Kearney Foundation Fellowship
Final Report Summary

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Project Title: The Effects of Nitrogen Addition at Different Stages of Decomposition

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The increasing availability of nitrogen (N) is one of the dominant components of global change (Vitousek 2004). Nitrogen increases plant growth, but effects on decomposition are mixed (Knorr et al. 2005). Decomposition is important because it releases CO_2—a greenhouse gas—to the atmosphere. Previous studies show both stimulation and inhibition of decomposition by nitrogen (Hunt et al. 1988, Hobbie and Vitousek 2000). Furthermore, N has different effects on decomposition at early as opposed to late stages of decomposition (Magill et al. 1998). My study further investigated the effects of N addition on decomposition of plant litter from a California grassland.

I compared N effects on decomposition of fresh litter, old litter, and older, more-decomposed litter (i.e., "light fraction"). I hypothesized that as N addition rates increase, decomposition of fresh litter and old litter would increase to a maximum value and then decrease, because N should speed microbial activity in carbon (C) and N cycling (Chung et al. 2007). This process helps contribute to the total efflux of C from litter respiration. In most terrestrial environments exposed to N deposition, decomposition of fresh and old litter should decrease after some optimum, because most microbes become stressed (Wu et al. 2005). The light fraction consists mainly of mature residue that supports little to no microbial activity (Stevenson and Cole 1999). Thus, I expect that the light fraction will display little to no change in decomposition under increasing N levels.

To test our hypotheses, we constructed a microcosm experiment with litter collected in 2007 from Sedgwick Natural Reserve in Santa Barbara (Table 1).

Substrate		C:N	Age (y)*	Definition
NL	New Litter	53	1	Current year plant production
OL	Old Litter	23	5	Soil Organic Matter <1 g/ml in density
LF	Light Fraction	15	15	Soil Organic Matter <2 g/ml in density

*Age of OL and LF, based on ^{14}C; age of NL assumed

Table 1: Ages and initial C:N ratios of substrates.

Litter was incubated for 90 days under four levels of N addition. Respiration of carbon dioxide was collected as an indicator of decomposer activity. We also measured the carbon and N content of the litter to determine if N responses are related to C:N ratios. Typically, C:N ratios of

litter strongly control decomposition rates, and we expected that N additions would shift these ratios.

Litter substrates were significantly different from one another. This was evident both overall (ANOVA, $P < 0.001$) and in the pairwise comparisons (Tukey, $P < 0.001$ in each case). More C was released by the new litter compared to the old litter; both released more C than the light fraction. There did not appear to be a significant effect of N level (ANOVA, $P=0.232$). Also, there did not appear to be a significant interaction between N level and litter substrate. This implies that the litter substrates showed no difference with regards to N response (Figure 1).

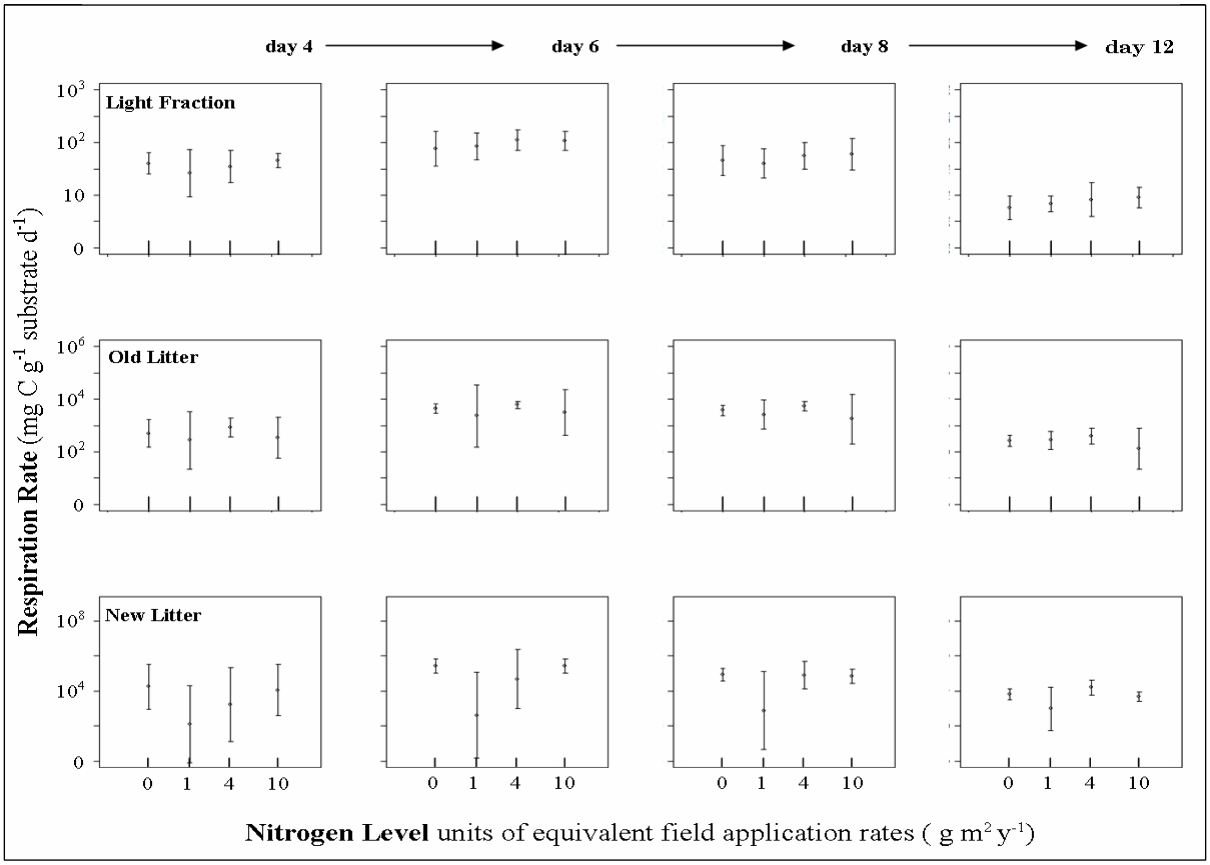

Figure 1: The respiration rates of light fraction, old litter, and new litter for N levels (0-, 1-, 4-, 10 g·N/m²) representing first 4 measurements. Figure prepared by David LeBauer.

I did not cross any major challenges. I felt that the opportunity that my professor and fellowships such as that from the Kearney Foundation has given me the necessary material, knowledge, and guidance to reach my goal as an undergraduate researcher. My overall achievement of my project has helped me contribute as a scientist to the ecological field of research. I am planning on further studies that could be conducted within a larger ecosystem-scale to improve our knowledge of N and C cycling within ecosystems. In doing so, policy makers may gain a better understanding of the ways anthropogenic N may impact the C budget in one of California's major ecosystems.