

The Lepidoptera of the salt marshes of Het Zwin including two species new for the Belgian fauna (Lepidoptera)

Maurice Jansen

Abstract. An inventory was made of the Lepidoptera of the salt marsh of the Zwin-reserve at the Dutch-Belgian border based on own investigations in the period 1982–2006 and on literature data in combination with collection data. Different sampling methods were used. Netting and light trapping were the most used methods for adults whereas pre-adult stages were reared out from tidal litter and from host plants. The number of salt marsh species found was 53 and 50 species were observed from other habitats. *Coleophora maritimella* Newman, 1873 and *Whittleia retiella* (Newman, 1847) are new for the Belgian fauna and were reared from tidal litter collected in March 2003 and May 2005 respectively.

Samenvatting. De Lepidoptera van schorren van Het Zwin met twee soorten nieuw voor de Belgische fauna (Lepidoptera)

Er werd een inventaris gemaakt van de vlinders van het schor van het natuurreservaat Het Zwin nabij de Belgisch-Nederlandse grens. Deze werd uitgevoerd in de periode 1982–2006 en is gebaseerd op literatuur- en collectiegegevens. Er werden verschillende methoden gebruikt waarvan net- en lichtvangsten voor het vangen van adulten de meest gebruikelijke zijn terwijl ook rupsen op planten en uit veekmateriaal werden uitgekweekt. Er werden 53 schorsoorten gevonden en daarnaast nog eens 50 soorten van andere habitats. *Coleophora maritimella* Newman, 1873 en *Whittleia retiella* (Newman, 1873) zijn nieuw voor de Belgische fauna en werden beide uit veekmateriaal gekweekt dat was verzameld in respectievelijk maart 2003 en mei 2005.

Résumé. Les lépidoptères des marais salants de la réserve naturelle Het Zwin comportant deux espèces nouvelles pour la Belgique (Lepidoptera)

Un inventaire des lépidoptères des marais salants de la réserve naturelle Het Zwin à la frontière belgo-hollandaise a été entrepris durant la période 1982–2006 et est basé sur des données provenant de la littérature et de diverses collections. Des méthodes différentes ont été utilisées, dont les captures avec un filet et à la lumière étaient les plus courantes. Aussi des chenilles trouvées sur leurs plantes nourricières et dans des débris ont été élevées. Au total 53 espèces typiques des marais salants ont été répertoriées, ainsi que 50 espèces d'autres biotopes. *Coleophora maritimella* Newman, 1873 et *Whittleia retiella* (Newman, 1873) sont nouveaux pour la faune belge; ces espèces ont été élevées des débris qui ont été recueillis en mars 2003 et mai 2005 respectivement.

Key words: Belgium – Het Zwin – *Coleophora maritimella* – *Whittleia retiella* – ecology – faunistics – salt marshes – Faunistics – First record.

Jansen, M. G. M.: Appelgaard 9, NL-4033 JA Lienden, The Netherlands. mgmjansen@gmail.com.

Introduction

The reserve "Het Zwin" (fig. 1) is the most southern spot of the Dutch coast along the North Sea and divided by the Dutch-Belgian border. At the Dutch side it is bordered by Cadzand-Bad and at the Belgian side there are the dunes and the tourist activities at Knokke-Heist. It is a "slufter" which consists of a sandy beach, dunes and salt marshes which are connected with a narrow corridor in the dunes towards the sea (fig. 2). The total salt marsh and mud flat area of the reserve on both sides of the border is about 150 ha (Anonymous 1993).

Including the dunes and mud flats, about 60 ha is property of the Netherlands, Ministry of Finance from which the covered area is about 30 ha (van Dort & Leusink 1998) calculated by means of summation of the areas of vegetations types. The Belgian part including the dunes, the marshes and tidal mud flats takes up about 190 ha including about 125 ha of salt marshes. Between both exists a gradually transition zone with higher situated desalinated sward like vegetations. At the Belgian part of the reserve in the transition zone to the dune vegetation the middle tidal litter zone with its drift-line community was taken as boundary. The environment has the average chlorine content of sea water with a maximum of 20.0 g/l on sites which are regularly drying out during the summer period based on Stikvoort *et al.* (2003). Depending on the height above sea-level in the transition zone towards the dunes the salt content is decreasing resulting in patchy vegetations with a mixture of stands dominated by halophytes and those dominated by glycophytic plant species. The salt marshes are inundated twice a day by the tides.

