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PCR-based approaches to study trophic interactions in soil ecosystems

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A variety of DNA-based approaches (e.g. microsatellites, RFLP analysis, AFLP analysis, PCR using specific primers and hybridization techniques) have successfully been applied to investigate trophic relationships in above-ground and marine systems (e.g. hosts of blood-sucking insects, parasitism rates and prey choice in generalist predators). These methods may also be used as powerful tools to disentangle trophic interactions in soil ecosystems, which are difficult to study by conventional approaches.

In Europe, white grubs (larvae of scarab beetles, Coleoptera, Scarabaeidae) belong to the most important soil pests. However, the identity and impact of naturally occurring invertebrate predators of eggs and larvae of European scarab beetles are unknown. Therefore, we developed and evaluated a PCR-based approach to identify DNA of scarabs in the gut of soil-dwelling invertebrate predators which have fed on this prey.

Our studies revealed that (1) the most important factors that influence detection of scarab DNA in the gut of predators are digestion time and fragment length of the amplified prey-DNA. (2) In contrast, meal size and individual digestion capacity of predators did not alter amplification success. (3) Carrion prey could be detected by the new method as efficiently as fresh prey. The latter finding highlights the importance to include alternative approaches, which enable to distinguish between active predation and scavenging as this is fundamental for conservation biological control strategies.

Moreover, special attention has to be paid to methods of sample preparation, as the presence of amplification inhibitors in DNA-extracts of soil-living invertebrates may cause false negative results: (1) Commercially available purification kits were partly capable to eliminate inhibitory substances present in our model predator-prey system, (2) BSA as amplification facilitator proofed to be more effective to overcome inhibi-

tion in PCR-reactions. In addition, we have developed a multiplex PCR analysis which enables us to identify false negatives and predators that have fed on a specific prey in one step.

Based on these results field caught soil living predators will be screen for white grub DNA to identify the range of predators which feed on these pests, the basis for creating new sustainable ways of control.