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ANTHROPOGENIC INFLUENCE ON A STRONGLY HABITAT-RELATED INSECT GROUP ON A NORTH SEA DUNE ISLAND

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KEYWORDS: Species turnover, leafhoppers, habitat size, human impact.

ABSTRACT

From 1986 to 1988 129 species of leafhoppers (Auchenorrhyncha) were recorded on the East Frisian dune island of Borkum. The different species compositions of various habitats are compared with the species compositions found by investigations between 1932 and 1938 (106 species); the strongest fluctuations in the interim of 50 years were recorded in the habitats influenced by human activities as woodlands and cultivated grasslands. Only ca. 25% of the species turnover on the island have been caused by human activities. Because of low demands on habitat size in most leafhopper species increasing urbanization and other anthropogenic influences only slightly affect the island species composition, provided that the different natural habitats are of a sufficient size.

INTRODUCTION

In the course of the past decades nearly all habitats on the East Frisian dune islands have been influenced by the immense increase in tourism: urbanization and dissection of the dune areas by paved pathways and roads, draining of moist sites by water catchment for drinking water supply, dike building for protection and building of settlements, harbours, airfields and golf courses. Furthermore, the massive import of various non-indigenous plant species for landscape gardening and the effect of reinforcement of dune areas should also be taken into account. However on all East Frisian islands there are also several areas which have remained nearly uninfluenced by human activities.

From 1986 to 88 the species composition of a strongly habitat-related insect group (leaf hoppers, cf. Fig.1) was investigated in the different types of landscape of the largest East Frisian dune island of Borkum (Fig. 2). The results were compared with the species composition found by investigations carried out between 1932 and 1938 with special regard to the increase in human influence on the natural habitats during the past 50 years (cf. Tab. 1).

TAB. 1. Anthropogenic influence in the 30s and 80s on the East Frisian island of Borkum.

	ca. 1930	ca. 1980
Urbanisation settlement/harbour (Km ²) roads, paved pathways (km)	ca. 2 ?	ca. 4 ca. 115
inhabitants	ca. 4000	ca. 7700
tourism guests/year	ca. 30000	ca. 120000
introduction of plant species trees/shrubs (total numbers) originally not indigenous	ca. 50 ca. 30	ca. 90 ca. 65



FIG. 1. Insect group investigated: Leafhoppers (Hemiptera: Auchenorrhyncha); a typical species of the subfamily Cicadellinae: *Cicadella viridis* (L.).

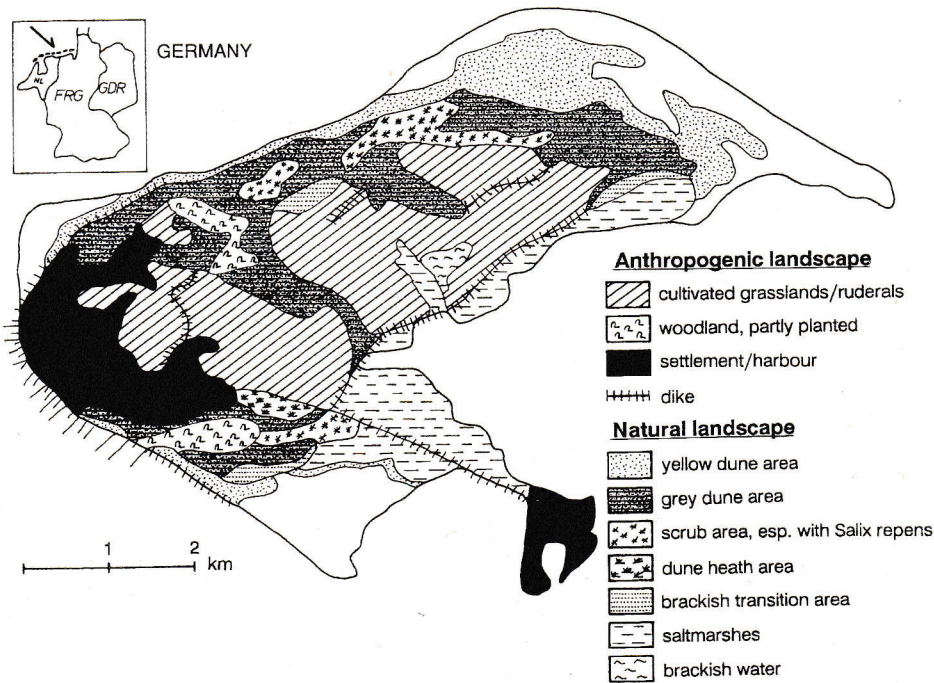


FIG. 2. Outline of landscape and habitat structure of Borkum (according to DIJKEMA & WOLFF 1983, modified).

MATERIAL AND METHODS

Investigations were carried out from 1986 to 1988 by sweepnet sampling and pitfall trapping (for details see Bröring & Niedringhaus, 1989). To reconstruct the species composition of the period 1932-38 the collection of F. and R. Struve was revised (Niedringhaus, 1989).

RESULTS AND DISCUSSION

Checking the 1932-38 collection, 106 species of leafhoppers were found. Presumably 16 species were overlooked by F. and R. Struve. Thus 122 species had colonized Borkum in the 30s. During 1986-88 129 species were recorded, 6 species have probably been overlooked, so that probably 135 species are established on Borkum in the 80s.

A total of 150 species in all have been recorded from Borkum, 71% were present in both periods of investigation (permanent species), 10% and 19% extinct and immigrated, respectively, during the past 50 years. Because of the relatively broad intercensus interval it must be taken into account that extinction and immigration rates can offset each other (cryptoturnover).