History and management

After inundations during the 11th century Het Zwin became the entrance to the harbour of the cities Brugge and Damme but the so called Zwingel started to silt up and during the 18th century no ships were able to use the Zwin channel any more. The reserve is a remnant of this connection with the sea. Before 1872 part of the coastal zone was reclaimed and embanked and in that year it got its present borders by the construction of the international dike. Dunes raised in its estuary and are now interrupted by the Zwin channel through which tidal water can go in, submerging the salt marshes behind the dunes. This sluffer channel is going to silt up as well and can only exist by removing the surplus of sand on a regular base as part of a management conservation plan. Since 1993 a part of the marsh at the Dutch east side is grazed by sheep. The Belgian part is partly open for public and both the dunes and salt marshes are visited by many tourists.

Methods

There have been 26 visits during the period 1935–1974 and 34 during the period 1982–2006 including 5 nights collecting at light with a sheet and a trap. Host plants were inspected for the presence of larvae and reared using the method described by Jansen (2005). Several species were found in the storm flood zone and reared from tidal litter deposited in the utmost southern part of the reserve and in the transition zone towards the dunes (fig. 3). This "veek" material was collected in March–May, put in cages and followed indoors. Lepidoptera data were collected in the next years by several persons: 1934–1935, 1945, 1961–1963, 1965, 1974, 1981–1982, 1984, 1993, 1997–1998, 2001–2006. A species is considered to be native to a salt marsh if larvae were found which were able to survive the environment and to complete their life-cycle in any salt marsh. Data were collected by the following persons: B. van Aartsen, G. Bentinck, H. Coldeweyj, A. Cox, C. Doets, M. Honey, E. Janmouille, M. Jansen, G. Langohr, T. de Oude, M. Parsons, M. Peerdeman, and H. van der

Wolf. The reserve was visited in March and from May to October. Usually during visits, collectors made an inventory of only a part of the Lepidoptera fauna. Concerning the data collected by M. Peerdeman in 1963 with a light trap Jansen (1979) indicated that these data originate from two different sites and were mixed by which it is impossible to know which data belong to the Zwin fauna.

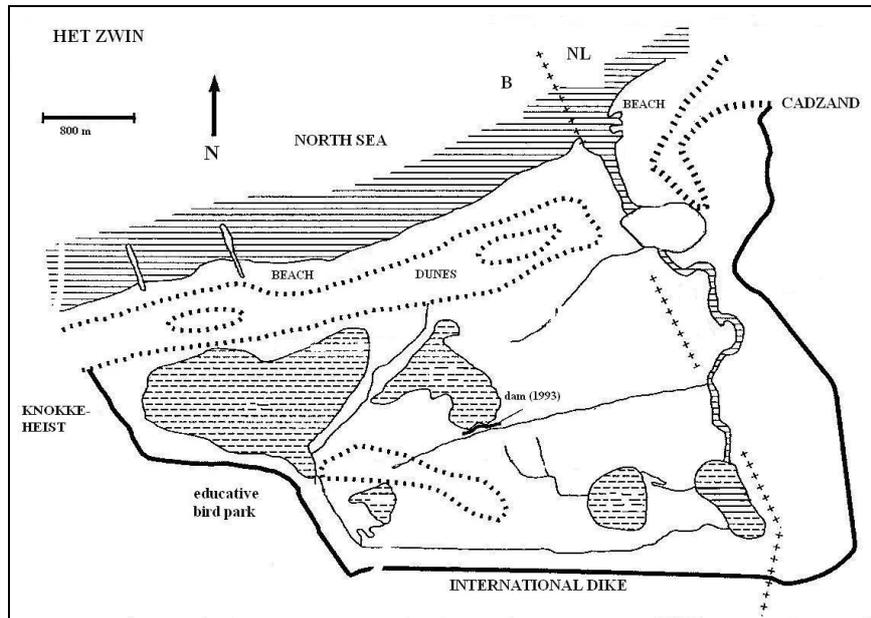


Fig. 1. Map of the Zwin area (changed after Anonymous 1993).

