
Assessing spatio-temporal interaction between species with the recurrent events approach

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Résumé

A key question of interspecific interactions revolves around how species strategically utilize space and time to avoid or get closer to each other. Stationary devices, particularly camera-trap surveys have become instrumental in studying larger, free-roaming terrestrial mammal species in this context. Contrarily to telemetry approach, camera traps cannot directly measure trajectory but they have been widely employed to estimate spatial and temporal overlaps as proxies of spatio-temporal interactions. However, relying solely on these overlaps is insufficient. The estimation of proximate co-occurrence (a species' likelihood of being detected after another at a location within a certain time window) can help to fill this gap. However, existing time-to-first-event models, commonly employed for this purpose, have limitations among which: they cannot fully quantify the interaction strength, i.e. how strongly one species change the occurrence probability of another, nor the duration of this effect, nor do they address the interaction directionality issue, i.e. which species affect the other. Recurrent event analysis, particularly the piece-wise additive mixed model (PAMM) from the General Additive Model family, offers a promising alternative. By considering all independent events, PAMM estimates non-linearly the temporal dynamics of visitation rate of the influenced species after the occurrence of another.

In a first part, we simulated camera trap observations involving two interacting species. We assessed PAMM's performance in estimating species interactions, compared to commonly used time-to-first-event approach. Meanwhile, we provide the workflow covering from data preparation to model fitting using the new *ctrecurrent* and the already existing *pammtools* packages. In a second part, we illustrated its application with few real-data examples among which wolf-red deer dyad and scavengers at carcasses.

The robust performance of PAMM underscores its potential as a valuable tool for studying species interactions based on stationary device monitoring. We conclude with a consideration of how other parameters, such as species relative abundances or information gathering on heterospecific presence, could affect the model's efficiency in detecting interactions and the potential extension of the framework to multi-species systems.

*Intervenant

Mots-Clés: interspecific interaction, avoidance, attraction, large mammals, spatiotemporal interaction, simulation, behavior, camera trap