sites. This choice was dictated by (i) the need for a well-known and well-studied species, such as *Fagus sylvatica,* common to selected sites along this transect and by (ii) technical constraints imposed by ^{15}N labelling field experiments (see below).

Methodology In late summer 1997, the first sampling occurred at the Collelongo site and the second in the Steigerwald forest. ^{15}N labelled litter (initially 0.85%N, 180 µg ^{15}N g litter^{-1}) was collected from the soil surface of each of three experimental plots. Then, nine soil samples (0-10cm, 10-20cm and 20-30cm) underneath the labelled area were taken. At last, the trees were cut and all tree compartments were collected. At both sites the remaining trees were wrapped into a nylon net from the beginning of September until November and the leaf litter of each tree was collected separately.

Decay constant *k* for beech litter decomposition was determined according to $X_t = X_0 e^{-kt}$, where X_0 = initial litter mass, X_t = mass at a given time, k is the decay constant for a given period, and t is time measured in years. Microbial biomass N was determined by the fumigation - extraction technique. ^{15}N analysis are in progress.

Results. Decay constant *k* was different for each site. The lowest value was measured at Collelongo followed by Aubure and the Steigerwald forest (Table 1). During the second year, the labelled litter in the Steigerwald forest became progressively invaded by white rot fungi, which leaded to a aggregation of the litter, whereas at Aubure and Collelongo the litter showed traces from the consumption by soil fauna.

The N concentration in the decomposing litter increased at all sites during the observation period, whereas the ^{15}N concentration decreased. Obviously, ^{15}N was released from the beech litter, because the ^{15}N concentration increased in the soil and plant compartment. In the leaves the $^{1}5N$ concentration increased weekly during the first year and drastically during the second year at both sites. Litter released N was taken up by mycorrhizal roots and further transferred to the leaves.

The large difference between the amount of annual litterfall from Aubure and the other sites is due to the age of the trees. The N concentration in solid and liquid soil compartments for all sites are presented in Table 2. In the soil of the Steigerwald forest the N concentration was about 90% to 40% lower than at the other sites. The same tendency had been observed for the microbial biomass, which reached highest values at Collelongo. High N mineralisation at the Collelongo site was reflected in the

NO_3^- and NH_4^+ concentration. Lowest values were observed in the Steigerwald forest. Two years after the distribution of the ^{15}N labelled litter the ^{15}N concentration in 0 - 10cm soil depth at Aubure and in the Steigerwald forest were nearly the same.

Table 1: Decay constant *k*, amount of annual litterfall, N and ^{15}N concentration in the labelled litter after the first sampling. ^{15}N concentration in leaves of the trees one and two years after the distribution of ^{15}N labelled litter. Standard deviation in brackets.

	k	N	^{15}N	^{15}N in leaves (μg ^{15}N g leaf^{-1})		litterfall
		(mg ^{15}N g litter^{-1})		year 1	year 2	(g tree^{-1})
Aubure	-0.27	12.3	0.289	0.26	1.09	378.4
Steigerwald	-0.36	11.8	0.157	0.11	2.09	81.3
Collelongo	-0.20	11.1	0.165			60.5

Table 2: N concentration in the solid soil N fraction and in soil extracts (microbial biomass and NO_3^-/NH_4^+) in 0-10cm soil depth, two years after the distribution of ^{15}N labelled litter. ^{15}N concentration in the solid soil N.

	Total N	microbial biomass N	N-NO_3^-	N-NH_4^+	^{15}N(total soil N)
	(%)	(mg N kg soil^{-1})			(μg ^{15}N kg soil^{-1})
Aubure	0.50	67.6 (5.1)	8.2	16.6	24.9
Steigerwald	0.12	16.6 (5.1)	8.1	2.3	30.8
Collelongo	1.17	267.9 (59.9)	23.5	13.5	

Aubure site

(3) Seasonal variability of leaching, accumulation and release of ^{15}N from labelled decomposing litter.

Results The ^{15}N enrichment of buds, leaves and leaf litter increased progressively during the three years (Figure 1). The first year was characterised by a slow increase in ^{15}N in each of the trees. Retranslocated N from the leaves during senescence was stored in buds, which inhibited the same ^{15}N enrichment than the leaves after bud break. During the second year the ^{15}N enrichment of the leaves increased drastically after bud break by ^{15}N from root uptake. Consequently, the ^{15}N enrichment of leaf litter and buds increased. The same trend was observed during the third year. Litter released N was rapidly incorporated in the tree N pool. The variability increased during the tree years, showing spatial differences in N uptake of the trees.

(4) Identification of major types of beech ectomycorrhizas by molecular diagnostics

Number of genets (i.e. mycelium sharing identical genotype) of *L. amethystina* and their spatial distribution of the fruiting bodies sampled during fall 1996 have been assessed by DNA heteroduplex analysis and microsatellite-primed PCR DNA amplification. The high genetic diversity of *L. amethystina* on this site has been confirmed. A typical feature of this site is the large number (> 500-600/ha) of intricated genets with a limited spatial distribution (>dm^2). Structuration of the fungal populations appears to be dictated by the spatial distribution of the root system of the host-plant. It is suggested that this high diversity has a large impact on the physiological features of the investigated fungal symbionts and thus, on their host-plants.

V. List of publications arising from the project

B Zeller, M Colin-Belgrand, E Dambrine and F Martin (1998) ^{15}N partitioning in beech trees following [^{15}N]urea spray. *Annales des Sciences Forestières*, in press

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Champenoux, 15 February 1998

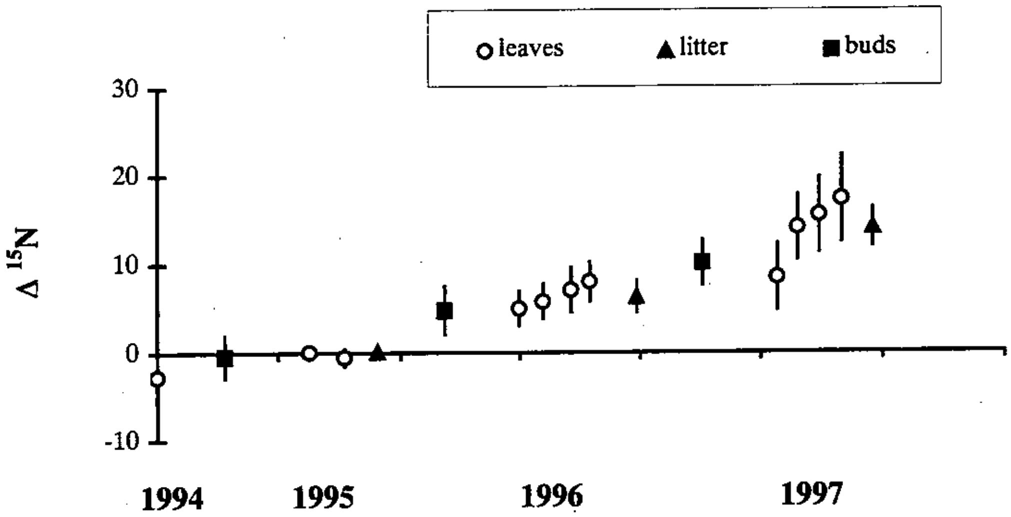

Figure 1: ^{15}N enrichment in buds, leaves and leaf litter of beech trees.

