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The distribution of and recolonisation by ground beetles (Carabidae) on burnt areas of different age in the active military training area »Oberlausitz«

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Abstract

Between April and July 2002, the consequences of the (desired) clearing of vegetation by routine shooting exercises on an active military training area in Saxony were investigated. All important taxa of epigeic invertebrates (spiders, ground beetles, wasps, bees, grasshoppers) were found after the burning of heather and forest sites. Shallow, short-term and small-sized patchy vegetation fires did not have any severe effect on the ground beetle assemblages. 71 species of ground and tiger beetles were found by pitfall trapping. The recolonisation by carabid beetles occurred immediately after the burning.

Zusammenfassung

Die Verbreitung der und Wiederbesiedlung durch Laufkäfer (Carabidae) auf gebrannten Flächen unterschiedlichen Alters auf dem aktiven Truppenübungsplatz »Oberlausitz« – Zwischen April und Juli 2002 wurden auf einem aktiven Truppenübungsplatz in Sachsen die Folgen der (erwünschten) Offenlandhaltung durch routinemäßig stattfindende Schießübungen untersucht. Auf den gebrannten Heide- und Forstflächen wurden alle wesentlichen Vertreter der epigäischen Wirbellosenfauna (Spinnen, Laufkäfer, Wespen, Bienen, Heuschrecken) nachgewiesen. Die Auswertung der Bodenfallen-Fänge von Lauf- und Sandlaufkäfern erbrachte 71 Arten. Die beobachteten kleinräumigen, kurzzeitigen und oberflächlichen Brände zeigten keine schwerwiegenden Auswirkungen auf die Carabidenzönose. Die Wiederbesiedlung der gebrannten Areale setzte sofort ein.

1. Introduction

Numerous endangered animal and plant species depend on the presence of open landscapes. Today, such locations have become rare in Central Europe, where they can be found mainly as man-made sites, like post-mining landscapes or military training areas. Both landscapes are characterised by an oligotrophic and unfragmented status and the latter present a mosaic of different biotopes due to the effects of military utilisation (UNSELT 1994, WALLSCHLÄGER et al. 2002). Shallow, short-term and small-sized patchy vegetation fires caused by routine shooting exercises, as well as tank driving exercises, which were

both studied on an active military training area in Eastern Saxony, account for an effective – and desired – clearing of vegetation.

Carabid beetles belong to one of the important groups of surface-dwelling arthropods with respect to species inventory and density. They are frequently used in ecological studies because they constitute bio-indicators due to their specific ecological requirements concerning abiotic and biotic habitat factors (THIELE 1977, WACHMANN et al. 1995).

The aim of our study was to investigate the distribution of and recolonisation by ground beetles on burnt areas of different age on the active military training area »Oberlausitz«.

2. Materials and methods

The military training area »Oberlausitz« in East Saxony is located between the towns and villages Weißwasser, Nochten, Rietschen and Steinbach and divided by the power plant Boxberg into an eastern (14 000 ha, shooting exercises, driving manoeuvres) and a western part (2000 ha, driving manoeuvres, e.g. by tanks). The training area has been in use since 1945 and is characterised by dry and sandy habitats, consisting of large pine forests, open inland dunes, covered mainly by *Corynephorus canescens* (L.) P. Beauv., *Calamagrostis epigejos* (L.) Roth and heath, *Calluna vulgaris* (L.) Hull (WANNER et al. 2001, 2002, 2005; WANNER & XYLANDER 2003a, b; WIESENER et al. 2004).

