Assessment of ecosystem health using fine litter production and nutrient budgets as indicator parameters

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INTRODUCTION

- The nature and value of earth's life support systems have largely been ignored until their disruption or loss highlighted their importance (Daily et al. 1997a).
- For example, deforestation has belatedly revealed critical role forests serve in regulating the water cycle, mitigating floods, drought, the erosive forces of wind and rain, and silting of dams and irrigation canals.

Introduction cont'd…..

- Daily et al. (1997b) suggest with certainty that ecosystem services are essential to civilization.
- These operate on a grand scale and in intricate and little-explored ways that most cannot be replaced by technology, and that anthropogenic activities are already impairing their flow.
- It is apparent that if current trends continue, humanity will alter virtually all of earth's remaining natural ecosystems.
- In addition, many of the human activities that modify or destroy natural ecosystems also cause deterioration of ecological services, which may result in adverse long-term effects on human welfare.

Definitions of Ecosystem health

- Homeostasis, absence of disease, diversity or complexity, stability or resilience vigour or scope of growth or a balance btn system components.
- All these represent pieces of the puzzle but none is comprehensive
- It seeks to understand and optimize the intrinsic capacity of ecosystems for self-renewal while meeting reasonable human goals.
- It encompasses the role of societal values, attitudes and goals in shaping our conception of health at human and ecosystem scales.

Rationale for ecosystem health assessment

- Therefore, health is a measure of the overall performance of a complex system that is built up from the behaviour of its parts.
- The assessment of the relative importance values range from subjective qualitative to objective and quantitative (Rapport et al. 1998).
- The missing link in the theory and practice of integrated environmental management is an approach to scale that will link theories of ecosystem health and ecosystem services.

Rationale for ecosystem health assessment

- Consequently, important elements on the health of ecosystems would provide insights as to whether ecosystems have the capacity to continue providing the required goods and services to humanity.
- These will then serve as important pathways to the understanding of the drivers of ecosystem health impairment within ecosystems.

Rationale for ecosystem health assessment

- The context of evaluating grassland, litter production and nutrient budgets would serve as benchmark, which will provide an integrated perspective on ecosystem health.
- This will aid in analysing the possible future trends for the nearby grassland inhabitants, who solely depend on the such grasslands for sustenance.

Rationale for ecosystem health assessment

- It is presumed that a healthy state of the grasslands could be used as a possible indicator of the state of livelihoods of the local people who depend on the ecosystem.
- Therefore, this would serve to contribute to current knowledge on the same issues with the generation of capacity in handling similar and emerging issues in the field of renewable natural resource management.

Study scenarios

- Influences of human activities/climatic variability on grassland productivity and nutrient cycling.
- The objectives could be to measure the effects of human disturbances/climatic variability on
  - site litter quantity (annual litter production)
  - quality (C: N and C: P ratios).
  - Stand nutrient cycling and
  - nutrient use efficiency in the litter compartment

Exercise

- In our different grasslands describe inherent ecosystem health indicators and how they can either be monitored and/or measured using specific components or compartments of the system

Materials and methods

- Plots measuring (100 X 50) m can be demarcated randomly in an area close to a settlement with evidence of human accessibility and use, a second can demarcated at least one kilometre from the first towards the interior of the reserve.
- The procedure needs to be repeated to obtain adequate representation for example the following were demarcated in the SW Mau forest reserve:
  - Mara A disturbed (MAD)
  - Mara A undisturbed (MAU),
  - Mara B disturbed (MBD),
  - Mara B undisturbed (MBU),
  - Itare A disturbed (IAD),
  - Itare A undisturbed (IAU),
  - Itare B disturbed (IBD) and
  - Itare B undisturbed (IBU).