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1 January - 31 December 1997

Partner: University of Sheffield

Principal Investigator: Professor D J Read

Scientific staff: Dr T Wallenda

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Sheffield
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UK

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I. OBJECTIVES FOR THE REPORTING PERIOD:

The objective of the reporting period was to examine the process of amino acid uptake by the major mycorrhizal types and to characterise this uptake by the determination of K_m and Vmax values for different amino acids.

II. OBJECTIVES FOR THE NEXT PERIOD:

Determination of K_m/V_{max} values for fungal isolates from CANIF sites and synthesised mycorrhizas.
$^{13}C/^{15}N$ experiments in the field and with synthesized mycorrhizas to compare uptake rates with data obtained from dissected roots and to investigate to which extent and in which form C and N are transferred from fungal symbiont to the host plant.

III. Are there any particular problems ? Is your part of the project on schedule ?

There are no particular problems. Project is on schedule.

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS* (use other pages as necessary but preferably no more than 2)

Mycorrhizal roots were collected along the CANIF gradient at Umeå (Sweden), Gribskov (Denmark) and Bayreuth (Germany) and immediately transferred for the uptake experiments to the respective nearby laboratories. After preparation of material for uptake experiments, excised mycorrhizas were incubated in uptake solutions containing the ^{14}C-labelled amino acids glutamine and glycine, selected because of their frequent presence in soil solutions, at various concentrations. After a 10 min uptake period, the roots were washed, frozen in liquid nitrogen and kept at -20°C until being freeze-dried. The freeze-dried samples were combusted in a Packard sample oxidizer and the trapped $^{14}CO_2$ analyzed by liquid scintillation to enable determination of amino acid uptake.

Previous experiments in Sheffield had shown that addition of metabolic inhibitors like 2,4-dinitrophenol during exposure to the organic N compound caused almost total inhibition of their uptake up to an amino acid concentration of 0.5 mM, indicating that in the range 0-0.5 mM uptake is essentially an active process.

All investigated mycorrhizal types took up amino acids, V_{max} values ranging from 2.5 to 25 nmol mg^{-1} d.wt. h^{-1}. K_m values determined for beech and spruce mycorrhizas ranged from 20 to 350 µM. The data show variability among different mycorrhizal types at a single site. E.g. the main type at Gribskov (*Russula ochroleuca*) had a low V_{max} value (about 2.5-5 nmol mg^{-1} d.wt. h^{-1}) compared to *Lactarius subdulcis* (the main type at Bayreuth) with V_{max} values of 15 to 25 nmol mg^{-1} d.wt. h^{-1}.

see next page for continuation

V. List of Publications arising from the project (include copies):

Publications are in preparation.

Signature of Partner: [signature]

Date: 20.2.98

In contrast to this interspecific variability, uptake kinetics of mycorrhizas of the same species at different sites (*Lactarius subdulcis* collected at Gribskov, Bayreuth, Sheffield) or the same species with different host plants (*Russula ochroleuca* with beech and spruce) were much less variable.

In addition, analysis of the uptake rates of glutamine and glycine supplied at a single concentration to a range of different mycorrhizal types at a single concentration (40 μM) at the different sites also showed considerable variability (1-15.8 nmol mg^{-1} d.wt. h^{-1}) indicating that species composition contributes significantly to functional diversity in a population of mycorrhizal roots. However, as far as the uptake capacity for amino acids is concerned, no obvious trends can be seen in relation to the geographical distribution of CANIF sites.

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1 February 1997 - 31 January 1998

Partner: Swedish University of Agricultural Sciences, Uppsala (part 7a)

Principal investigator: Prof. T. Persson

Scientific staff: A. Rudebeck, P. Karlsson, U Seyferth, M Sjöberg

Address: Dept. of Ecology and Environmental Research, Swedish University of Agricultural Sciences, Box 7072, S-750 07 Uppsala, Sweden

Telephone: +46 18 672448

Fax: +46 18 673430 E-mail: Tryggve.Persson@eom.slu.se

I. OBJECTIVES FOR THE REPORTING PERIOD (part 7a)

(1) To determine in situ C and N organic pools and C and N mineralisation rates for each soil horizon (to a depth of 50 cm) in samples taken to the laboratory at the sites Nacetin, Jezeri, Sorø and Skogaby.
(2) To determine field nitrification potentials based on laboratory studies at these sites.
(3) To identify nitrifier types at Skogaby, Aubure, Fichtelgebirge and Collelongo.
(4) To formulate response functions for temperature/moisture based on data from Skogaby and identify in which aspect the model needs improvement.
(5) To compare ammonium and nitrate formation rates in undisturbed monoliths and in sifted soil horizons from Skogaby in the laboratory for comparison with similar studies at Åheden, Gadevang/Gribskov and Klosterhede.
(6) To evaluate the studies made in N fertilisation experiments in the long-term field N fertilisation experiments at Stråsan and Skogaby.
(7) To evaluate effects of soil faunal effects on C and N mineralisation.
(8) To start studies of net and gross N mineralisation using ^{15}N, primarily at Skogaby.

II. OBJECTIVES FOR THE NEXT PERIOD

(1) To synthesise data on in situ C and N organic pools and C and N mineralisation rates for each soil horizon (to a depth of 50 cm) in samples from all CANIF sites.
(2) To synthesise data on field nitrification potentials based on laboratory studies with soil materials from all CANIF sites.
(3) To go on with the identification of the nitrifier types at different CANIF sites.
(4) To publish results on response functions for temperature/moisture based on data from Skogaby.
(5) To evaluate the comparisons of soil processes in undisturbed and disturbed soil layers.
(6) To publish results on the long-term N-fertilisation experiments (see §6 above).
(7) To publish results on soil faunal effects on C and N mineralisation.
(8) To evaluate data on the $^{15}NO_3$ dilution study at Skogaby.

PART B

III. Are there any particular problems? Is your part of the project on schedule?

The subproject is on schedule except for objective 3, where more time than expected was needed for the characterisation of nitrifiers.

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS* (use other pages if necessary but preferably no more than 2)

(1) The C and N soil pools in the beech and spruce stands at Sorø, Jezeri, Nacetin and Skogaby is still under determination.
(2) The net nitrification potential (the rate of nitrate produced in the absence of roots) was high at Sorø, reasonably high at Jezeri and low at Nacetin. At the latter site, pH was lower than at any other site in the CANIF project and reached a minimum of 3.25 (in water suspension) in the 0-10 cm mineral soil layer.
(3) DNA has been extracted, and signals have been obtained with probes with specific ammonium oxidizers. The methods are refined based on the materials from Skogaby.
(4) Rates of C mineralisation, net N mineralisation, nitrification and N_2O production were earlier studied at 6 different temperatures and 4 soil moisture levels for two different soil layers at Skogaby. To obtain a better resolution as regards soil moisture, a new study was made with 10 different moisture levels. The data are in accordance with the former ones, but give a more accurate description of moisture dependency at dry conditions. The study is still ongoing.
(5) A further comparison between undisturbed and disturbed soil has been made, at this time for Skogaby humus. The study is under evaluation.
(6) A field mineralisation study has been finished for the spruce site at Stråsan, where different plots were treated with 0, 35, 70 and 105 kg N per ha and year for about 20 years. The study is under evaluation.

V. List of publications arising from the project (include copies):

Up till now nothing has been published of the data gathered in 1997.