The sandy and dry slope »B2«, which burnt mosaic-like due to shooting exercises in June 2000, is located on the eastern part of the military installation. The small burnt areas were covered after the fire with *Calluna vulgaris*, *Pteridium aquilinum* (L.) Kuhn and *Calamagrostis epigejos*. The unburnt control areas were dominated by *C. epigejos*. Additionally, large areas were covered with *P. aquilinum*, *Rumex acetosella* L. and *Rubus fruticosus* L. The sandy and dry study area »B3« is a small hill that burnt in June 2000. Before the fire took place, it was covered with *C. vulgaris*. Two years after the burning, the area was dominated up to 35 % by *C. canescens*. Three adjacent, moist beech stands rich in humus (»B4, B5, B6«) burnt as a corridor in April 2002. The surrounding unburnt areas are covered with *Betula pendula* Roth as well as *C. epigejos*, *Deschampsia flexuosa* (L.) Trin., *Hieracium pilosella* L. and *Vaccinium vitis-idaea* L. in undergrowth. Due to the moist soil rich in humus, the burnt areas were covered densely with vegetation (e.g. *P. aquilinum*) within two weeks after the fire. The burnt area of the sandy study location »B7« was formed in June 2001. It was covered after the fire by *C. canescens*, *R. acetosella*, *H. pilosella* and *Teesdalia nudicaulis* (L.) R. Br. The unburnt control area was covered with *C. epigejos* and *C. vulgaris*. The western part of the military training area is characterised by a large inland dune with little vegetation, cleared mainly by tank tracking. In the vicinity of the tank tracks, pine afforestations as well as heath can be found.

Epigeic arthropods were caught by pitfall traps – white cups with 6.8 cm in diameter; 5 traps in a distance of 4 m aligned in a row, filled with an aqueous solution of acetic acid (3 %) and ethanol (20 %) according to MÜHLENBERG (1993). Arthropods were trapped from 4 April to 22 July 2002. Traps were emptied predominantly every two weeks (access to the traps depended on military activities). Carabid beetles were determined to species level after FREUDE et al. (1976). The cluster analysis of species inventory was computed with the MVSP software using the unweighted pair group method of average linkage (UPGMA) and Soerensen indices. For statistical analyses, CHEAIB & HAF (1987) and MÜHLENBERG (1993) were consulted.

3. Results

7049 individuals of 71 carabid species were collected and analysed with regard to their distribution and recolonisation on burnt and unburnt sites. Most ground beetles belonged to xerophilic (WACHMANN et al. 1995) species like *Poecilus lepidus* (Leske) and *Calathus erratus* Sahlberg. In addition, species with a high adaptation to their dry habitat such as, e.g., *Amara fulva* (O. F. Müller) as well as species with a lower degree of specialisation colonised a variety of different locations.

Two of the species are classified as endangered according to the Red Data Book for Saxony (ARNDT & RICHTER 1995): *Amara quenseli* (Schönherr) and *Cymindis macularis* Fischer de Waldheim, and one, *Miscodera arctica* (Paykull), as critically endangered.

Directly after the fire took place, all burnt and unburnt areas showed comparable numbers of individuals and taxa of epigeic arthropods. The ground beetle coenosis did not show any striking differences between burnt and unburnt sites: A cluster analysis on the basis of Soerensen indices considering single proofs of carabids separates clearly the eastern from the western part of the military training area, but there is no consistent trend with regard to burnt and unburnt sites (Fig. 1). In principal, the same picture emerges after rejecting single proofs from the analysis (Fig. 2).

The individuals which had been collected can be mainly assigned to eurytopic species, like *Calathus erratus*, *Harpalus rufitarsis* (Duftschmid), *Carabus violaceus* L., and *Poecilus lepidus*. More stenotopic species, like *Amara quenseli*, *Amara fulva*, *Cymindis macularis*, and *Harpalus hirtipes* (Panzer) were found in habitats without vegetation, especially in the western part of the military training area. This area was kept open exclusively by tanks. However, the highly endangered tiger beetle *Cicindina arenaria viennensis* (Schränk), which occurred frequently in 2001 in the western part of the military training area (WANNER et al. 2001), was completely absent (with respect to pitfall trapping) in the following year.