Litter collection and processing

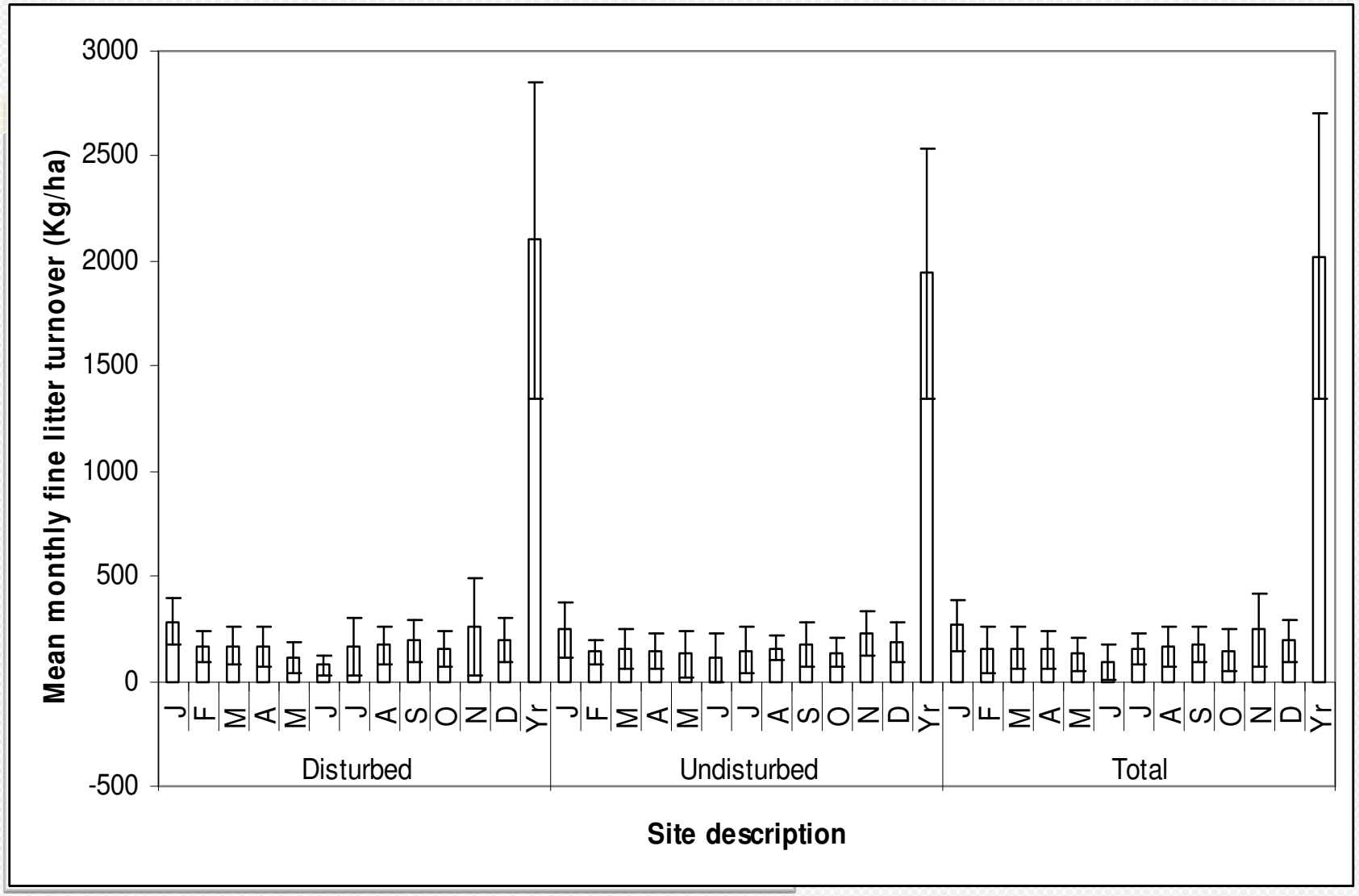
- Litter baskets constructed of stainless wire ring and fine mesh screen bottom (0.5m^2) were placed at random at positions at least one metre above the ground in each of the 8, 50x100 plots (n = 120).
- Litter collections were made every 28 days dried at 65 °C and weighed.
- A composite sample of the oven-dried litter was drawn for analysis of nitrogen N, P, K, Mg, Ca, & C Using standard procedures