Signature of the partner:

Date: 5 February 1998

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1.2.97 – 31.1. 98

Partner: Swedish University of Agricultural Sciences, Uppsala (part 7b)

Principal Investigator: Dr. Hans Persson

Scientific Staff: Kerstin Ahlström

Telephone: +46 - 18 67 24 26

Fax: + 46 - 18 67 34 30 E-mail: Hans.Persson@eom.slu.se

I. OBJECTIVES FOR THE REPORTING PERIOD (part 7b):

(1) To quantify root distribution (and rooting depth), in terms of dry weight, root length, carbon and nitrogen content in stands of Norway spruce and European beech.

(2) To relate the fine root distribution to fine root dynamics obtained from "root windows" (see project report of the Hohenheim University Group). To initiate cross-site comparison on root distribution and growth dynamics in co-operation with other root and mycorrhizal scientists between all sites.

(3) To be able, within the framework of the project, to quantify the seasonal changes in the amount of fine roots (Norway spruce and European beech) at the Aubure site.

II. OBJECTIVES FOR THE NEXT PERIOD:

(1) To report results on root distribution (and rooting depth) in terms of dry weight, root length, carbon and mineral nutrient content in stands of Norway spruce and European beech.

(2) To relate results on the fine root distribution to fine root dynamics obtained from "root windows" (see project report of the Hohenheim University Group). To carry out cross-site comparison on root distribution and growth dynamics in co-operation with other root and mycorrhizal scientists between all sites for the final report.

(3) To report results on the seasonal changes in the amount of fine roots (Norway spruce and European beech) at Aubure.

(4) To finish and report results from the Waldstein and Schacht sites on the distribution of fine roots in a Norway spruce and a European beech stand.

PART B

III. Are there any particular problems? Is your part of the project on schedule?

Root sampling has been on schedule. Most results are now available from the Aubure site, where the most extensive sampling was carried out (see below Fig. 1.). Data from the other sites are in progress. Chemical analyses have been carried out (N, P, K, Ca, Mg, Na, Mn, Al and Fe) for two samplings at Aubure (in May and in September). The co-operation together with the German Bayreuth group on cross-site comparisons of our data sets has started. Data have been handed over to the Dutch group for modelling.

IV MAIN RESULTS OBTAINED: *METHODOLOGY; RESULTS; DISCUSSION; CONCLUSIONS* (use other flags if necessary but preferably no more than 2)

- There is a concentration of living fine roots to the 0-2.5 cm layer of the European beech stand compared with the same layer in the Norway spruce stand.
- Dead fine roots are found much deeper down in the soil profile in the European beech stand than in the Norway spruce stand.
- Considerable more fine roots are to be found in European beech than in Norway spruce stands.
- There was no correlation between the amount of fine roots in the total soil profile and depth of the humus layer in the Norway spruce stand – similar data are not available from the European beech stand (no humus layer).
- The living fine roots in both the Norway spruce and European beech stands are very superficially distributed.
- The most vital fine roots in both stands were found in the top 0-5 cm layer - the live to dead ratio is much higher in that part of the soil profile.
- Fine roots in both forest stands seem to be uniformly but patchy distributed, independent of the distance to the nearest sampling tree.
- There is a substantial seasonal fluctuation in the amounts of living, dead and standing crop of fine roots (live + dead) in both stands.

V. List of publications arising from the project (include copies):

Persson, H. and Ahlström, K. 1998. Effect of nitrogen deposition on tree roots. In: Rastin, N. & Bauhus, J. (Eds.) Going underground - ecological studies in forest soils, in press.

Signature of Partner:

Hans Persson

Date February 5th, 1998

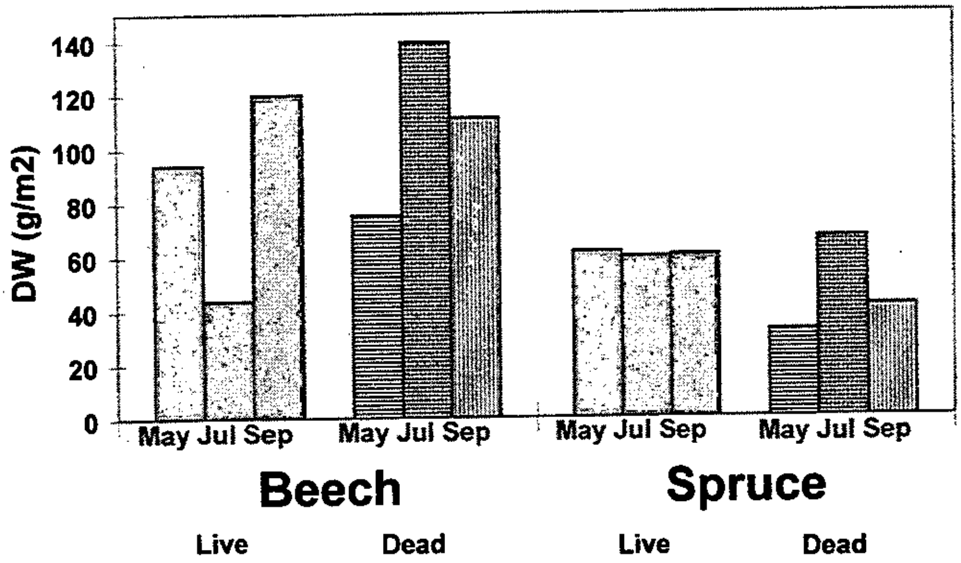

Fig. 1. The standing crop (live and dead) of fine roots (< 1 mm in diameter) at the Aubure European beech and Norway spruce sites.

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1. February 1997 to 31. January 1998

Partner: Danish Forest and Landscape Research Institute, DFLRI

Principal Investigator: Dr. Bjørn R. Andersen

Scientific staff: Dr. Bjørn R. Andersen

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I. OBJECTIVES FOR THE REPORTING PERIOD:

Continuous sampling and analysis (N compounds, DOC, base cations) of soil water samples from the stands along the CANIF gradient. Emphasis on hydrology in Danish beech stand (dependent on our success in obtaining supplementary national funding). Installation of sampler equipment at the Italian sites. Completion of data base containing meteorological and stand data for the CANIF sites followed by hydrological modelling for all sites in co-operation with Dutch partner.

II. OBJECTIVES FOR THE NEXT PERIOD:

Completion of data base containing meteorological and stand data for the CANIF sites followed by hydrological modelling for all sites in co-operation with Dutch partner. Ending the sampling programme and analysis (N compounds, DOC, base cations) of soil water samples from the stands along the CANIF gradient. Include measurements of TON and TOC from a limited number of Danish forest stands selected due to a relatively heavy atmospheric N input (securing mutual benefits to an on-going Nordic project). Estimation of N fluxes in the soil compartment. Prepare manuscript for a chapter in the planned book covering the entire project periods of NIPHYS and CANIF.

III. Are there any particular problems ? Is your part of the project on schedule ?

We have again experienced a period with prolonged dry soil conditions at several sites, and consequently obtained far fewer soil water samples than anticipated. The installation programme in Italy was finally completed in the spring 1997 but Italy too had relatively dry conditions resulting in few samples until late 1997. The completion of a data base containing meteorological and stand data for the CANIF sites followed by hydrological modelling for all sites in co-operation with our Dutch partner is in progress but has been somewhat delayed. We have not succeeded in obtaining national funding for conducting a more detailed study on hydrological conditions and their possible effects on the C and N cycling at the Danish beech site. As a consequence of these deviations from the planned work, we adjusted our project schedule during 1997 resulting in spending only 49% of the original budget. The postponed work is now scheduled for the final part of the contract period.

IV. MAIN RESULTS OBTAINED:

METHODOLOGY. No changes in the methodologies used.

