THE EFFECTS OF NITROGEN ADDITION AT DIFFERENT STAGES OF DECOMPOSITION

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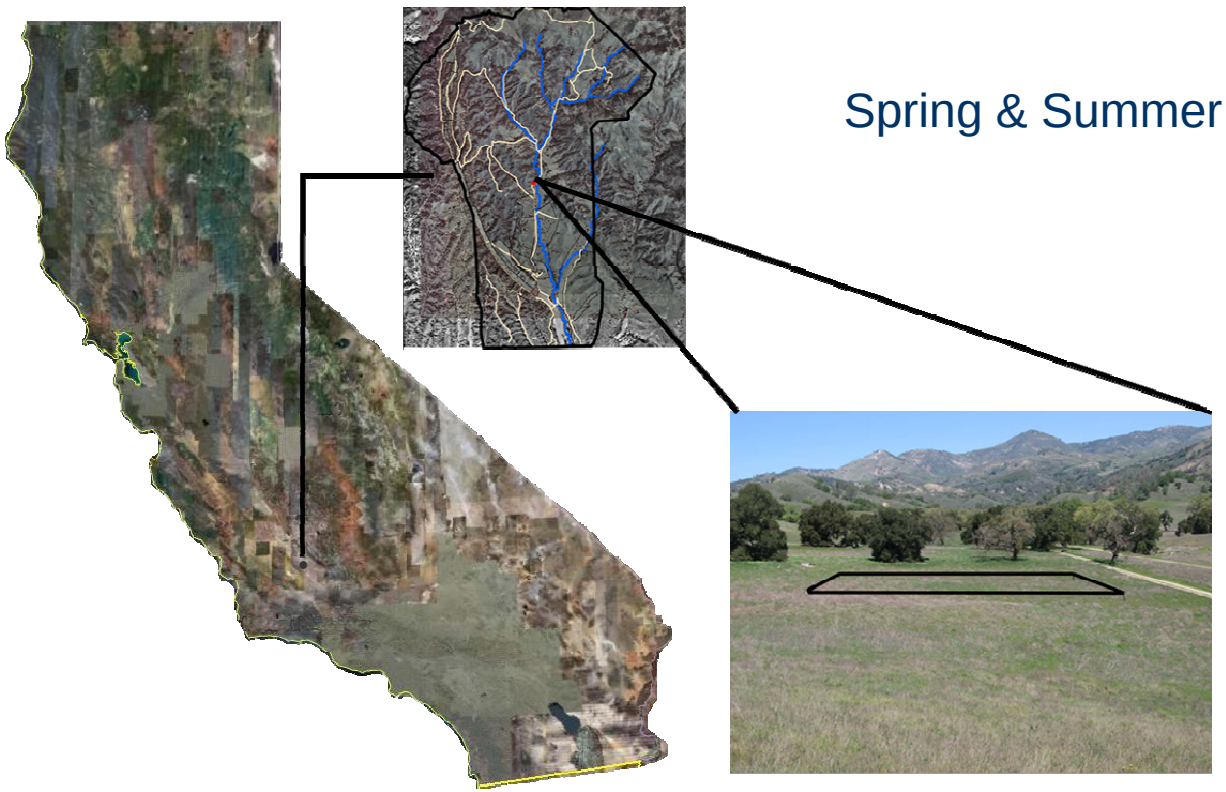
Research Goal

- The purpose of this experiment was to investigate effects of nitrogen (N) addition at contrasting stages of decomposition in a California grassland.