Total fine litter nutrient inputs

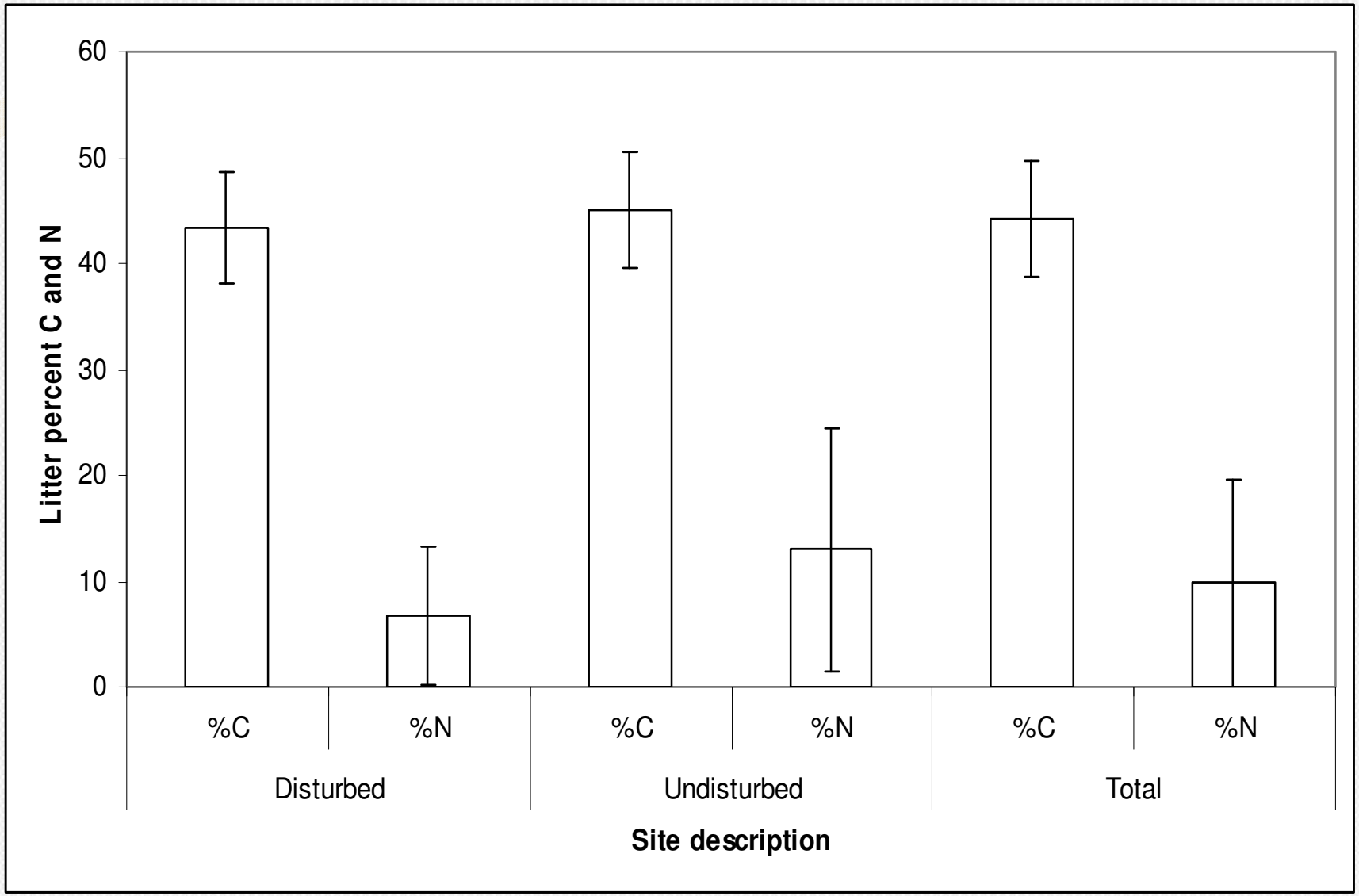
- Total fine litter nutrient inputs (Kg ha^{-1} yr^{-1}) to the sites were calculated by
  - multiplying monthly litter production values for each sampling site by nutrient concentration for the same site and month and adding them over the entire year (Read and Lawrence 2003).