Results

The total number of Lepidoptera species which has been ascertained is 104 which number can be divided in 54 salt marsh species and 50 other species of a total of 96 species in The Netherlands from which there is evidence or strong indications they belong to the ecosystem. During the survey, emphasis was laid on salt marsh species and therefore the species from other habitats were considered as side catching. The tidal drift zone was considered to be an element of the salt marsh. It is to be expected that the number of species of the dune ecosystem is much higher.



Fig. 2. Het Zwin with salt marsh vegetation along the Zwin-channel with interrupted dunes on the background.



Fig. 3. Het Zwin with cover of *Beta maritima*, *Atriplex littoralis* and *Tripleurospermum maritimum* on tidal litter alongside the dike at the utmost southern part.

Table 1. Salt marsh species and their main host plants. M= monophagous O= oligophagous P= polyphagous.

Salt marsh species	Host plants of salt marsh species
<i>Whittleia retiella</i>	(O) <i>Puccinellia, Artemisia, Atriplex</i>
<i>Bucculatrix maritima</i>	(M) <i>Aster tripolium</i>
<i>Plutella xylostella</i>	(P) <i>Cakile</i>
<i>Goniodoma limoniella</i>	(M) <i>Limonium vulgare</i>
<i>Coleophora adjunctella</i>	(M) <i>Juncus gerardii</i>
<i>Coleophora glaucicolella</i>	(O) <i>Juncus</i>
<i>Coleophora salinella</i>	(M) <i>Atriplex</i>
<i>Coleophora maritimella</i>	(M) <i>Juncus maritimus</i>
<i>Coleophora saxicolella</i>	(O) <i>Atriplex</i>
<i>Coleophora sternipennella</i>	(O) <i>Atriplex, Suaeda</i>
<i>Coleophora versurella</i>	(O) <i>Atriplex</i>
<i>Coleophora atriplicis</i>	(O) <i>Atriplex, Salicornia, Suaeda</i>
<i>Coleophora deviella</i>	(M) <i>Suaeda</i>
<i>Coleophora adspersella</i>	(O) <i>Atriplex, Suaeda</i>
<i>Coleophora salicorniae</i>	(M) <i>Salicornia</i>
<i>Chrysoesthia drurella</i>	(O) <i>Atriplex littoralis, A. prostrata</i>
<i>Chrysoesthia sexguttella</i>	(O) <i>Atriplex littoralis</i>
<i>Monochroa moyses</i>	(M) <i>Bolboschoenus maritimus</i>
<i>Scrobipalpa salinella</i>	(O) <i>Salicornia</i>
<i>Scrobipalpa instabilella</i>	(M) <i>Atriplex portulacoides</i>
<i>Scrobipalpa nitentella</i>	(O) <i>Atriplex, Suaeda, Salicornia</i>
<i>Phalonidia affinitana</i>	(M) <i>Aster tripolium</i>
<i>Gynnidomorpha vectisana</i>	(M) <i>Triglochin</i>
<i>Agapeta hamana</i>	(O) <i>Cirsium arvense</i>
<i>Cochylidia implicitana</i>	(O) <i>Aster tripolium</i>
<i>Aphelia viburnana</i>	(P) <i>Aster, Atriplex littoralis</i>
<i>Eucosma tripoliana</i>	(M) <i>Aster tripolium</i>
<i>Agdistis bennetii</i>	(M) <i>Limonium vulgare</i>
<i>Gymnancyla canella</i>	(M) <i>Salsola kali</i>
<i>Chrysoteuchia culmella</i>	(P) <i>Elytrigia atherica</i>
<i>Crambus perlella</i>	(O) <i>Elytrigia atherica, Festuca rubra</i>
<i>Agriphila straminella</i>	(O) <i>Festuca rubra</i>
<i>Pediasia aridella</i>	(O) <i>Festuca, Puccinellia</i>
<i>Ostrinia nubilalis</i>	(P) <i>Atriplex littoralis</i>
<i>Thymelicus lineola</i>	(P) <i>Elytrigia atherica</i>
<i>Pieris brassicae</i>	(O) <i>Cakile, Crambe</i>
<i>Pieris rapae</i>	(P) <i>Cakile</i>
<i>Eupithecia centaureata</i>	(P 1) <i>Aster, Limonium Suaeda, Artemisia</i>
<i>Eupithecia simpliciata</i>	(O 2) <i>Atriplex littoralis, A. prostrata</i>
<i>Autographa gamma</i>	(P) <i>Aster, Atriplex, Beta</i>
<i>Cucullia asteris</i>	(O) <i>Aster tripolium</i>
<i>Amphipoea fucosa</i>	(O) <i>Bolboschoenus</i>
<i>Archanara geminipuncta</i>	(M) <i>Phragmites</i>
<i>Discestra trifolii</i>	(P) <i>Aster, Atriplex</i>
<i>Lacanobia suasa</i>	(P) <i>Aster, Beta, Plantago</i>
<i>Mythimna impura</i>	(P) <i>Festuca rubra, Phragmites</i>
<i>Agrotis ripae</i>	(O) <i>Suaeda, Cakile, Salsola</i>
<i>Spilosoma urticae</i>	(P) <i>Atriplex littoralis, Juncus gerardii</i>