RESULTS. We still observe that organically bound N is a significant part of total N in soil solutions from the investigated stands. Our measurements can not demonstrate that there is a direct relationship between concentrations of DON (dissolved organic N) and DOC (dissolved organic C). Samples from the new installations in Italy has not yet been transferred to Denmark for analysis.

DISCUSSION. It is probably because many other processes than those associated with N cycling influence the concentrations of DOC that we can not demonstrate a direct link between measured C and N concentrations.

CONCLUSIONS. Our original hypothesis on the significance of DON compared to inorganic N compounds is still supported by our measurements. Consequently, we continue to argue the need to include DON data when assessing N cycling and leaching to systems outside forest ecosystems. In particular, it may be necessary to address the possibility of organic N leaching into ground water sources normally thought to be better protected by forest cover than other land-use forms.

V. List of Publications arising from the project (include copies):
None.

Signature of Partner:

Bjørn R. Andersen

Date: 6. March 1998

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 01.02.1997 - 31.01.1998

Partner: Justus-Liebig-University Giessen

Principal Investigator: Prof. Dr. Volkmar Wolters

Scientific Staff: Dagmar Schröter

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Germany

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e-mail:
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Dagmar.Schroeter@allzool.bio.uni-giessen.de

I. OBJECTIVES FOR THE REPORTING PERIOD:

(i) continuation of sampling of soil cores to determine the structure of the invertebrate communities; (ii) determination of feeding rates, trophic connectivity and mineralization rates of the soil food webs; (iv) evaluation of data

II. OBJECTIVES FOR THE NEXT PERIOD:

(i) finalising sampling programme; (ii) concluding determination of the structure of soil communities along the European transect; (iii) complementary microcosm experiments; (vi) modelling the contribution of soil organisms to C and N mineralization; (iv) final evaluation of data and report.

III. Are there any particular problems? Is your part of the project on schedule?

It was not possible to extent the sampling scheme to all sites because of lack of time and (wo)man power. It was therefore decided to continue with the last years sampling design to get maximum output (four coniferous sites along the transect).

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSION* (use other pages as necessary but preferably no more than 2)

Investigation of the four coniferous sites (Aubure, Waldstein, Skogaby, Åheden) was continued with two more complete samplings, in spring and summer of 1997. Parameters measured are identical to those reported last year. Data were evaluated.

Results of the laboratory microcosm experiment reported last year were evaluated.

Main results see next page (supplement)!

V. List of Publications arising from the project (include copies):

B. Pieper, A. Klein, K. Ekschmitt & V. Wolters (1997): Umsatz der organischen Substanz in Waldböden: Einfluß von Abundanz und Diversität der Collembolen. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft, 85, II, 571-574.

D. Schröter, A. Hülsmann, A. Pflug & V. Wolters (1997): Die Bodenfauna in der organischen Auflage entlang eines europäischen Transekts. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft, 85, II, 599-602.

D. Schröter, A. Hülsmann, A. Pflug & V. Wolters (1998 in prep.): Climate effects on soil biota of coniferous forests: a transect approach. Contribuition to the GCTE-LUCC Open Science Conference on Global Change, March 1998, Barcelona, Spain.

Signature of Partner:

Date: 30.1.98

Supplement

Main results (continued):

Only the first sampling (autumn 1996) could be included in the detailed statistical analyses so far. The sites showed characteristic invertebrate communities. Trophic connectivity between mesofauna, microfauna and microflora systematically changes along the transect, with large and small scale climatic gradients affecting the structure of the edaphon. For example, abundance of all invertebrate taxa (except Nematoda) showed a significant positive correlation to the water content of the organic layer. Humidity thus explained both within-site as well as between-site variation. This offers a chance for predicting the potential effect of climatic change. A thick organic layer in combination with unexpectedly high CO_2-elevation and microbial biomass at the Northern Swedish site pointed to an enormous microbial potential, probably depressed by adverse environmental conditions. Alteration in climate may be of particular significance at this site.

First analyses of material from the second sampling suggest a decreasing abundance and diversity of testate amoebae from South to North, while the percentage of active testate amoebae increased.

In a co-operation with Peter de Ruiter (DLO Research Institute for Agrobiology and Soil Fertility; Haren, NL) the soil biotic data of the sites were incorporated into a food web model (Peter de Ruiter, Anje-Margriet Neutel and John C. Moore (1994), TREE, 9, 378-383). Preliminary results for the coniferous site in Aubure show a contribution of soil biota (fauna + microflora) to C and N mineralization of approximately 2200 kg C/ha*year and 65 kg N/ha*year respectively. Diversity effects are recently being tested.

According to the results of the microcosm experiment abundance and community structure of the mesofauna affects soil processes. Collembola abundance was found to stimulate microbial C-mineralization up to a threshold level, beyond which mineralization decreased probably as a result of overgrazing. Effects of species composition under static as well as dynamic microclimate (temperature and humidity) were related to different life strategies and tolerances of the Collembola species. This confirms the results from the field experiment with 15N.

PART B

DETAILED REPORT OF THE INDIVUDUAL PARTNERS

Reporting period: 1997 (Second year)

Partner: 10 IT (GB) Institute of Terrestrial Ecology

Principal Investigator: Dr A F Harrison and A P Rowland

Scientific Staff: Dr D D Harkness (NERC Radiocarbon Laboratory), J S Garnett.

Address: Natural Environment Research Council, Institute of Terrestrial Ecology,
Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU, UK

Telephone: 00-44-15395-32264
Fax: 00-44-15395-34705 E-Mail: T.Harrison@ITE.AC.UK

Research Area: Total carbon and nitrogen fluxes in coniferous and deciduous forest soils.

I. OBJECTIVES FOR THE REPORTING PERIOD.

Obtain litter and soil samples from remaining sites (Collelongo and Monte di Mezzo in Italy, and Aheden in N. Sweden) and prepare samples for chemical analysis for organic C and N and radiocarbon analysis. Submit these samples for analysis for analysis. Collate analytical data as it becomes available and commence calculation of C and N pools of the soils of the various forest sites. Convert the $\delta^{14}C$-data into estimates of carbon ages, using the NERC Radiocarbon Laboratory model and evaluate the information as it becomes available.

II. OBJECTIVES FOR THE NEXT PERIOD.

Obtain and collate all the data for all the forest sites. Complete calculation of the soil carbon and nitrogen pools and calculate C and N fluxes for all sites. Integrate the data with other site data on climate, forest productivity and Eddy Covariance data (for the sites for which it is available). Make information available to others within the consortium, particularly the modellers for model development and validation.

III Are there any particular problems ? Is your part of the project on schedule ?

There are no problems. Yes, the programme is on schedule.

IV. MAIN RESULTS OBTAINED : METHODOLOGY, RESULTS, DISCUSSION AND CONCLUSIONS.

Litter and soil samples from all the CANIF forest sites, from Aheden in N. Sweden to Collelongo and Monte di Mezzo in Italy have now been obtained and processed. Soil dry mass (<2mm fraction) and bulk density have been determined for the litter layer, 0-5 cm, 5-10 cm and 10-20 cm horizons and sub-samples from each layer in all cores from all forest sites have been chemically analysed using the Tinsley method for organic C and Kjeldahl digestion method for N. We are now in the process of computing up the estimates for the total C (kg c m^{-2}) and N (kg N m^{-2}) pools for all the soils (litter to 20 cm depth) in all the forests. We should have the estimates calculated by mid-February and should be in a position to start relating the results to site characteristics (tree species, site latitude, climatic data) and discuss the results with other members of the research group, particularly the modellers after that time.