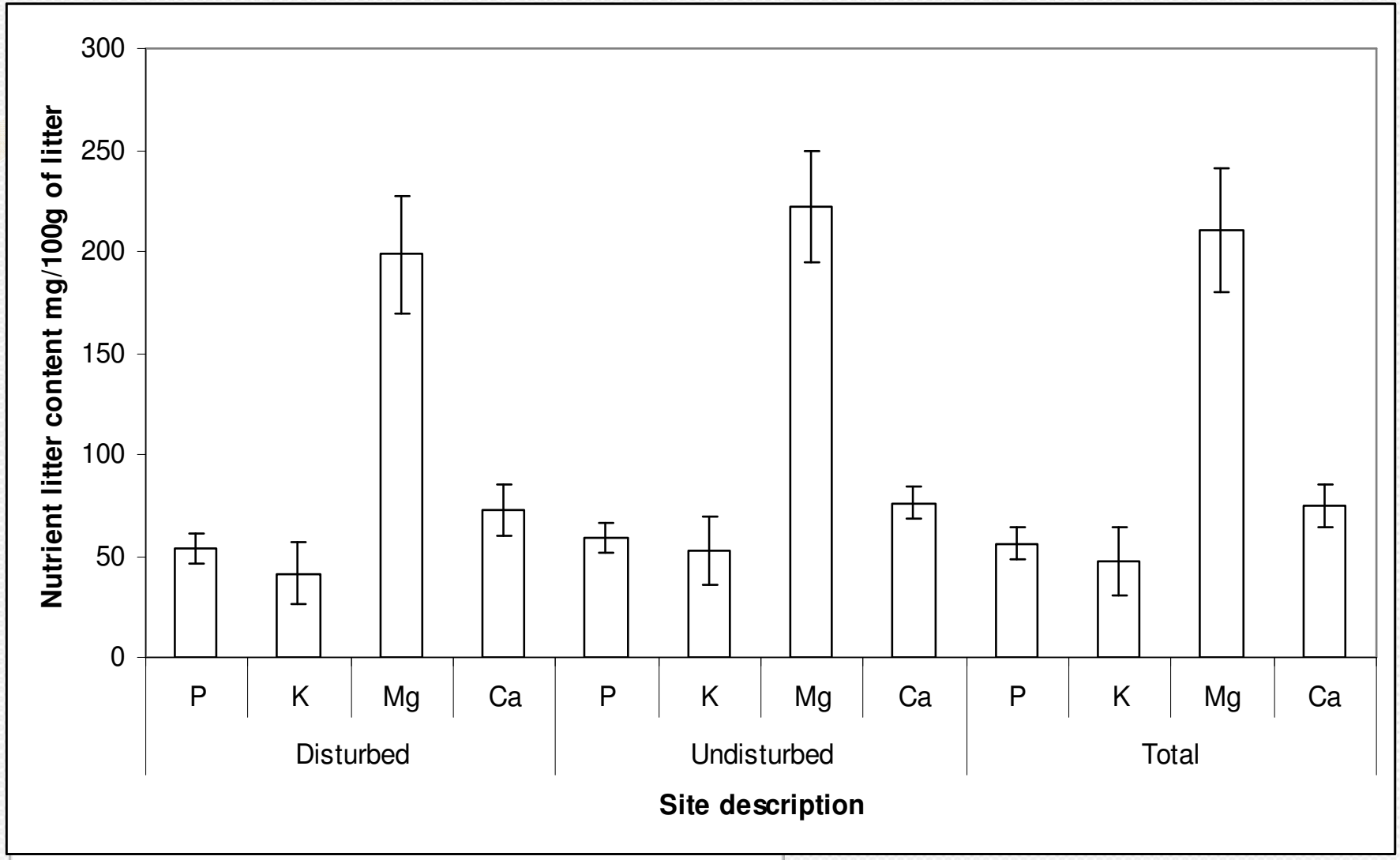
Stand nutrient use efficiency

- Annual nutrient input values were used to calculate within stand nutrient use efficiency (NUE) defined
  - as kilograms of dry litter mass per kilogram of nutrient content (Vitousek 1984).
- This was used to assess and define stand *nutrient* cycling (Vitousek and Silver 1994).