Table 2. Species from other habitats.

<i>Nemophora metallica</i>	<i>Phlyctaenia coronata</i>
<i>Bucculatrix bechsteinella</i>	<i>Pleuroptya ruralis</i>
<i>Phyllonorycter blancardella</i>	<i>Palpita unionalis</i>
<i>Leucoptera malifoliella</i>	<i>Mimas tiliae</i>
<i>Lyonetia clerkella</i>	<i>Colias croceus</i>
<i>Agonopterix alstromeriana</i>	<i>Polyommatus icarus</i>
<i>Cosmiotes sp.</i>	<i>Vanessa cardui</i>
<i>Batia lunaris</i>	<i>Inachis io</i>
<i>Coleophora trifolii</i>	<i>Aglais urticae</i>
<i>Coleophora therinella</i>	<i>Lasiommata megera</i>
<i>Cosmopterix zieglarella</i>	<i>Coenonympha pamphilus</i>
<i>Ptocheuusa paupella</i>	<i>Pyronia tithonus</i>
<i>Bryotropha terrella</i>	<i>Maniola jurtina</i>
<i>Bryotropha senectella</i>	<i>Hipparchia semele</i>
<i>Clepsis consimilana</i>	<i>Camptogramma bilineata</i>
<i>Lozotaeniodes formosana</i>	<i>Cosmorhoe ocellata</i>
<i>Orthotaenia undulana</i>	<i>Hoplodrina blanda</i>
<i>Celypha rosaceana</i>	<i>Hoplodrina ambigua</i>
<i>Celypha lacunana</i>	<i>Apamea monoglypha</i>
<i>Eucosma campoliliana</i>	<i>Xestia c-nigrum</i>
<i>Emmelina monodactyla</i>	<i>Oligia latruncula</i>
<i>Aphomia zelleri</i>	<i>Chortodes elymi</i>
<i>Homoeosoma sinuella</i>	<i>Mythimna pallens</i>
<i>Eudonia lineola</i>	<i>Mythimna litoralis</i>
<i>Pediasia contaminella</i>	<i>Noctua pronuba</i>
<i>Sitochroa palealis</i>	<i>Tyria jacobaeae</i>

Comments on a few species

Whittleia retiella (Newman, 1847)

The species belongs to the Psychidae and is new for the Belgian fauna. It is a remarkable species with winged males and wingless females which are rarely observed. Because of their small size and the habit to fly low above the soil they are very inconspicuous and usually found by chance.

