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Dung beetles, ecological functions and services

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[1]University of Turin – Department of Life Science and Systems Biology; [2]University of Turin – Department of Agricultural, Forest and Food Sciences Dung beetles, ecological functions and services.

Dung beetles (Coleoptera: Scarabaeoidea) represent a notable example of organisms that play a key role in ecosystem functioning. Through the manipulation of livestock faeces they contribute to dung removal, bioturbation, nutrient cycling and plant growth enhancement. Through laboratory and field experiments we assessed their contribution to: a) soil nitrogen cycling, b) fluxes of greenhouse gases (GHGs) and c) grassland restoration. Soil nitrogen cycling. By means of mesocosm field experiments utilising 15N-enriched dung, we assessed the role of dung beetles in regulating interrelated multiple ecosystem processes in alpine pastures over spatial (20 cm soil depth) and temporal (one month, three months, and one year) scales. We used a trait-based approach and focused on the nesting strategy as a discrete trait, by contrasting functions provided by tunnelers and dwellers. The two functional groups simultaneously influenced at least seven ecological interconnected functions, i.e. dung removal, transport of dung-derived nitrogen into the soil, microbial ammonification and nitrification processes, uptake of dung-derived nitrogen by plants, herbage growth and botanical composition. Tunnelers and dwellers were found to be complementary for specific functions and for the spatial and temporal scales over which the functions operated. Overall, mixed species assemblages performed better than single species ones, likely due to their higher differentiation of nesting patterns and body sizes within each functional group. Fluxes of GHGs. Dung pats are known to emit greenhouse gases GHGs. A closed chamber system was used to measure fluxes of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) from cattle dung pats with different assemblages of four species of dung beetles belonging to different functional groups by increasing or reducing fluxes with respect controls. Results indicate that different species contribute highly unevenly to GHGs emissions. Dung beetles, especially when are mixed assemblages, may reduce GHG emissions in terms of CO2 equivalents, thus potentially contributing to attenuate global warming and related climate changes. Grassland restoration. In recent decades, pastoral abandonment has produced profound ecological changes in the Alps. The reduction in grazing has led to extensive shrub encroachment of semi-natural grasslands, which may represent a threat to open habitat biodiversity. To reverse shrub encroachment, we assessed short-term effects of two different pastoral practices on vegetation and dung beetles. Dung beetles, as a result of the removal of shrubs, responded more quickly than vegetation to pastoral practices. Given the effect of dung beetles on soil nitrogen cycling, the resulting increase in dung beetle abundance and diversity may have a positive effect on meso-eutrophic grassland restoration. As a general conclusion, we emphasize that all the functions we studied in the three experiments were beneficial to humankind and may be considered therefore as true ecosystem services provided by dung beetles.