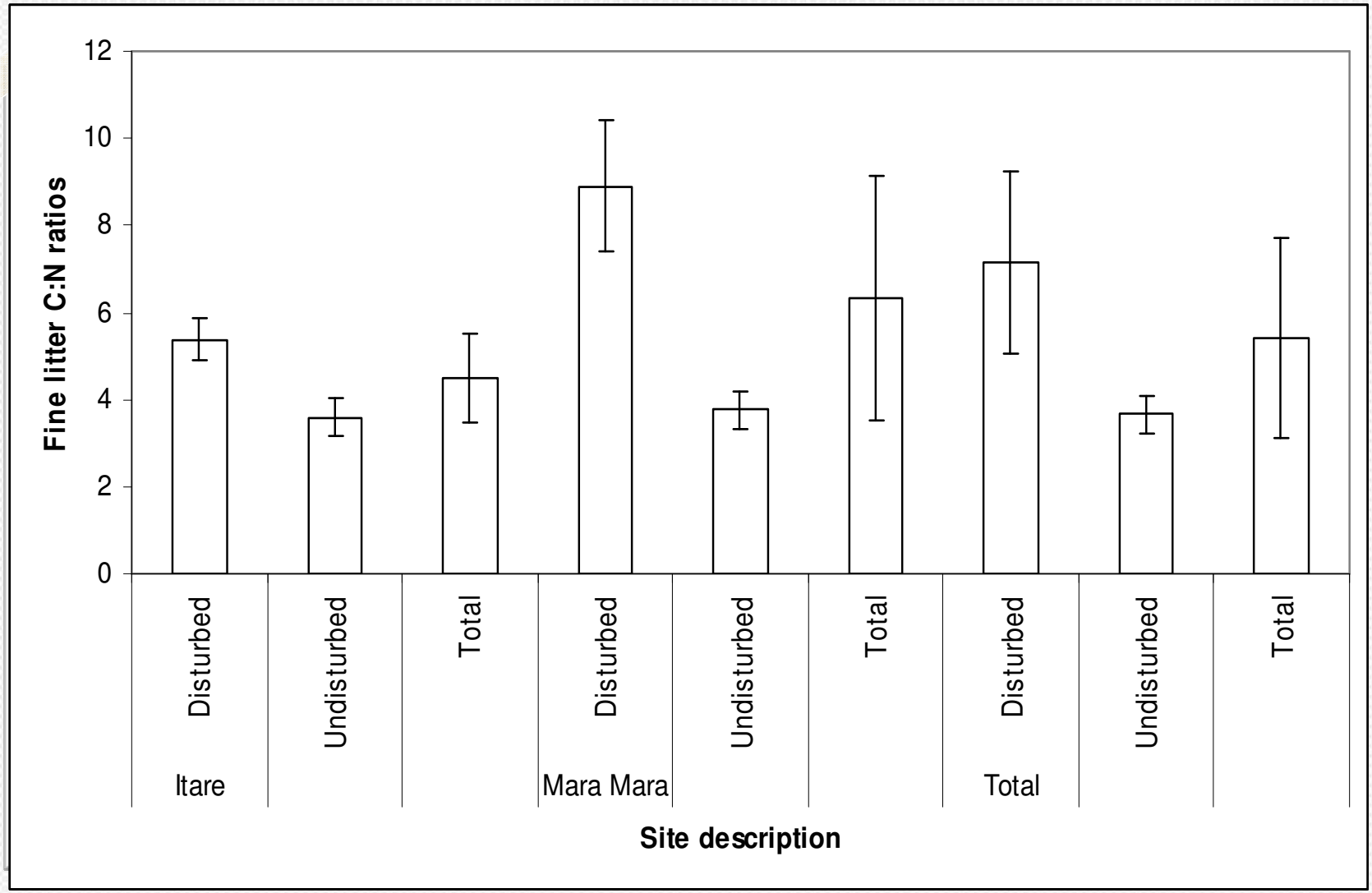


Mean monthly fine litter turnover in Kg/ha, in the (SW Mau Forest reserve) turnover values in disturbed and undisturbed sites