All litter and soil samples have been prepared and submitted for $\delta^{14}C$ analysis by accelerator mass-spectrometry, including some additional samples from the spruce site Nacetin in the Czech Republic. The $\delta^{14}C$ data for litters and soil samples are now available for the forest sites Skogaby (spruce), Hillerod (beech), Waldstein (spruce), Schacht (beech), and Aubure (spruce and beech). Those for Monte di Mezzo (spruce), Collelongo (beech), Aheden (spruce) and Nacetin (spruce) are still awaited. The available $\delta^{14}C$ data have been converted mean carbon ages for the total organic carbon present in litter and soils using the model; the modelled age is defined as the average time in years since the carbon was 'captured' from the atmosphere by photosynthesis.

The resolution and reproducibility of the $\delta^{14}C$ technique coupled with the modelling of organic matter ages are encouraging and are consistent with results obtained from UK forests. For those sites which provisional data is currently available, mean age of carbon, as measured and defined above, suggest that the litter layer is c 7 years for the beech sites and c 16 years for spruce sites. One reason for the 'older' carbon in the litter of the spruce forests may well be that the average carbon age ie age since carbon capture by photosynthesis, of litter inputs is greater, as spruce is evergreen and it retains its needles for several years before they fall as litter. This aspect is being investigated. Beech sites also appear to have younger soil organic matter in the 0-5cm layer of the mineral horizon compared with those of the spruce sites; c 110 years in the former and 165 years in the latter. No age differences between beech and spruce is indicated for the 5-10 and 10-20 cm layers, where the organic matter appears generally to be > 300 years old.

V. List of publications arising from the project

None at this stage in the project.

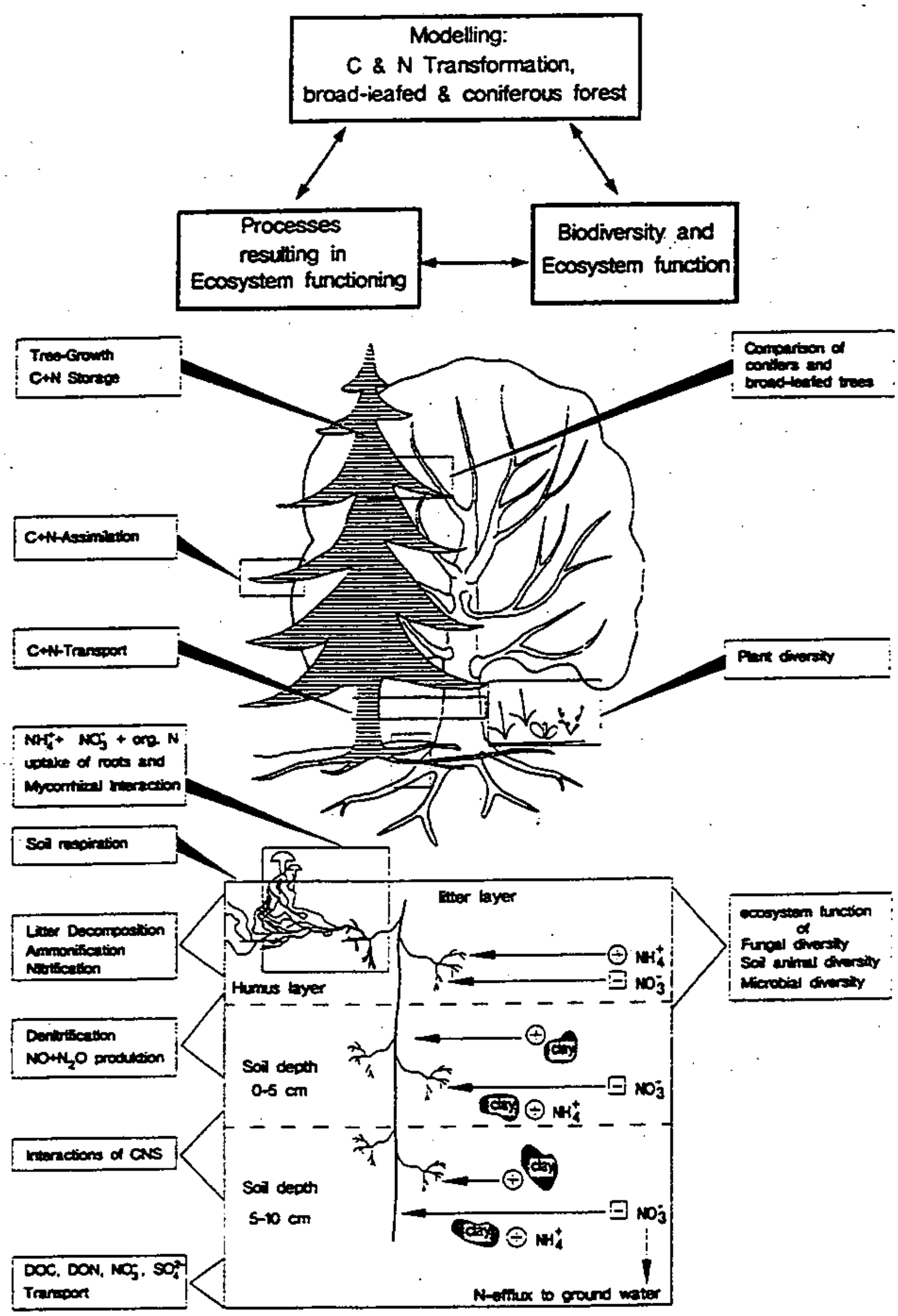
Signature of Partner: Anthony Harrison
Date: 17th February 1998

CANIF - Carbon and Nitrogen Cycling in Forest ecosystems

Annual Report
1.2.1997 - 31.1.1998

EEC contract No ENV4-CT95-0053
and
subcontract No ERB IC20 CT960024

E.-D. Schulze (coordinator)



Bayreuth, Germany
February, 1998

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PART B

DETAILED REPORT OF THE INDIVUDUAL PARTNERS

Reporting period: 1997 (Second year)

Partner: 10 IT (GB) Institute of Terrestrial Ecology

Principal Investigator: Dr A F Harrison and A P Rowland

Scientific Staff: Dr D D Harkness (NERC Radiocarbon Laboratory), J S Garnett.

Address: Natural Environment Research Council, Institute of Terrestrial Ecology,
Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU, UK

Telephone: 00-44-15395-32264
Fax: 00-44-15395-34705 E-Mail: T.Harrison@ITE.AC.UK

Research Area: Total carbon and nitrogen fluxes in coniferous and deciduous forest soils.

I. OBJECTIVES FOR THE REPORTING PERIOD.

Obtain litter and soil samples from remaining sites (Collelongo and Monte di Mezzo in Italy, and Aheden in N. Sweden) and prepare samples for chemical analysis for organic C and N and radiocarbon analysis. Submit these samples for analysis for analysis. Collate analytical data as it becomes available and commence calculation of C and N pools of the soils of the various forest sites. Convert the $\delta^{14}C$-data into estimates of carbon ages, using the NERC Radiocarbon Laboratory model and evaluate the information as it becomes available.

II. OBJECTIVES FOR THE NEXT PERIOD.

Obtain and collate all the data for all the forest sites. Complete calculation of the soil carbon and nitrogen pools and calculate C and N fluxes for all sites. Integrate the data with other site data on climate, forest productivity and Eddy Covariance data (for the sites for which it is available). Make information available to others within the consortium, particularly the modellers for model development and validation.