Collected material and methods

In 2003 two males from the Dutch part of the reserve were reared. Tidal litter was collected on 23.iii.2003 from which two male specimens emerged on 15 and 20.iv.2003. Tidal litter collected on the Belgian part of the reserve on 13.v.2005 was put in a cage from which one adult male emerged on 15.v.2005. Although tidal litter was collected in 14 different sites in the southwestern part of The Netherlands, *W. retiella* was only detected in Het Zwin.

Biology

Although considered to be a typical element of salt marshes (Hättenschwiler 1985) there is a lack of knowledge of its biology which is contributed by its rather cryptic life habit: the females are wingless and the cases are difficult to find. As a result there are very few documented reliable observations of host

plants. In the Netherlands the species has a wide ecological range and is an inhabitant of very different habitats. Heylaerts made the first observation of the species in The Netherlands at Breda in 1877 and found three larval cases on the trunk of a *Populus* tree and one year later on *Poa annua* and *Artemisia* sp. (Doets 1938). Van Aartsen found dozens of specimens at Burgsluis on a grassy seedike in 1994, both Leefmans and Bentinck found specimens in the same habitat near Diemen (Doets 1938), Van der Wolf (pers. comm. 2005) found many specimens in a *Lotus* vegetation on the Wadden Island Vlieland scrutinizing it when in a kneeling position. Lempke (1961) recorded *W. retiella* from heathers in Sleswig-Holstein and Sinnema (2006 and pers. comm. 2007) collected the species by netting in 2005 in a Junco-Molinion fen-meadow. Doets (1938) found larvae by netting on *Festuca rubra* and *Holcus lanatus* during March whereas in captivity almost every grass species was eaten like e.g. *Lolium perenne*, *Poa annua* and *Elytrigia repens*. Tutt (1901, II: 47) recorded the species from the Thames estuary where it was observed to be present on *Atriplex* sp. and *Plantago* sp. Single cases were found by myself on *Atriplex portulacoides* at a salt marsh of Zierikzee in 1983 and on *Artemisia maritima* at the Zuidgors at Ellewoutsdijk in 4.ix.1996. It is questionable whether these two last mentioned host plants were the plants on which the larvae lived but it is not the first time they were found on something different than Gramineae. In contrast to most other halophytic species *W. retiella* seems to have no optimum in a particular habitat although the numbers in coastal surroundings are striking.

The Dutch larvae were found in March, May and September. That is in accordance with the biology as described by Hättenschwiler (1985). There is one annual generation. In the UK the adult male has especially been observed during late May and in early June whereas the Dutch specimens were observed from the first half of April to the first decade of June with a peak in the first decade of May.

Recognition

The shape and colour of the case is much alike those of *Epichnopterix plumella* ([Denis & Schiffermüller], 1775) and covered with flat longitudinally pieces of grass with a length of 8–12 mm. The adult male of *W. retiella* however has white and black spots whereas the male from *E. plumella* is almost uniformly black.

Geographical distribution

The species was formerly found in a limited number of countries: United Kingdom, The Netherlands, Germany, Denmark and Sweden (Arnscheid 2007). Its occurrence was expected by De Prins (1998) who indicated the species was already mentioned from Belgium without the presence of any specimens in Belgian collections. The international significance of *W. retiella* is important due to this restricted geographical distribution. Its cryptic lifestyle, by which *W. retiella* is difficult to detect, contributes to that and therefore the species may be overlooked and present in more localities in Belgium or elsewhere in Europe.

***Coleophora maritimella* Newman, 1873**

The species belongs to the Coleophoridae and this is the first record for Belgium. After the first record in The Netherlands (Jansen 1985) the species has been found on most sites where *Juncus maritimus*, its host plant, is growing. Both the host plant and the insect are restricted to the coast. The moth species shares its monophagy and the larval habits with three family members which occur in the Zwin reserve: *C. adjunctella* Hodgkinson, 1882 from *Juncus gerardii*, *C. salicorniae* Heinemann & Wocke, 1877 from *Salicornia* sp. and *Goniodoma limoniella* (Stainton, 1884) living on *Limonium vulgare*. The abdomen of these larvae is hidden in a fruit from which the content was eaten before or in the case of *C. salicorniae* it is living in a tip of a branch of the host plant.

