HOOFDSTUK 13 SUMMARY

THE DUTCH HOVERFLIES (DIPTERA: SYRPHIDAE)

The Netherlands are a small country, but nevertheless a respectable number of 328 species of hoverflies are known from within its borders. The knowledge of the hoverfly fauna of the Netherlands has greatly improved over the last 10 years, as a result of a national recording scheme. This book presents a comprehensive review of knowledge on the Dutch hoverfly fauna in a way that should be attractive not only for serious entomologists, but also for amateur naturalists and anyone interested in nature policy and -management. The first nine chapters deal with general topics like ecology, behaviour, diversity, evolutionary history, taxonomy, threats and conservation of hoverflies. In chapter 10, the species accounts give information separately for each species.

CHAPTER 1 Introduction

This chapter provides a brief overview of the contents of the book, as well an introduction to the morphology and variety in colours and forms of hoverflies. The contributions of the authors of the book are briefly described and all others who contributed in one way or the other are acknowledged.

CHAPTER 2 History of the hoverfly-study in the Netherlands and database

Dutch entomologists have studied hoverflies ever since the early 19th century. The first checklists of Diptera from the Netherlands (by Snellen van Vollenhoven and Van der Wulp) were published around 1850 and listed around 60 species. In 1898, Van der Wulp and De Meijere recorded 177 species. De Meijere's last checklist, completed in 1950, listed around 200 species. Thanks to the efforts of people like Van Aartsen, Van Doesburg, Van der Goot, Lucas and several others the number of known species would increase rapidly in the decades to follow: Barendregt listed 272 species in 1978. With the identification keys of Van der Goot and Barendregt hoverflies gained much popularity among young Dutch naturalists. This popularity triggered the start of the Netherlands Syrphidae recording scheme in 1998 by a group of young syrphid workers, several of which would eventually become the authors of this book. The recording scheme resulted in a database containing more than 400.000 records, comprising 328 species, gathered by over 400 volunteers (names listed in appendix 1).

CHAPTER 3 Biology of hoverflies: adults

This chapter reviews the current knowledge of the biology of adult hoverflies, with special focus on the fauna of the Netherlands. Topics treated are flower visiting and other foraging behaviour, reproduction (including territorial behaviour, courtship, copulation and oviposition), daily activity patterns, migration, death causes (including predation and parasites). In separate boxes, brief excursions from the main text are made to the topics 'facts and figures of flying', singing hoverflies, mimicry and the various origins of colour morphs.

CHAPTER 4 Biology of hoverflies: immature stages and life cycle

While adult hoverflies are real eye-catchers, the immature stages are much more elusive. However, understanding the various ecological demands and peculiarities of hoverfly larvae is critical for understanding the life and occurrence of hoverflies. In this chapter, the species are divided among several ecological categories according to their larval feeding habits and microhabitats (see also appendices 4 and 6). Larval development and pupation are described, as well as death causes like predation and parasitoids. The last part of the chapter deals with several aspects of the life cycle of hoverflies: flight period (and differences in flight period between males and females), generations, diapause and species diversity throughout the year. Eight types of life cycles are recognized, based on flight period, number of generations per year and stage of hibernation.

CHAPTER 5 Distribution

The distribution of hoverfly species in the Netherlands is analyzed by comparing the species composition of 1591 investigated 5×5 km grid cells. Of these grid cells, 875 were investigated well enough to participate in the analysis. Based on a TWINSPAN analysis of the species composition in these cells, 12 clusters are recognized. Each cluster is characterized by its own species composition, which in most cases contains a set of characteristic species, i.e. species which are represented in a certain cluster exclusively or significantly more than in other clusters. The occurrence of all species per cluster is listed in appendix 5. The clusters have 18 species in common. The most species-rich cluster is formed by the calcareous lime soils of the southern part of Limburg (cluster 1), the most south-eastern province. Clusters 2-5, all on sandy soils and well-forested, are also species-rich. The remaining clusters are less rich in species, but some contain characteristic species, like the heath lands of cluster 7, the moist grasslands of cluster 11 and the fenlands of cluster 12. The chapter concludes with a brief discussion of the position of the Netherlands in Europe with regard to its hoverfly fauna. A few species characteristic for fenland (cluster 12) appear to be represented better in the Netherlands than in surrounding countries: *Anasimyia contracta*, *Orthonevra geniculata* and *Parhelophilus consimilis*. The coastal species *Lejops vittatus* and *Sphaerophoria loewi* also seem to be less rare in the Netherlands than elsewhere in northwest Europe.