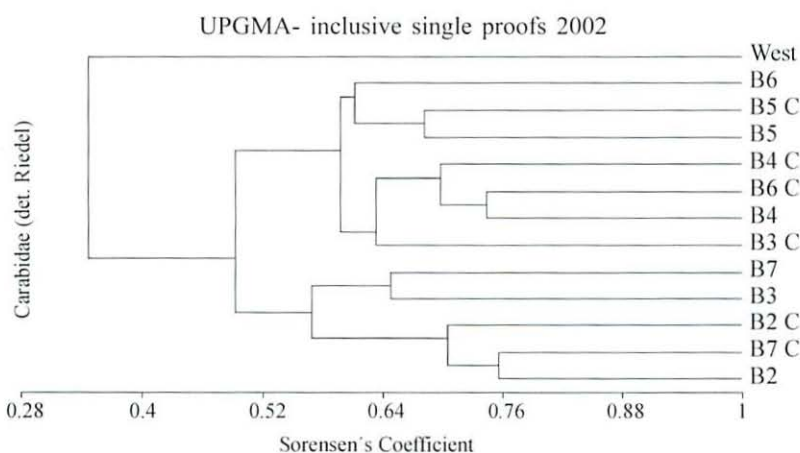


Fig. 1 Cluster analysis on the basis of Soerensen indices including single proofs (C = Control site)

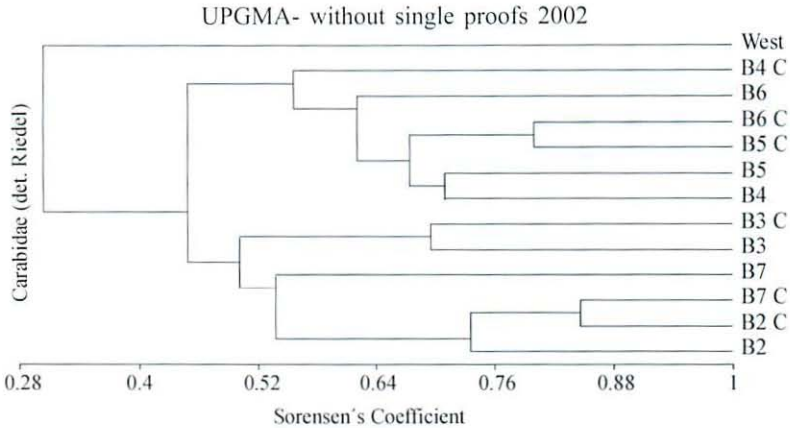


Fig. 2 Cluster analysis on the basis of Soerensen indices not including single proofs (C = Control site)

4. Discussion

Although concerns have been raised about the detrimental effects on rare and localised arthropods attributed to ecosystem management by fire (reviewed in SWENGEL 2001), fire as a tool for vegetation clearing may be a promising approach in habitat management (e.g. UNSALT 1994). However, burnings which occur regularly may influence (but not severely damage), the composition of flora and fauna of the respective site (FERNANDEZ & COSTAS 2002).

Numerous studies have shown that fire causes a faster mineralisation of nutrients, at first leading to a better availability of potassium and magnesium, for example, for plants, while later a nutrient loss due to a facilitated efflux, e.g. by erosion, will occur (FERNANDEZ & COSTAS 2002). However, the observed shooting exercises caused only short and shallow fires restricted to a few 100 m² (WANNER et al. 2002), therefore a large-scaled impact on the nutrient status of soils cannot be expected.

The composition of carabid species may be influenced by the vegetation cover, for here even small changes may result in significantly altered microclimatic properties (SPIESS & ZEBITZ 1995) to which ground beetles react very sensitively. The moist sites (e.g. »B4, B5, B6« in this study) revealed a pronounced humus layer. Thus, only two weeks after the fire the destroyed vegetation had recovered completely. In contrast, the dry and sandy sites »B2« and »B3« remained open even two years after the burning, resulting in a completely different microclimate as compared to the unburnt control sites, but differences in the composition of the carabid species could not be found in the cluster analysis. The clustering resulted in three clusters depending on the site characteristics and not on the occurrence of fire: the western site with its special character of an open dune, the three dry and sandy sites, and the three moist and humus-rich sites in the eastern part of the training area.

To conclude, it remains often difficult to assign any habitat management method to the occurrence of a distinct species. Numerous environmental factors of abiotic or biotic nature may affect the species inventory and density. But the study on hand points out that at least transient fires, as observed on the active military training area »Oberlausitz«, did not reveal any severe, detrimental effects on the ground beetle coenosis. Thus, such fires may be useful for the preservation of open landscapes.

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