Collected material and methods

On 23.iii.2003 tidal litter was collected in the Dutch and utmost southern part of the reserve from which one adult emerged on 21.vi.2003. On 21.v.2004 tidal litter collected in the Belgian part of the reserve and ten cases were counted from which one adult male emerged at the end of June 2004 (genitalia slide number MJ 1357). About 70 larval cases were counted on the host plant on the same date. On 13.v.2005 tidal litter was collected in the Belgian part of the reserve from which two adults emerged on vii.2005 (genitalia slide numbers MJ 1345 and MJ 1366). It is worth noting that no *Juncus maritimus* stands are growing in the Dutch part. The tidal litter material which is round up in the southern part of the reserve during high tide and spring tide originates from the whole reserve including that of the Belgian part. There are several *Juncus maritimus* stands in the transition zone between the salt marsh and the dunes on which *C. maritimella* is living. Adults are active during the day by dark and cloudy weather. The best period is at dusk when they can be collected by sweep netting but they can also be obtained by light trapping, however in smaller numbers.

Biology

The larva eats the flowers and fruits. The case is an empty fruit and the presence of a hole may be an indication of the presence of *C. maritimella* or *C. glaucicolella* on the plant. The larvae are present from September till May. Part of the population hibernates on the host plant and another part leaves the plant and shelters elsewhere in the vegetation, so the larva can be found during the whole period. Due to the fact that the larvae shelter in an old fruit, they are almost unrecognizable but after collecting some stems with fruits and storing these inside a room at room temperature they start to walk around. The adults of most Coleophoridae can only be distinguished by studying the genitalia structure (Emmet *et al.* 1996).

Geographical distribution

The species occurs in North Africa, the Near East and in the following European countries: Ireland, United Kingdom, The Netherlands, Denmark, Sweden, Spain, Portugal, Italy, Croatia, Albania, Greece, Cyprus, Crete and Bulgaria (Baldizzone & van der Wolf 2007).

Discussion

Probably additional salt marsh species will be found in the future. The Zwin reserve has many species in common with another nearby reserve: the Verdronken Zwartepolder near Nieuwvliet which is situated about 4 km north of the Zwin reserve and which is a "slufter" as well: it has also a small salt marsh behind the dunes and a narrow opening towards the sea. Both reserves have 35 salt marsh species in common whereas 15 species were only found at the Verdronken Zwartepolder and 18 species were only found at Het Zwin. Examples of species which were only found in the Zwin-reserve are *Elachista scirpi*, *Coleophora deviella*, *Coleophora adpersella* and *Scrobipalpa samadensis* whereas *Monochroa tetragonella*, *Coleophora asteris*, *C. alticolella* and *Cnephasia longana* are examples of species only found in the Verdronken Zwartepolder. Many of these species which are absent in either of the two reserve are common species like *Agapeta hamana*, *Lacanobia oleracea* or *Elachista argentella*. Therefore it is likely that sampling effort, coincidences like local weather conditions, but also local or temporary extinctions due to changes in host plant distributions contribute to these faunistic differences in this metapopulation ecosystem. An example of the influence of host plant population in relation to the moth population is that between *Beta maritima* and *Scrobipalpa ocellatella*. *Beta* populations (fig. 3) are usually fluctuating and after 1998, the year of discovery of this Gelechiid moth the number of plants decreased and only a few small ones were left. Both reserves are part of the dune ecosystem and the climatic and environmental conditions are almost the same. As a result both faunas are comparable and differ much more from the brackish marshes in the eastern part of the Western Scheldt north of Antwerp (Jansen 2005).