Sedgwick Reserve, Santa Ynez Valley, California-Natural Grassland



Spring & Summer 2007

Research Questions

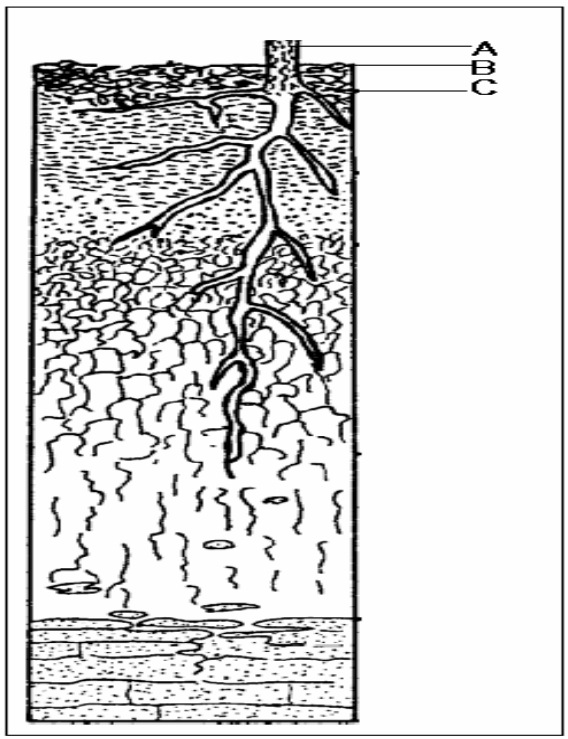
- Does nitrogen have an effect on decomposition rates?
- Does nitrogen have a direct effect on the aged litter?
- Does the amount of nitrogen have a indirect effect on aged litter?
- compared N effects on decomposition of fresh litter, old litter, and light fraction

Hypothesis

- Hypothesis: As N addition rates increase, decomposition of fresh litter and old litter will increase to a maximum value, and ultimately decrease. It’s expected decomposition rates of light fraction to be unaffected by N levels.

Materials & Methods

- Microcosm-scale experiment



- 3 different substrates
  - Fresh litter (A)
  - Old Litter (B)
  - Light Fraction (C)

Ages and Initial C:N ratios of substrates

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

- New litter consisted of standing dead leaves that were produced during the growing season of 2007
- The top 10 cm of litter and soil was extracted using a soil corer.

Nitrogen effects were studied using seven species extracted from Sedgwick Natural Reserve

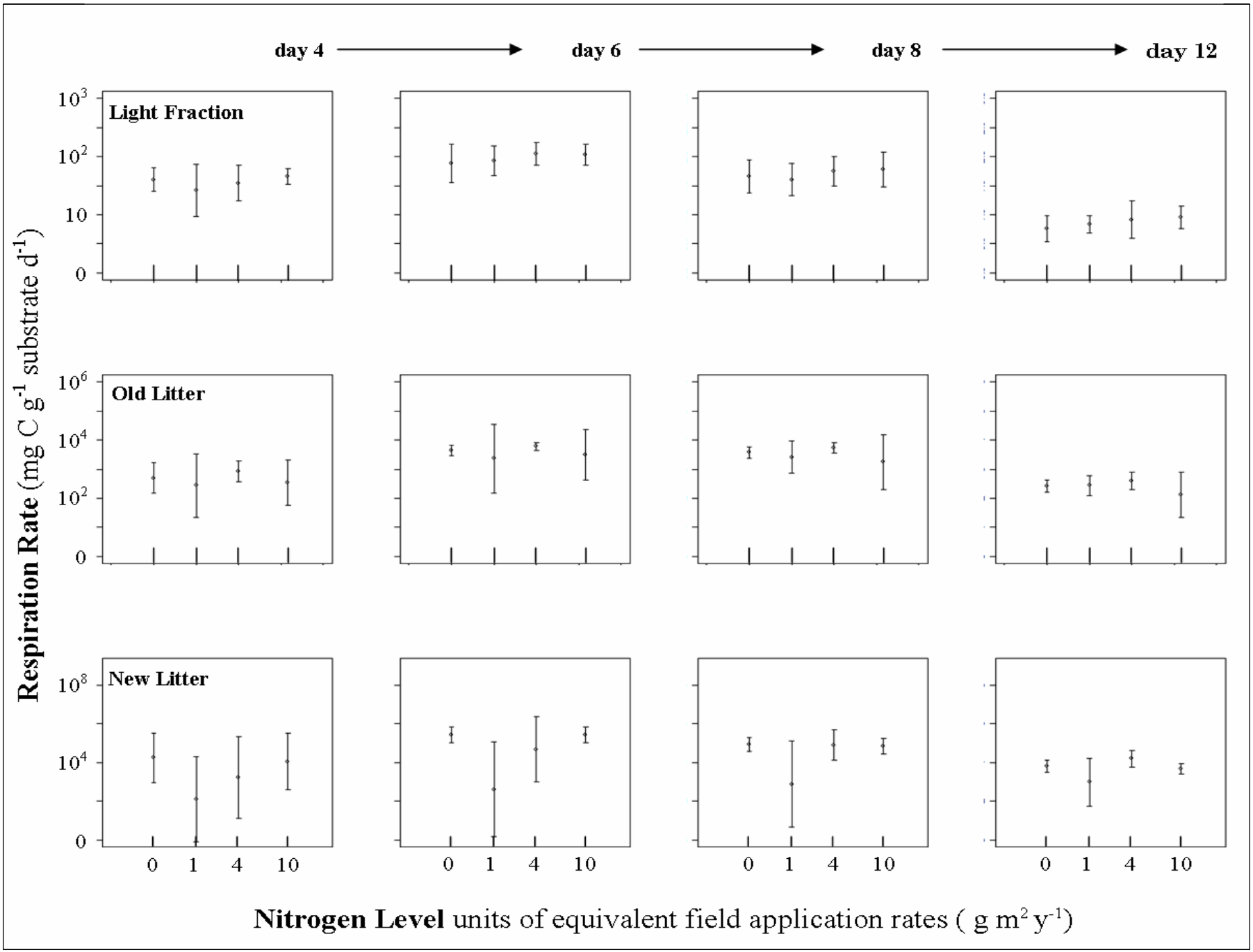
- *Bromus hordeaceus* (Poaceae)
- *Bromus diandrus* (Poaceae)
- *Nassella pulchra* (Poaceae)
- *Avena barbata* (Poaceae)
- *Erodium cicutarium* (Geraniaceae)
- *Lactuca serriola* (Asteraceae)
- *Artemisia californica* (Asteraceae)