III Are there any particular problems ? Is your part of the project on schedule ?

There are no problems. Yes, the programme is on schedule.

IV. MAIN RESULTS OBTAINED : METHODOLOGY, RESULTS, DISCUSSION AND CONCLUSIONS.

Litter and soil samples from all the CANIF forest sites, from Aheden in N. Sweden to Collelongo and Monte di Mezzo in Italy have now been obtained and processed. Soil dry mass (<2mm fraction) and bulk density have been determined for the litter layer, 0-5 cm, 5-10 cm and 10-20 cm horizons and sub-samples from each layer in all cores from all forest sites have been chemically analysed using the Tinsley method for organic C and Kjeldahl digestion method for N. We are now in the process of computing up the estimates for the total C (kg c m^{-2}) and N (kg N m^{-2}) pools for all the soils (litter to 20 cm depth) in all the forests. We should have the estimates calculated by mid-February and should be in a position to start relating the results to site characteristics (tree species, site latitude, climatic data) and discuss the results with other members of the research group, particularly the modellers after that time.

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The resolution and reproducibility of the $\delta^{14}C$ technique coupled with the modelling of organic matter ages are encouraging and are consistent with results obtained from UK forests. For those sites which provisional data is currently available, mean age of carbon, as measured and defined above, suggest that the litter layer is c 7 years for the beech sites and c 16 years for spruce sites. One reason for the 'older' carbon in the litter of the spruce forests may well be that the average carbon age ie age since carbon capture by photosynthesis, of litter inputs is greater, as spruce is evergreen and it retains its needles for several years before they fall as litter. This aspect is being investigated. Beech sites also appear to have younger soil organic matter in the 0-5cm layer of the mineral horizon compared with those of the spruce sites; c 110 years in the former and 165 years in the latter. No age differences between beech and spruce is indicated for the 5-10 and 10-20 cm layers, where the organic matter appears generally to be > 300 years old.

V. List of publications arising from the project

None at this stage in the project.

Signature of Partner: Anthony Harrison
Date: 17th February 1998

CANIF - Carbon and Nitrogen Cycling in Forest ecosystems

Annual Report
1.2.1997 - 31.1.1998

EEC contract No ENV4-CT95-0053
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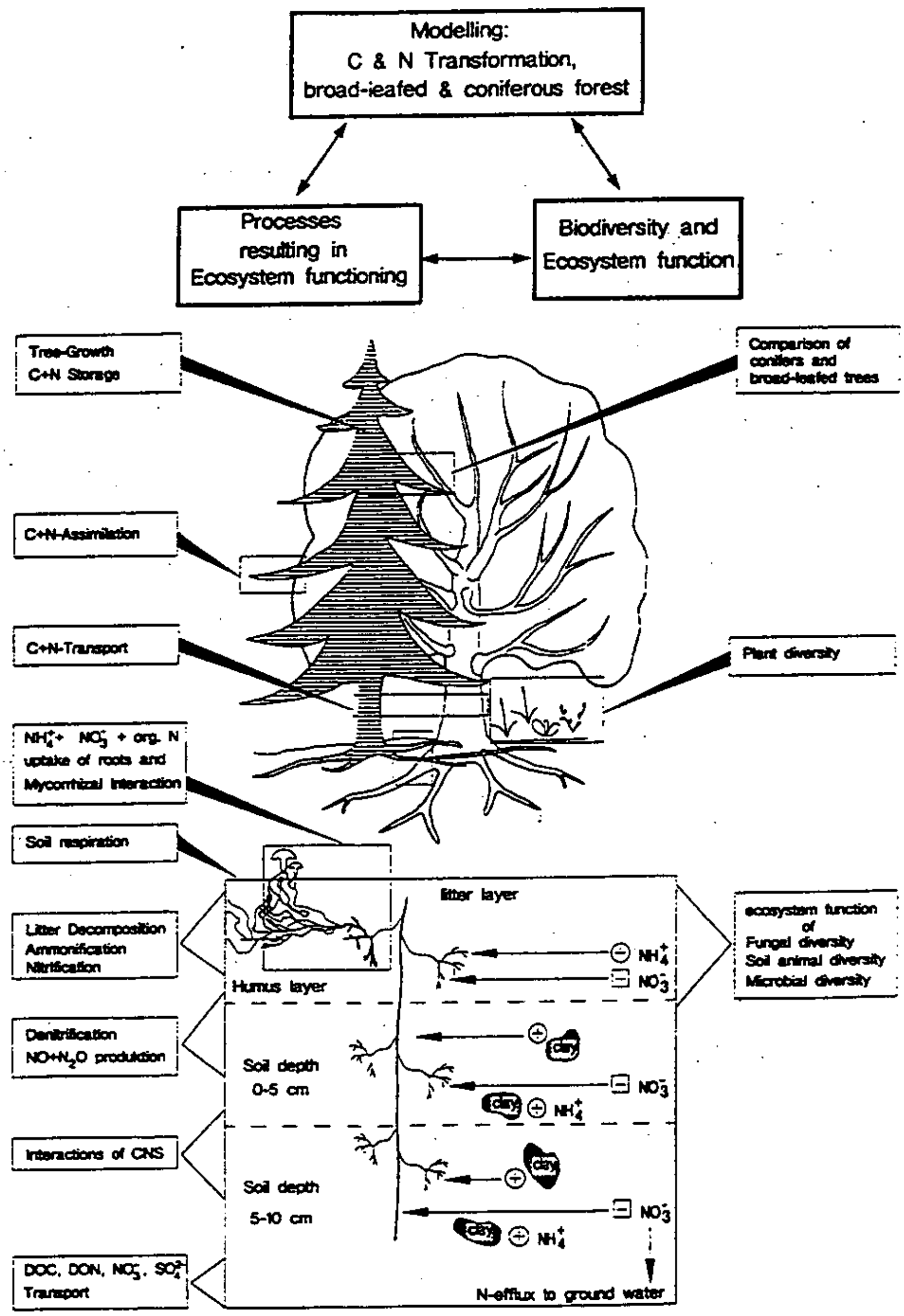
E.-D. Schulze (coordinator)



Bayreuth, Germany
February, 1998

PART B

DETAILED REPORT OF THE INDIVUDUAL PARTNERS

Reporting period: 1997 (Second year)

Partner: 10 IT (GB) Institute of Terrestrial Ecology

Principal Investigator: Dr A F Harrison and A P Rowland

Scientific Staff: Dr D D Harkness (NERC Radiocarbon Laboratory), J S Garnett.

Address: Natural Environment Research Council, Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU, UK

Telephone: 00-44-15395-32264
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Research Area: Total carbon and nitrogen fluxes in coniferous and deciduous forest soils.

I. OBJECTIVES FOR THE REPORTING PERIOD.

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II. OBJECTIVES FOR THE NEXT PERIOD.

Obtain and collate all the data for all the forest sites. Complete calculation of the soil carbon and nitrogen pools and calculate C and N fluxes for all sites. Integrate the data with other site data on climate, forest productivity and Eddy Covariance data (for the sites for which it is available). Make information available to others within the consortium, particularly the modellers for model development and validation.

III Are there any particular problems ? Is your part of the project on schedule ?

There are no problems. Yes, the programme is on schedule.