Acknowledgements

I am indebted to Giel Jacobusse and Stichting Het Zeeuwse Landschap for giving permission for research and for help with many questions and I thank Chris Struijf, conservator of the nature reserve Het Zwin at Knokke for his valuable information. The author thanks Willy De Prins and Janny Sinnema for information about *Whittleia retiella*. I express my gratitude to Anton Cox, Hugo van der Wolf and the late Bob van Aartsen for making collection data available and for useful information.

References

- Anonymous 1993. Vegetatiekaart van het Natuurreservaat "Het Zwin". Toestand 1993. 1-26 + 3 bijlagen + vegetatiekaart. — Eurosense. Administratie waterinfrastructuur en zeezeven. Dienst der Kusthavens.
- Arnscheid, W. 2007. Psychidae. — In: Karsholt O., & E. J. van Nieukerken (eds.), Fauna Europaea: Lepidoptera, Moths. Fauna Europaea Version 1.3, <http://www.faunaeur.org>.
- Ballizzone, G. & H. W. van der Wolf 2007. Coleophoridae. — In: Karsholt O., & E. J. van Nieukerken (eds.), Fauna Europaea: Lepidoptera, Moths. Fauna Europaea Version 1.3, <http://www.faunaeur.org>.
- De Prins, W. 1998. Catalogue of the Lepidoptera of Belgium. — *Studiedocumenten van het K.B.I.N.* **92**: 1–236.

- Doets, C. 1938. *Epichnopteyx retiella* Newman. — *Entomologische Berichten, Amsterdam* **10**: 7–8.
- Dort, K. W. van & L. Leusink 1998. Toelichting bij de Vegetatiekartering Het Zwin en Verdronken Zwarte Polder 1995 op basis van false-colour luchtfoto's 1: 5000. — Rapport MDGAE-9861: 1–47. Meetkundige Dienst. 1–46 + Supplement
- Emmet, A. M., J. R. Langmaid, K. P. Bland, M. F. V. Corley & J. Razowski 1996. Coleophoridae. — In: Emmet, A. M. (ed.). *The Moths and Butterflies of Great Britain and Ireland. Vol. 3. Yponomeutidae-Elachistidae*. Harley Books, Colchester. [chapter pagination 126–338].
- Hättenschwiler, P. 1985. Psychidae. — In: J. Heath & A. M. Emmet (eds.) *The moths and butterflies of Great Britain and Ireland. Vol. 2*. — Harley Books, Colchester. [chapter pagination 128–151].
- Jansen, G. W. 1979. Beheersrichtlijnen ten behoeve van het Zwin – een natuureservaat gelegen op de grens van België en Nederland. — Verslag nr. 501 Wageningen.
- Jansen, M. G. M. 1985. *Coleophora maritimella* Newman, nieuw voor de Nederlandse fauna (Lepidoptera: Coleophoridae). — *Entomologische Berichten, Amsterdam* **45**: 1–2.
- Jansen, M. G. M. 2005. The Lepidoptera fauna of three brackish salt marshes including two species new for the Belgian fauna (Lepidoptera). — *Phegea* **33**: 59–68.
- Lempke, B. J. 1961. Catalogus der Nederlandse Macrolepidoptera (Achtste supplement). — *Tijdschrift voor Entomologie* **104**: 111–186.
- Sinnema, S. 2006. Twee interessante soorten in Friesland. — In: H. ten Holt: Verslag van de najaarsbijeenkomst van de sectie Ter Haar op 26 november 2005 te Lexmond. — *Franje* **9**: 25.
- Stikvoort, E. (ed.), C. Berrevoets, M. Kuijper, F. Lefèvre, G. J. Like, M. Lievaart, D. van Maldegem, P. Meininger, B. Peters, A. Pouwer, H. Schippers & J. Wijsman 2003. Monitoring van de effecten van de verruiming 48'–43'. — MOVE Hypothesendocument 2003. MOVE Rapport 7 RIKZ/2003.09.
- Tutt, J. W. 1901. Practical hints for the field lepidopterist. — London/Berlin, 1–166. [P. Waring Reprint 1994 *The Amateur Entomologist* **23**].
-