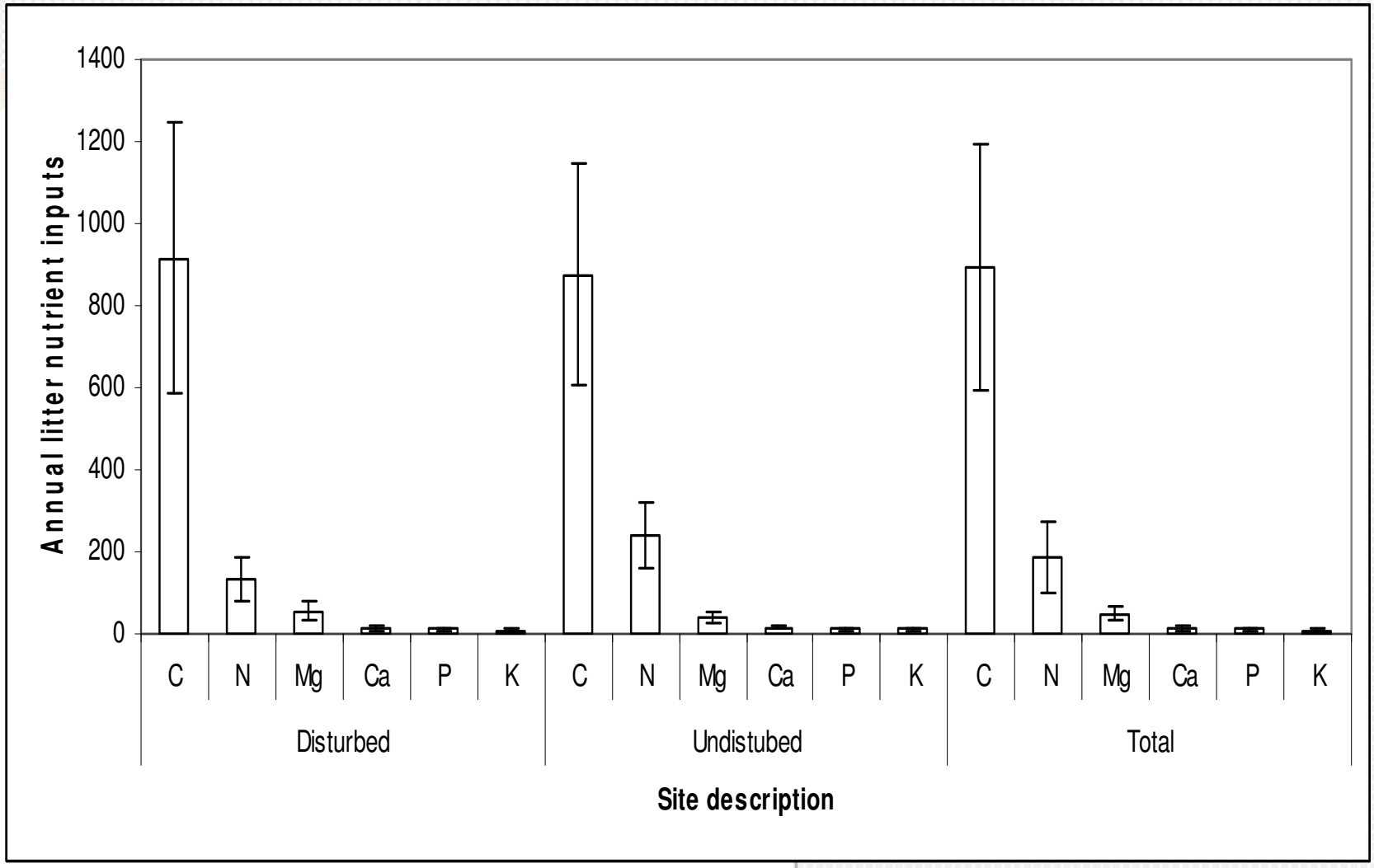

60
50
40
30
20
10
0
Litter percent C and N
%C
%N
%C
%N
%C
%N
Disturbed
Undisturbed
Total
Site description



