**INTRODUCTION**

Carbon and nitrogen stable isotope ratios are now widely used in ecological science. Recent publications have shown that this method has a potential advantage in describing soil food webs (Ponsard & Arditi 2000; Scheu & Falca 2000) as well as other food webs, which have been studied for several decades. However, isotopic studies on soil food webs are still under development (Eggers & Jones 2000), so that fundamental research on a specific group is also useful at this stage.

There are several studies on specific taxonomic groups; for example, on earthworms (Schmidt et al. 1997; Neilson et al. 1998; Hendrix et al. 1999). Neilson et al. (2000) have shown that epigeic (litter-feeding) earthworms were separated from endogeic (soil-feeding) earthworms using C and N isotope ratios, although anecic (deep-burrowing and litter-feeding) earthworms were rather site dependent. These studies suggest that there is a 'humification gradient' (i.e. state of decay of plant material) in feeding habits within a taxonomic group in detritivores, which are at the base of...
soil food webs. These variations remain to be studied, as well as the recent discussion on trophic level enrichment on δ15N (e.g., Eggers & Jones 2000).

Termite (Isoptera) is another example. They are dominant soil invertebrates occurring mainly in tropical and subtropical ecosystems and play important roles in the decomposition process (Wood & Sands 1978). Differences in δ13C have been used to study changes in vegetation between C3 (largely woody forms) and C4 plants (mostly tropical grasses) (Boutton et al. 1998), and feeding habits of termites on vegetation have been demonstrated (Lepage et al. 1993). Termites have a well-developed set of functional classifications (Bignell & Eggleton 2000). Donovan et al. (2001) presented a quantitative functional classification of termite feeding groups based on gut content analysis as correlated with the morphology and anatomy of worker termites and separated feeding groups into four (I–IV). Groups II, III and IV termites are found in the Termitidae but only Group I is found in the Termitidae. This classification ranks species along a humification, with Group I feeding on the least humified plant material and Group IV feeding on the most humified material. Groups III and IV (so-called ‘soil-feeders’) termites have increasingly modified gut and mandible structures according to their respective positions along the humification gradient. This classification is in good agreement (Eggleton & Tayasu in press) with the groupings by δ13C and δ15N values, which have ranked species on the humification gradient (Tayasu 1998).

Termites are one of the prominent ecosystem engineers (Jones et al. 1994), which construct physical structures that often allow other animals to inhabit. Some termites make epigal nests (mounds), which are made by feces or soils. In a dry evergreen forest (DEF) in Thailand, termites are abundant soil macro-invertebrates and their biomass ranges up to 11 g m⁻² (fresh wt, Inoue et al. 2001). Group III soil-feeders occur in Thailand but Group IV has not been found in Thailand (P. Eggleton et al., pers. comm., 2001). Typical epigal nests are made by the genus Microtermes (carton nests), Termites, Dicuspiditermes (both are earthy nests) and Macrotermes (fungus-growing termites; producing large earthy nests) (Y. Takematsu et al., pers. comm., 2001).

Carbon 14 is a naturally occurring, cosmogenic isotope that is normally used for carbon dating of materials up to 45,000 years (half-life = 5730 years; Stuiver & Polach 1977). It has also been used to study retention time of carbon in the biosphere using ‘bomb carbon’ that has been dispersed by thermonuclear tests that maximized atmospheric values of 14C in 1962/63. Since the ending of atmospheric tests, bomb-induced 13C concentrations in the atmosphere declined with an e-folding time of (16.3 ± 0.2) year, which has been estimated from long-term 13CO₂ observations in Germany (Levin & Kromer 1997), mainly due to anthropogenic CO₂ emissions from fossil fuels and mixing between atmosphere and ocean. This trend can be used to study turnover of soil organic matter (O’Brien & Stout 1978), and to trace ‘bomb’ 14C incorporation in animals in forested and grassland ecosystems (Rafter & Stout 1969; Stout & O’Brien 1972; Beavan & Sparks 1998). It should be noted that the 14C technique is useful in forested ecosystems or natural grassland, where changes in 13C signals between C3 and C4 plants are not available.

Several of the isotopes in the decay series from 238U to stable 206Pb have been applied in environmental research (Fowler et al. 1998). The 210Pb (half-life = 22.3 years) formed by radioactive decay of 222Rn through a series of short-lived intermediates has been widely applied as a tracer of atmospheric transfer. It has been commonly used to provide a date record, for example, in lake sediments. At a local scale, as precipitation of 210Pb can be considered as a constant (Branford et al. 1998), it can be used to quantify the inputs to terrestrial surfaces in preceding decades. 137Cs (half-life = 30.1 years) is derived from atmospheric nuclear testing which, like ‘bomb’ carbon, reached maximum levels in 1963/64. 137Cs is useful for estimating turnover in soils (Dörr & Münnich 1989), such as the contribution of earthworms to soil mixing estimated by using 137Cs (Tomlin et al. 1992) and 14C (Stout & Goh 1980).

The aim of the present paper is to present preliminary results on radioisotopes (14C, 137Cs and 210Pb) together with C and N stable isotope ratios, in order to study feeding habits, trophic position, turnover time of carbon, and movement of litter and soils. Finally, we suggest some directions in the study of soil food webs.