CHAPTER 6 Hoverflies in their habitats

This chapter describes the main habitats of hoverflies in the Netherlands, as well as their species composition. The habitats are described at the landscape level, based on the experience of the authors, rather than on quantitative data based on field records. At the landscape level fairly accurate predictions of the hoverfly fauna at a site can be made. The presence, however, of specific microhabitats, including larval habitats and stands of flowers for the adults, has a large

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impact on the local hoverfly fauna. We designed a hierarchical set of habitats, in which habitats grouped at higher hierarchical levels have species in common, and the habitats at the lower levels are differentiated by more specialized species. Accounts on all habitats are given, including number of species, occurrence in the Netherlands, typical species and for most habitats a photo is given. For each species separately occurrence per habitat is indicated in appendix 6.
The number of species, and number of unique species are shown in figure 6 (categories in the same order as mentioned above). In figure 5 the total number and unique species are given for the higher level aggregates. Table 2 gives the Sørensen similarity indices (in percentages).
The habitat categories are (colours correspond to those used in appendix 6):

Forests
Deciduous forest: mature deciduous forest on marl or loess; deciduous forest on clay; deciduous forest on nutrient rich sandy soils; wet forest on peat soil; deciduous forest on nutrient poor sandy soils.
Coniferous forest: dry coniferous forest; wet coniferous forest.

Open habitats
Dry, open habitats: calcareous grassland; dry oligotrophic grassland; dry heathland; dry nutrient rich grassland; dry hypertrofic agricultural grassland.
Moist to wet open habitats: wet heath land; peat moor; flower rich reed-lands; moist grassland on peat; moist grassland on clay; moist grassland on sand; moist hypertrofic agricultural grassland.
Ruderal habitats: fallow and wasteland; arable field; salt marshes.

Urban habitats
Gardens and parks.

CHAPTER 7 Trends, threats and protection
This chapter starts with an analysis of the changes in occurrence of hoverflies in the period 1950-2002, measured as changes in numbers of records. For this, a new method is used, which is essentially a non-parametric rank correlation (Spearman) of the number of records of a species per year (compared to other species) over the years. Contrary to more traditional methods, this method allows to establish trends for more common and widespread species as well. This method could be used for 201 species, of which 45 showed a significant increase and 33 a significant decrease. For 124 rarer species, a secondary and less reliable method was used: Chi^2-statistic. In general, many species with a negative trend have aquatic saprophagous larvae, whereas none of these have terrestrial saprophagous larvae.
A second analysis deals with extinction and establishment of species in the Netherlands in the 20th century. In this period, 16 species established populations and 11 went extinct.
This is followed by an analysis of species threatened by extinction, currently or in the near future. One-third of all species is endangered to some degree.
The causes of many changes in the Syrphidae population are investigated, focusing on main topics: more intensive land-use, more and older forests, less wetlands, eutrophication, acidification and global warming. Suggestions for the protection of hoverflies are given for major hoverfly habitats.

CHAPTER 8 Phylogenetic relationships and nomenclature
Current ideas on the evolution of hoverflies are described, based on literature concerning fossil evidence and recent phylogenetic hypotheses. The chapter contains a systematic checklist of all 328 hoverfly species known from the Netherlands, with notes on classification and differences with previous checklists based on changes in taxonomy, nomenclature and re-identifications. Vernacular names have been created for all Dutch hoverfly species. This is briefly discussed in this chapter, but names themselves are only mentioned in the species accounts. A list is given of 33 species known from adjacent parts of Europe, which could be expected to show up in the Netherlands some day. A separate box gives etymological explanations of generic names of hoverfly genera occurring in the Netherlands.

CHAPTER 9 Studying hoverflies yourself
This chapter aims to provide practical information for the study of hoverflies. The first part deals with the adults: where to find them, how to catch, mount and conserve them. The second part deals with the immature stages in roughly the same way.

CHAPTER 10 Species accounts
In this chapter summarized information is given for all hoverfly species known from the Netherlands. Species accounts are sorted in alphabetical order and include information on identification and taxonomy, distribution and biology. For every species a map indicating the distribution of Dutch records is given, as well as a flight diagram. Genera have their own accounts too.
Every species account is concluded by an English summary in the following format:

Indication of abundance
Example: 'Fairly common'.
Based on 5×5 km grid cells in which the species was found in 1990-2007: very rare (1-5 cells), rare (6-19 cells), scarce (20-59 cells), fairly common (60-199 cells), common (200-649 cells), very common (>= 650 cells). For number of grid cells, number of records etc. see appendix 8.

Indication of trends and (if applicable) conservation status
Example: 'Less common before 1950, decreased since. Vulnerable.'
The trend indications are based on two different calculations. The relative abundances (grid cells occupied divided by grid cells investigated) in the period before 1950 and in the period 1950-2002 are compared by a Chi^2-test (only mentioned if a significant difference was found). The trend

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within the period 1950-2002 is calculated by a Spearman's Rho analysis. As two different methods have been applied to different periods, the calculated trends may sometimes be paradoxical, as in the given example.
If applicable, conservation status is indicated by the terms strongly threatened, threatened, vulnerable and susceptible. See chapter 7 and appendix 7 for a more extensive explanation in Dutch.

Habitat in The Netherlands
Example: 'Moist coniferous and mixed forests.'
Based on Dutch records of the species. If only one or few records are available, this may not always be a representative habitat indication.

Ecology / behaviour (facultative)
Notes on behaviour, larval habitat et cetera are only given if the authors feel that Dutch information adds to published information in international literature.

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