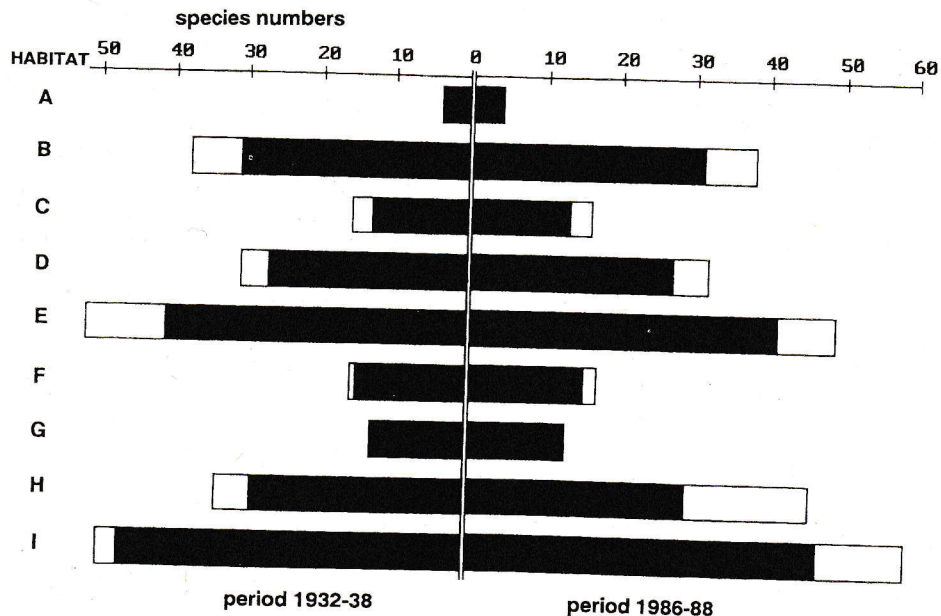


FIG. 3. Differences in the numbers of species between the periods 1932-38 and 1986-88 in various habitats on Borkum (black bars: species present in both periods, white bars: extinction and immigration species, respectively; habitats: A = yellow dune; B = grey dune; C = dune heath; D = shrubs, esp. with *Salix repens*; E = brackish transition area; F = reed marshes; G = saltmarshes; H = woodlands, partly planted; I = cultivated grasslands/ruderals).

The differences in species numbers between the 30s and the 80s in the various habitats are not significant (Fig. 3). In both periods most of the species were recorded in the heterogenous areas of the dune habitats, the brackish transition areas, the cultivated grasslands and the woodlands. The investigations of the seaside-exposed habitats as yellow dune areas and saltmarshes revealed small numbers of species. No fluctuation in species composition can be assumed.

Species turnover in leafhoppers in natural and anthropogenic habitats are presented in Fig. 4. Only in woodlands the turnover rate is very high due to the increase in plant species, especially trees and shrubs (cf. Table 2) and the development of larger forest-like sites. With a single exception the fluctuations of species compositions within the other habitats are not affected by human activities.

Thus a total of ca. 25% of the species turnover have been caused by human activities, mainly by the import of trees and shrubs. The remaining proportion of turnover is due to general area extension (2 species), competition effects (?) or stochastic variations predicted by the equilibrium theory of island biogeography (Mac Arthur & Wilson, 1963, 1967).

Most of the leafhopper species obviously require only small habitat sizes to stabilize their populations in general (often only some 10 m²). Therefore increasing urbanization and influences of tourism have only a minor effect on the island species composition, provided that the different natural habitats are of a sufficient size. On the other hand, it is not known whether the species compositions islands typical are stable in the long term under these conditions.

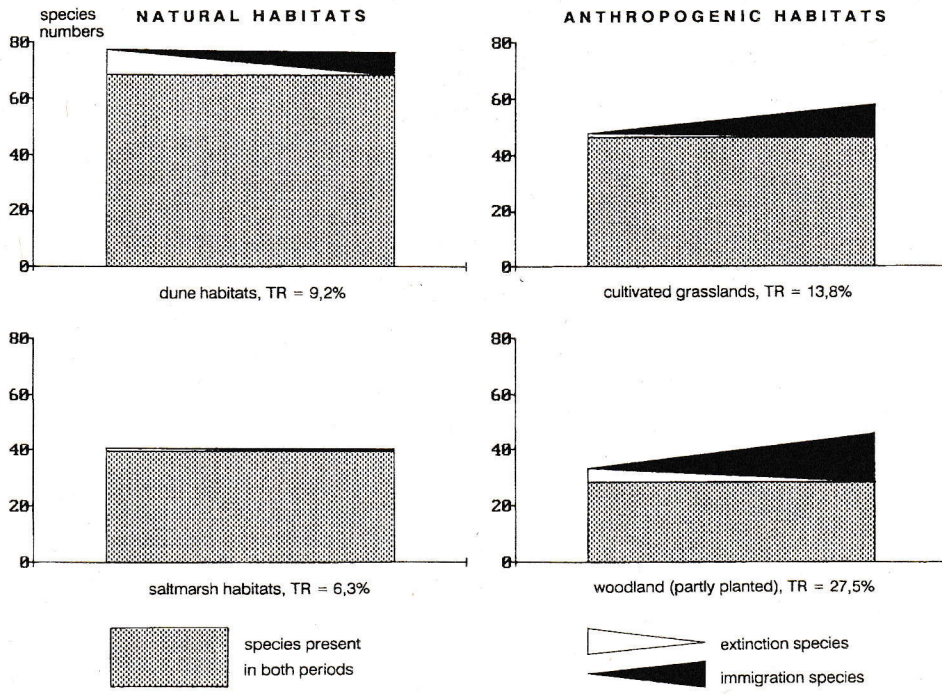


FIG. 4. Turnover of species in leafhoppers in natural and anthropogenic habitats on Borkum (TR = turnover rate in % per 50 years, according DIAMOND 1969).

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