This thesis consists of one chapter accepted for publication in a book and four papers published in international journals with impact factors. All of the contributions deal with the role of wood ants in energy and nutrient fluxes in forest ecosystems. Wood ant nests are known as hot spots of carbon dioxide (CO_2) production and are also thought to affect methane (CH_4) flux. Stable high temperatures are maintained in ant nests even in cold environments. This study is focused on quantification of CO_2 and CH_4 flux in wood ant nests, contribution of ants and microbes to CO_2 production, properties of nest material that affect CO_2 production and the role of ants and microbes in the maintenance of nest temperature.

The research was conducted in temperate and boreal forests inhabited by wood ants (*Formica* s. str.). Gas fluxes were measured either by an infrared gas analyser or a static chamber technique. Ants and nest materials were also incubated in a laboratory. Material properties potentially influencing CO_2 flux, such as moisture, nutrient content or temperature were determined.

According to the results, CH_4 oxidation was lower in wood ant nests than in the surrounding forest soil suggesting that some characteristics of ant nests hinder CH_4 oxidation or promote CH_4 production. Wood ant nests clearly are hot spots of CO_2 production in temperate forests originating mainly from ant and also from microbial metabolism. Most important properties positively affecting CO_2 production were found to be moisture, nutrient content and temperature. Nest temperature is maintained by ant and microbial metabolism; nests from colder environments produce more metabolic heat to maintain similar temperature as nests from warmer environments.

This thesis contributed a great deal to the better understanding of the role of wood ants in nutrient and energy fluxes. Abundance of wood ant nests in some forests can be very high and therefore ant nests may largely increase heterogeneity in forest ecosystems.