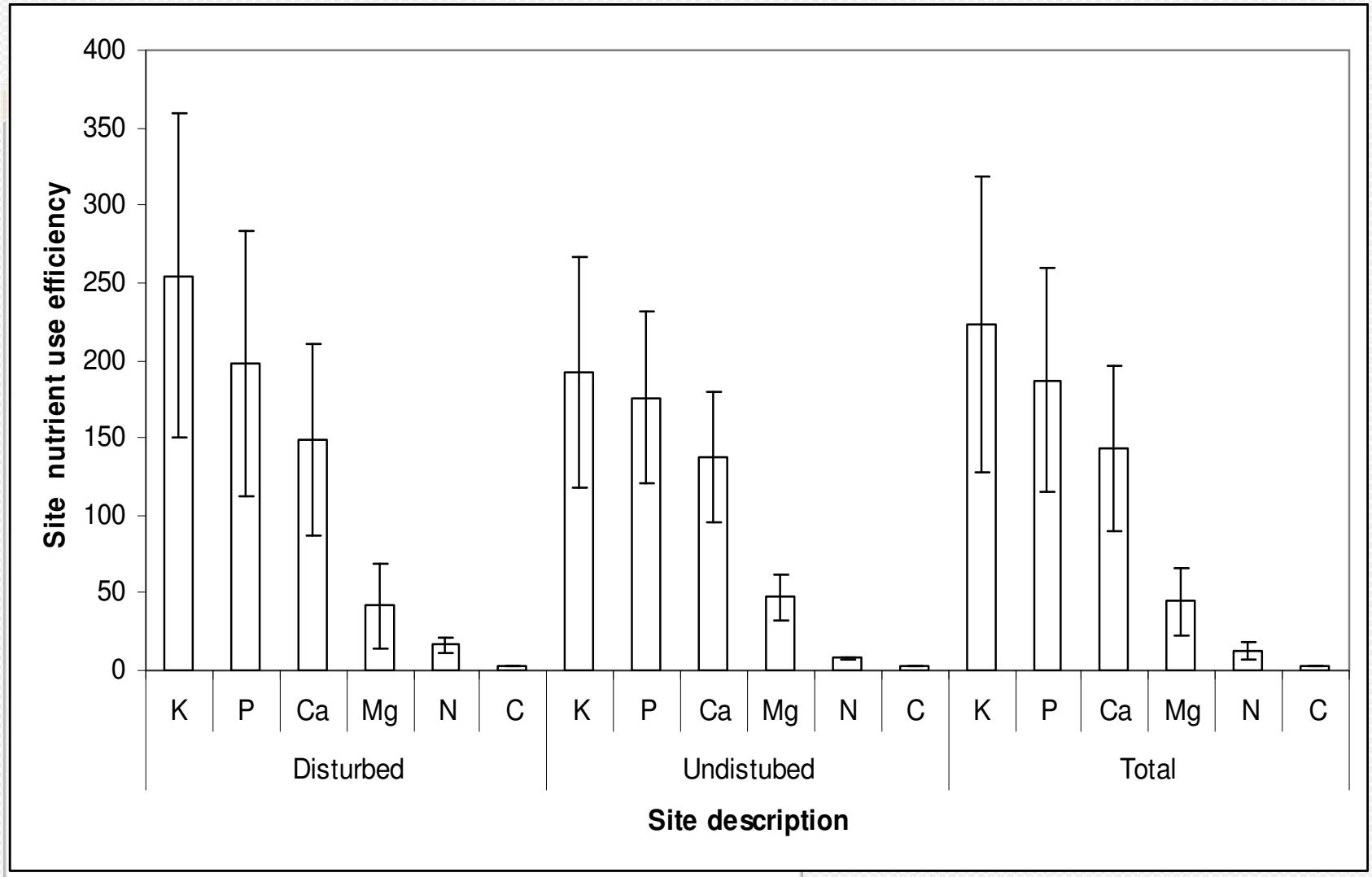
Mean differences in mean fine litter nutrient content (P, K, Mg and Ca) across disturbed and undisturbed plots in the Mau forest reserve



Differences in C: N fine litter ratios in the disturbed and disturbed sampling sites in the SW Mau forest reserve. Variations between Mara Mara and Itare forest sites are also illustrated.



Differences in mean fine litter annual nutrient (C, N, Mg, Ca, P and K) inputs in Kg ha^{-1} yr^{-1}across disturbed and undisturbed plots in the SW Mau forest reserve. Total fine litter nutrient inputs (Kg ha^{-1} yr^{-1}) to the sites were calculated by multiply monthly litter production values for each sampling site by nutrient concentration for the same site and month and adding them over the entire year.



Within stand nutrient use efficiency (NUE) defined as kilograms of dry litter mass per kilogram of nutrient content for K, P, Ca, Mg, N and C. in the SW Mau forest reserve.

Its sunset in the savannah, how will sunrise be?

Vielen Dank!

Thank You

Asanteni Sana

Gracias!!

Grazie!

Amsegnalew

O brigado

Xie xie