BIOCHEMICAL SYSTEMATICS OF THE LEAF MINING MOTH FAMILY NEPTICULIDAE (LEPIDOPTERA). II. ALLOZYME VARIABILITY IN THE STIGMELLA RUFICAPITELLA GROUP

by

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ABSTRACT

Allozyme variation analysis at eight loci has been used to evaluate genetic differentiation and systematic relationships in the Stigmella ruficapitella group (Lepidoptera, Nepticulidae). Species identification was only possible after electrophoretic analysis in combination with mine descriptions.

By comparing zymograms five different groups could be distinguished to which the names of S. basiguttella, S. roborella, S. atricapitella and S. samiatella could be given, although the identification of the last-mentioned species is still uncertain. S. basiguttella—which was formerly considered to be one species—turned out to consist of two genetically distinct, sympatrically occurring, sibling species. Again allozyme analysis proved to be a superior technique in discriminating sibling species.

Heterozygosity levels resembled those observed in other species groups of Stigmella. Genetic distances ranged from 0.22 to 1.95, setting the basiguttella complex apart from the other three species. Average genetic distance was somewhat smaller than observed in other nepticulid species groups, but still larger than in quite a number of Lepidoptera genera, indicating little recent speciation.

Intraspecific differentiation in S. roborella was low. Indirect means of estimating gene flow between populations indicated considerable levels of gene exchange in this species.

KEY WORDS: Allozymes, diagnostic characters, Stigmella, sibling species, gene flow, speciation.

INTRODUCTION

Although delineation of species is still dominated by traditional (mostly morphological) approaches which certainly will maintain their value in the future, molecular data and quantitative analysis are now widely and increasingly used in systematics (BERLOCHER, 1984; BUTH, 1984; MENKEN & ULENBERG, 1987). Since the introduction of allozyme

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electrophoresis in population biology by Lewontin & Hubby (1966) and Harris (1966) large amounts of information on variation at the protein level have accumulated (Nevo et al., 1984; Graur, 1985). Despite much heterogeneity in variability levels among and within taxonomic groups, nearly all species contain vast amounts of allozyme variability (Powell, 1975; Nevo et al., 1984; Graur, 1985; Menken, 1987). This almost inexhaustible reservoir of characters has proved to be very successful in characterizing species and discriminating sibling species in particular (for Nepticulidae see Wilkinson et al., 1983; Menken & Ulenberg, 1987; Van Driell & Menken, 1988; Menken & Wiebosh-Steeman, 1988; Menken, 1989a; Menken, 1990b).

The European species of the genus Stigmella Schrank, by far the largest genus in the leaf-mining moth family Nepticulidae, were partly revised by Johansson (1971). He was the first to divide the genus into several species groups, the S. ruficapitella group being one of them (see table I). Within this species group four new species were described, S. cerricoolella was reduced to a subspecies of S. basiguttella and redescriptions were provided for three species previously named. Later two more species were added to the species group, respectively by Borkowski (1972) and Klimesch (1978). Nowadays in Europe the S. ruficapitella group contains 13 species (Van Nieukerken, 1986), six of which are known from The Netherlands. Most species are exclusively leaf-mining on Quercus, but some feed also on Castanea sativa, whereas S. tristis Wocke is monophagous on Betula nana.

Until recently no phylogenetic studies in the genus Stigmella were available. This makes the established species groups rather tentative, although Van Nieukerken (1986, and pers. comm.) suggested that in part these species groups are monophyletic. In a recent study by Van Driell & Menken (1988) it was clearly demonstrated that three species groups in the genus Stigmella indeed mirrored groups based on allozyme variation analysis. The present paper is an extension of this biochemical approach to the S. ruficapitella group. This group is particularly difficult in that it is problematical and often uncertain to identify an individual in the field by means of (morphological) larval and mine characters, except for S. basiguttella.

MATERIALS AND METHODS

Collecting and Rearing

Individual larvae were collected in their mines in the field during 1979-1983. In The Netherlands the following 76 samples were taken from 23 different localities (see table I and fig. 1; the numbers in parentheses refer to the number of samples taken per locality): 1. Schiermonnikoog (1); 2. Ameland (4); 3. Texel (3); 4. Nijemirdum (3);