IV. MAIN RESULTS OBTAINED : METHODOLOGY, RESULTS, DISCUSSION AND CONCLUSIONS.

Litter and soil samples from all the CANIF forest sites, from Aheden in N. Sweden to Collelongo and Monte di Mezzo in Italy have now been obtained and processed. Soil dry mass (<2mm fraction) and bulk density have been determined for the litter layer, 0-5 cm, 5-10 cm and 10-20 cm horizons and sub-samples from each layer in all cores from all forest sites have been chemically analysed using the Tinsley method for organic C and Kjeldahl digestion method for N. We are now in the process of computing up the estimates for the total C (kg c m^{-2}) and N (kg N m^{-2}) pools for all the soils (litter to 20 cm depth) in all the forests. We should have the estimates calculated by mid-February and should be in a position to start relating the results to site characteristics (tree species, site latitude, climatic data) and discuss the results with other members of the research group, particularly the modellers after that time.

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V. List of publications arising from the project

None at this stage in the project.

Signature of Partner: Anthony Harrison
Date: 17th February 1998

PART B

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 1.2.1997 to 31.1.1998

Partner: No. 8, University of Copenhagen

Principal Investigator: Sten Struwe

Scientific staff: Morten Miller, Annelise Kjøller, Sten Struwe

Address: Department of General Microbiology
Sølvgade 83 H
DK-1307 Copenhagen K

Telephone: +45 35 32 20 50

Fax: +45 35 32 20 40 **E-Mail:** struwe@mermaid.molbio.ku.dk

I. OBJECTIVES FOR THE REPORTING PERIOD:

The aim of a joint study between the Danish and the Italien partners was to investigate the interaction of substrate quality, climate and saprophytic fungal activity in beech litter along the CANIF European transect.

II. OBJECTIVES FOR THE NEXT PERIOD:

The objectives of the last period of CANIF will be:
1. A continuation of the studies of decomposition of beech litter at the selected CANIF sites.
2. Extention of the gas measurements to other CANIF sites conducted in campaigns in selected periods to identify maximal emission events. The sites are the same selected for the decomposition studies.

III. **Are there any particular problems ? Is your part of the project on schedule ?**

There is good progress and the studies will be concluded in late autumn.

IV. **MAIN RESULTS OBTAINED:** ***METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS*** **(use other pages as necessary but preferably no more than 2)**

see attachment

V. **List of Publications arising from the project (include copies):**

Kjøller, A. & Struwe, S. 1997. Microbial diversity and its relation to decomposition processes. In: Functional Implications of Biodiversity in Soil. V. Wolthers ed. Ecosystem research report no 24. European Commission. Brussels. pp 83-98.

Hui, Xu, Struwe, S. & Kjøller, A. 1997. Emission of N_2O from beech forest soil. In: Proceedings of 7th International Workshop on Nitrous Oxide Emissions. April 21-23, 1997, Cologne, Germany. pp 473-478.

Miller, M., Palojärvi, A., Rangger, A., Reeslev, M. & Kjøller, A. 1998. The use of fluorogenic substrates to measure fungal presence and activity in soil. Applied and Environmental Microbiology 64: 613-17.

Møller, J., Miller, M. & Kjøller, A. 1998. Fungal-bacterial interaction on beech leaves; influence on decomposition and dissolved organic matter quality. Submitted to Soil Biology and Biochemistry.

Signature of Partner:

Date: 24.2.1998

DECOMPOSITION STUDIES

Experimental design:

Experiment 1. To study the decomposition of beech litter, originating from different geographical locations, (different litter quality) at one site under the same environmental conditions, beech litter from Aubure, Schacht and Soroe has been transplanted to the Italian site at Collelongo.
The aim will be to identify links between fungal activity, resource quality and N-content during decomposition of beech litter. Special emphasis will be put on the role of N as a rate regulating factor at different stages of decomposition.

Experiment 2. To study the decomposition of a standard beech litter along the CANIF European transect, Italian beech litter has been transplanted to the Aubure, Schacht and Soroe sites. Cellulose filter paper has been included as a control. The emphasis will be to investigate the influence of climate on fungal community structure, litter decomposition and the role of N-deposition.

Copenhagen contribution - short description and rationale

- Determination of content/availability of fungal specific enzyme activities relating to fungal presence and activity.

  The novel application of fluorescent substrates for specific detecting and quantifying fungal activity, may increase our understanding of the functional role of saprophytic fungi in decomposition processes on litter of different ressource quality and under different climatic conditions. The nondestructive technique is a unique tool in filling the gap between process oriented research and organism based ecological studies. Cellulase and chitinase activity techniques are available

- Quantification of soluble polyphenols.

  The content of polyphenols have an important rate regulating role especially at later stages of decomposition. Thus the content and temporal dynamics of polyphenols is an important parameter for changes in litter ressource quality during different stages of decomposition. The dynamics of polyphenol degradation may differ under different climatic conditions and may influence the fungal community structure.

- Quantification of total dissolved primary amines (TDPA).

  TDPA comprises a very important group of readily available dissolved organic N compounds derived mainly from depolymerization of complex organic N-sources such as proteins and chitin. Thus the temporal dynamics of this pool will be an important parameter in interpreting the role of N as a rate regulating factor at different stages of decomposition.

- Total N (Kjeldahl extraction).
- Ash content.
- Soil wash isolations to monitor changes in fungal community structure.

Time schedule:

6 collections are anticipated after 4, 8, 12, 16 , 20 and 24 months - 1997 - 1998.

Sampling dates: 1: March 1997; 2: July 1997; 3: November 1997; 4: March 1998; 5: July 1998; 6.: November 1998.

Procedures at each sampling time:

10 nylon litter bags are harvested at each site.

7 nylon litter bags are used for determination of mass loss + cellulose and lignin content (Francesca).

3 nylon litter bags are send by airfreight in a heat insulated container with an ice box.

The first three samplings have been analysed in the laboratory but the data obtained are not yet processed. Not untill after the last sampling in November 1998 the results of the experiments can be evaluated.

C ANIF

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: February 1. 1997 - January 31. 1998

Partner: Wageningen Agricultural University
Nature Conservation and Plant Ecology Group

Principal Investigator: Professor Dr. F. Berendse

Scientific staff: Dr. H. van Oene

Address: Nature Conservation and Plant Ecology Group
Wageningen Agricultural University
Bornsesteeg 69
NL-6708 PD Wageningen, The Netherlands

Telephone: +31 317 484973

Fax: +31 317 484845 E-mail: Frank.Berendse@STAF.TON.WAU.NL

I. OBJECTIVES FOR THE REPORTING PERIOD:

- to adapt and to test the model further
- to construct a data bank with data needed for the model for all sites
- to perform a sensitivity analysis to determine the relative impacts of the different processes and parameters
- to validate the model using data from a ^{15}N pulse labelling experiment in a 15-year
- old spruce stand
- to visit other partners to gather data and visit the field sites
- to parameterise the processes included in the model

II. OBJECTIVES FOR THE NEXT PERIOD:

- to finalise parameter estimation
- to finalise the data bank with data needed for the model for all sites
- to perform a sensitivity analysis to determine the relative impacts of the different
- processes and parameters
- to validate the model using data on carbon and nitrogen pools, N productivity and N mineralisation
- to validate the model using data from a ^{15}N pulse labelling experiment in a 15-year
- old spruce stand
- to make simulations for inter-site comparisons
- to make simulations for tree species comparisons
- to analyse the effects for climatic change on ecosystem variables

III. Are there any particular problems? Is your part of the project on schedule?

The gathering of data for parameter estimation and model validation lays behind schedule. Measurements and analyses went still on through whole 1997 therefore the databank could not be completed. Parameter estimation will now be mainly based on literature data. For some sites it is hard to obtain all data necessary for modelling.

