Modelling Trade Offs between Ecological and Economic Performances in Grazed Grasslands: Importance of Temporal Stocking Density

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Modelling trade offs between ecological and economic performances in grazed grasslands : importance of temporal stocking density

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Key words : cost-effectiveness , grassland birds , grazing , trampling , viability

Introduction Recent changes in grassland management have led to increasing threats on farmland birds populations (Newton , 2004) . Through its impact on sward structure , grazing can promote suitable habitats for ground nesting birds (Tichit , Renault and Potter , 2005) . However it can also have negative side effects on birds dynamics through nest trampling . We developed a cost effectiveness approach to asses the effect of nest trampling by cattle on the economic and ecological performances of grazed grasslands .

Materials and methods To study trade offs between ecological and economic performances , we relied on a co-viability model (Tichit et al . 2007) . It comprises two interactive sub-models describing : i) grazed sward dynamics and ii) a staged structured stochastic matrix model of bird dynamics . Both sub-models are linked through the direct and indirect effects of grazing on the demographic parameters of two bird species . During incubation , stocking density has direct effects on bird fecundity through nest trampling . The following month , sward height influences chicks' survival (indirect effects) . The model predicted stocking density sequences satisfying both production constraints (cattle feeding requirements) and ecological constraints (sward height and trampling thresholds during incubation and rearing stage) . We compared different grazing strategies leading to a defined ecological objective according to their economic performance . Ecological criterion correspond to maximum reduction of 10% in both birds' populations after 15 years (starting with 100 individuals at t = 0) . Economic criterion was based on the avoided feeding cost permitted through grazing . Grass height constraints were defined so as to compel juvenile survival to be optimal .

Results Several grazing strategies satisfied the ecological criterion . However , the best ecological strategy was the worst on the economic viewpoint . The best economic strategy ensuring ecological objectives in the long term implied a 0 .5 LU .ha^{-1} stocking constraint in April and May . This strategy allowed an economic performance of 235 .8 €. ha^{-1} (Figure 1) and was consequently 27% less profitable than the best reachable economic performance . The initial grazing peak in spring was split in two . A first peak appeared in March and another one in June . This illustrates a need to anticipate grass growth so as to maintain suitable habitats during the breeding months .

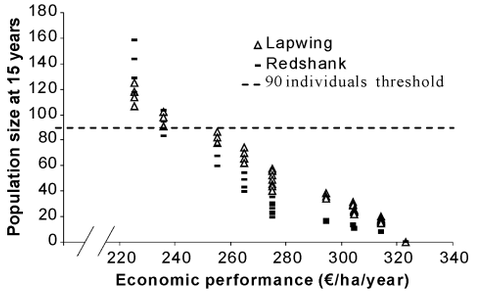

Figure 1 *Ecological and economic performances for different trampling intensities .*

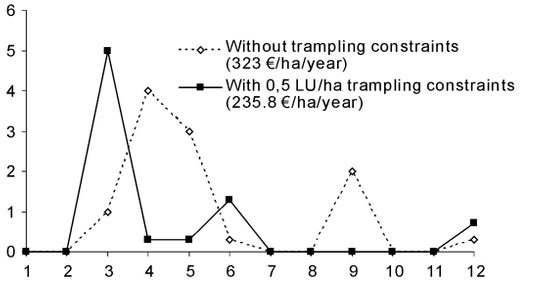

Figure 2 *Shift in stocking density sequences driven by trampling threshold .*

Conclusions The trade off between economic and ecological performances is highly dependent on the stocking density sequences . A maximal economic performance seems to be sorely compatible with ecological outcomes . The impact of cattle trampling on waders is all the more important since nesting occurs during the two months where grass growth is the strongest . Even if it implies lower economic performances , limited grazing is compatible with ecological goals and is essential to produce an optimal habitat for waders . These results are useful to reflect on agri-environment schemes aimed at both economic and ecological objectives .

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