Materials & Methods

- 4 different levels of nitrogen
  - 0-, 1-, 4-, and 10 g·N/m²
- Incubated for 90-day period with Inoculum
- Organized into a randomized complete block design
- 6 replicates for each N level, substrate type
- Measurements taken with LiCor

Results

- Overall, litter substrates are significantly different from one another (ANOVA, $P < 0.001$; Tukey, $P < 0.001$ in each case).
- Effects of N addition do not vary amongst different stages of decomposition (ANOVA, $P=0.232$).


day 4
day 6
day 8
day 12
Light Fraction
Old Litter
New Litter
Respiration Rate (mg C g-1 substrate d-1)
Nitrogen Level units of equivalent field application rates (g m2 y-1)
0
1
4
10

Results

- Overall change of decomposition rate with substrate compared to nitrogen level
- Changes greater as substrate is younger and exposed to more nitrogen

Conclusion

- Nitrogen had no significant effect on the decomposition of the light fraction, old litter, and new litter.
- Our findings were consistent with Chen et al.’s (2008) study

Conclusion

- Many fungi and bacteria decompose organic material readily under N.
- In this case, microbial activity was positively affected when levels of N were exceptionally high for prolonged periods.
- But as the litter gets older, enzyme activity slowly decreases because structures are not as competent as early microbe structures.

Conclusion

- Findings were also consistent with those of Joergensen and Potthoff (2004), who found unbalanced exchanges of unstable substrates in microbial communities.
- Extracellular enzymes become deactivated and eventually unstable as litter aged. This may be the reason why the substrates did not interact with N.

Conclusion

- There may have been an unbalance of litter species with various respiration rates
- Some of these particular species may have higher respiration rates than other species that could be a potential factor in the overall experiment

Conclusion

- Evident Source of Error: NOT *In Situ* experiment
- The lack of N effects in our study may have resulted because the experiment was conducted in a microcosm-scale environment and did not allow for all naturally occurring environmental factors to take place as they would under *in situ* conditions.
- The absence of naturally occurring environmental factors may have caused decomposer enzymes to be unstable

Conclusion

- Other source of error:
  - Human contamination-Possibly some of the tubes did get contaminated while measurements were taken, which would explain the large error bars in Figure 1.

Further Studies

- Further studies could be conducted within a larger ecosystem-scale project to improve our knowledge of N and C cycling within ecosystems.
- Observing geographical features of area can help aid into fully understanding all factors that contribute to an overall well-functioning ecosystem.

Outcomes and Goals of Research

- Policy makers may gain a better understanding of the ways anthropogenic N may impact the C budget in one of California's major ecosystems.
- Reduce carbon footprint for a more Green Earth.

Acknowledgements

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