IV. MAIN RESULTS OBTAINED: *METHOLOGY, RESULTS, DISCUSSION, CONCLUSIONS* (use other pages as necessary but preferably no more than 2)

The model is a dynamic proces-oriented model, running with a timestep of one day (can be varied between 1 day and 1 month). The model describes plant growth, soil organic matter dynamics, hydrology and soil chemistry. The model includes processes like light interception and C-assimilation, decomposition, mineralisation, N uptake, water uptake, evapotranspiration, and leaching. It keeps track of the C and N pools and fluxes in the vegetation, in the soil organic matter and in the soil.
During 1997 the soil chemistry module is adapted for calcereous soils (the Italian site). For validation purposes with data from ^{15}N isotope studies, the model is extended with isotope fractionation of the processes nitrification, mineralisation, uptake, cation exchange, tree leaf and root nitrogen redistribution, deposition and leaching.
To stimulate standardised data gathering, databank files were set up in a standardised format. These files were distributed to be filled in by the site-responsible groups and groups measuring data at several sites. The data to be included were discussed on the 1997 project meeting.
During 1997 the groups in Umeå and Uppsala were visited to discuss the structure of the dataset, and for field site visit. Early that year the Italian field site Collelongo was visited.
For parameterisation of the moisture and temperature dependency of the processes decomposition and mineralisation, literature data were compared with measured data. Isotope fractionation parameters were estimated from literature.

V. List of Publications arising from the project (include copies):

Signature of Partner:

Date: 9-2-98

DETAILED REPORT OF THE INDIVIDUAL PARTNERS

Reporting period: 31/01/1997 - 31/01/1998

Partner: Tomas PACES

Principal Investigator: E.-D. Schulze

Scientific staff: F. Buzek, M. Novak, J. Cerny, H. Groscheova

Address: Czech Geological Survey
Klarov 3
CZ-118 21 Prague
Czech Republic

Telephone: +420-2-5816945

Fax: +420-2-5816748 E-Mail: paces&cgu.cz

I. OBJECTIVES FOR THE REPORTING PERIOD:

(1) Evaluation of nitrogen isotope fractionation in soil mineralized nitrogen, contribution of nitrogen in atmospheric deposition to soil nitrogen.
(2) Evaluation of the diferences in nitrogen biogeochemical cycles in acidified and unacidified forest catchments.
(3) Sampling of spruce canopy throughfall and soil water at Aubure, Skogaby, Aheden and Viterbo over a period of 3 months, processing of soil samples from these sites. Determination of $\delta^{34}S$ ratios in spuce throughfall, soil water and 3 bulk soil horizons. Identification of common trends in S metabolism across the noth - south European transect.

II. OBJECTIVES FOR THE NEXT PERIOD:

(1) Sampling at four Czech sites: Cervena Jama (spruce), Nacetin (spruce), Jezeri (beech) and Salacova Lhota (spruce). Measuremnt of seasonal variation in DON and NH_4 content and ^{15}N fractionation. Carbon isotope fractionation in soil organic carbon. Determination of relationships between the humic substances and physical particles of soils.
(2) Speciation of S isotopes in inorganic sulfate, ester-sulfate and carbon-bonded sulfur in the soils of the CANIF sites, i.e., along the longitudinal transect across Europe. A combined $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ analysis of vertical profiles through these soils. Monthly $\delta^{34}S$ monitoring at the two Czech study sites - Jezeří and Salačova Lhota (Bulk deposition, spruce canopy throughfall and surface discharge).

PART B

III. Are there any particular problems ? Is your part of the project on schedule ?

(1) Our method of soil extract stabilization was not efficient and we could not finish the measurements of DON variation on monitored sites. The method has been improved and a new field sampling will start in April 1998. The evaluation of mineralized nitrogen isotope fractionation, the measurement of nitrogen and sulphur mass balance and the measurements of sulfur isotopes are on schedule.

(2) Samples of atmospheric deposition (spruce canopy throughfall) and soil water from the Italian site are currently being taken. The originally planned sampling scheme (6 samples spanning a period of 3 months) was delayed in connection with the lysimeter installations which took place only in mid-1997. Sofar, we were not able to obtain soil samples from Aheden, which would complement existing water samples, and soil samples from the spruce stand at Viterbo.

IV. MAIN RESULTS OBTAINED: *METHODOLOGY, RESULTS, DISCUSSION, CONCLUSIONS* (use other pages as necessary but preferably no more than 2)

(1) High atmospheric deposition in the past have affected recent nitrogen cycling in acidified forest soils. Changes in soil nitrate production, admixing of atmospheric nitrogen and nitrogen consumption were described using changes in 15N fractionation of mineralized nitrogen in soil. For exchangeable ammonium an effect of admixing of atmospheric ammonium could be identified at low concentrations only (mineral soil horizons). Input of atmospheric nitrate was detected in soil nitrate (lysimeters), its contribution varied from 15 to 40% of total nitrate content.
Method of mineralization of DON (total reduction of all nitrogen) was improved to give more reproducible results in concentration and ^{15}N measurements. Thymol addition is not sufficient for long time period of stabilization of cooled soil extracts.
(2) Denitrification is inhibited and mineralization of organic matter is increased in the spruce forest with extremly high input of dry SO_2 and wet H_2SO_4. While Fagus Sylvatica exposed to higher atmospheric input of S compounds remains healthy and fixes nitrogen, the same atmospheric input of S causes dieback of Picea abies and leaching of nitrates from the damaged forest.
(3) Three sites under study (Aubure, Aheden and Načetín) exhibited a decrease in d34S of soil water relative to atmospheric deposition. The fourth site (Skogaby) exhibited the same trend over a period of 2 out of 3 monitored months. We suggest that this isotope shift provides evidence for organic cycling of the incoming sulfate S. The importance of the mineralized S in soil water solutions is not influenced by low mean annual temperatures of Aheden (Central Sweden). All three sites studied sofar (Aubure, Skogaby, Načetín) had similar S isotope trends in bulk soil: with an increasing depth $\delta^{34}S$ also increased. We interpret this positive S isotope shift as complementary to the negative S isotope shift of water vertically penetrating the soil profile. Collectively, the cycling of the incoming sulfate S through organic matter appears to play a more important role that previously believed.
Jezeří and Salačova Lhota were subjected to monthly monitoring of $\delta^{34}S$ in atmospheric deposition and surface discharge in 1997. The results are given in the enclosed paper (Novák, 1998). At Jezeří we also evaluated an elevational gradient in d34S (elevation span of 440 meters). The trends are described in a paper by Groscheová et al. (1998).

V. List of Publications arising from the project (include copies):

Paces T., Cerny J., Havel M., Krejci R., Pacesova E. (1997) Acidification during dry, rainy and snowy events in the Czech Republic (central Europe). In:

Buzek F., Černý J., Pačes T. (1998) The bahaviour of nitrogen isotopes in acidified forest soils in the Czech Republic. Water, Air and Soil Pollution 81 (in print).

Novak M. (1998) d34dynamics in the system bedrock-soil-runoff-atmosphere:Results from the GEOMON network of small catchments, Czech Republic. Int. Symp. on Water-Rock Interaction - 9, Balkema (in print).

Groscheova H., Novak M., Havel M., Cerny J. (1998) Effect of altitude and tree species on d34 S of deposited sulfur (Jezeri catchment, Czech Republic). Water, Air and Soil Pollution 81 (in print).

Signature of Partner: T. Pačes

Date: 06/02/98