

Yponomeutoid Moths

(Lepidoptera: Yponomeutidae, Plutellidae, Argyresthiidae)

of Israel

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OF ISRAEL

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Contents

1. Preface	1
2. Introduction	3
3. General Points	5
3.1. Biology of Yponomeutoid moths	5
3.1.1. Egg and embryonic development	5
3.1.2. Larval development and larval behaviour	5
3.1.3. Pupa	9
3.1.4. Adult	10
3.1.4.1. Sexual behaviour, oviposition, and fecundity	11
3.2. Distribution and consortive connections of Yponomeutoid moths	14
3.2.1. Distribution and habitats	14
3.2.2. Taxonomic diversity of the Yponomeutoid moths in Israel and in “Evolution Canyon”, Lower Nahal Oren, Mt. Carmel, Israel	14
3.2.3. Characteristics of Yponomeutoid moths as components of biocenoses	18
3.3. Economic significance	21
4. Classification of the Yponomeutoid moths	23
4.1. A way of classification	23
4.2. Relationship between higher taxonomic units of Yponomeutoid moths	24
5. Systematics	26
5.1. Key to families Yponomeutidae, Argyresthiidae, and Plutellidae	26
5.2. Keys to subfamilies of the families Yponomeutidae and Plutellidae	26
5.2.1. Key to subfamilies of the family Yponomeutidae	26
5.2.2. Key to subfamilies of the family Plutellidae	28
6. Family Argyresthiidae Bruand, 1850	29
7. Family Yponomeutidae Stephens, 1829	40
8. Family Plutellidae Guenée, 1845	54
9. Acknowledgements	79
10. References	80
11. Index to taxonomic names	91

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1. Preface

Interest and information concerning human knowledge connected with the natural environment have increased considerably during the last fifty years. Biodiversity in general, and insects as the most abundant animal group, in particular, plays a central role in biology. The lepidopteran representatives belong to the vast faunal complex that dominates in almost all terrestrial biocenoses including mountains, lowlands, forests, steppes, and deserts as well as orchards, agrocenoses, gardens, and parks. In this book we dealt with the phytophagous moths of three microlepidopteran families distributed worldwide: Yponomeutidae, Argyresthiidae, and Plutellidae. These families are suitable candidates for studying the dynamics of insect-plant interactions and the main evolutionary processes in nature leading to population differentiation and ultimately to speciation. However, the prerequisite for such studies is the knowledge of taxonomic diversity, trophic connections, and distribution, which are the main topics in our book.

The representatives of the families Yponomeutidae, Ypsolophidae, and Plutellidae are known from the Lower Cretaceous (Kuznetsov 1941; Common 1990). Presently, there are about 485 recorded species of these three families in the Palearctic region. From these species, 135 are recorded in the family Yponomeutidae, 70 species in Argyresthiidae, and more than 120 species in Plutellidae (Gershenson 1990a; Zagulajev 1990; Agassiz & Friese 1996; Gershenson & Ulenberg 1998). Other faunal regions share the following species richness in the three aforementioned families: Nearctic – 212 species, Neotropical – 271 species, Ethiopian – 153 species, Oriental – 294 species, and Australian – 426 species (Heppner 1998).

So far, the best elaborated work on Yponomeutoidea families has been done in taxonomy and biology (Friese 1960; Moriuti 1977; Heppner 1977, 1981, 1991, 1998; Kyrki 1984, 1990; Gershenson 1990a; Zagulajev 1990; Menken 1982, 1989, 1996; Gershenson & Ulenberg 1998). This work allows us to generalize about the adaptive morphological evolutionary changes in this family as follows: decrease of imaginal sizes, disappearance of ocellae, development of naked galea (haustellum), rudimental maxillae palpa, shortened basal branching of the forewing anal vein, fusing of the M3 and Cu1 veins of the hindwings, modification of the VIII-th abdominal segment to the paired lobes in males, and presence of the spined abdominal tergites. Special characteristics are present in the structures of male genitalia: tergal fusing of the IXth and Xth segment formed as a roof-like tegumen; the ventral part of the IXth sternite is transformed to a well developed saccus, and, both valves are symmetrical, i.e., homologous with legs of the larval IXth segment. The appendage of the Xth tergite – gnathos – is well developed. Evolution of the female genital structures is indicated by the shortened papillae analis, paired vaginal lobes, which are derivatives of the VIIIth abdominal sternite, and a rudimentary Xth

abdominal segment with a mostly undeveloped ovipositor. Evolutionary changes in larvae are expressed by the presence of two-ranked circles of spines on the abdominal legs and the ability of the early larval instars in most species to mine buds, stems, and leaves of the food plants. Evolved pupae show a reduction in the number of tergal spines. Adults are capable of additional nutrition, a character correlated with their ability of a prolonged flying.

This work is the first overview of the Yponomeutoid moths from Israel, demonstrating their regional taxonomic diversity expressed in 3 families, 3 subfamilies, 6 genera, and 25 species collected in Israel from 2000 to 2003. For each species, main references, diagnostic characters including external morphology of the imago, male genitalia, trophic connections, geographical distribution, and comparative remarks are given. Keys to the identification of the Yponomeutoid moths from Israel to families, genera, and species are presented. The following three species are newly recorded for Israel: *Yponomeuta plumbellus* (Den. et Schiff.), *Y. sedellus* Tr., and *Argyresthia conjugella* Zell.

2. Introduction

Yponomeutoid moths (Yponomeutidae s. lat., in the definition given by Moriuti (1977)) constitute a rather poorly known group, especially outside of Europe, North America, Japan, and the former USSR. As a consequence, the evolutionary classification of Yponomeutoid moths is hampered by (i) an insufficient knowledge, particularly of tropical representatives, (ii) unsolved taxonomic relationships between nominative groups, mainly on family and subfamily levels, and (iii) the lack of abundant fossil material. In the Middle East, including Israel, the Yponomeutoid fauna has been virtually unknown in deep contrast to the biogeographic and faunistic importance of the region (Tchernov & Yom-Tov 1988). The first records of Yponomeu-

toid species, from the area known today as the State of Israel, were documented by Amsel (1933). Later, Amsel's records were included in the "Prodromus Faunae Palaestinae" (Bodenheimer 1937). During the last sixty years of the 20th century, a few Yponomeutoid species from Israel were mentioned also by Bytinski-Salz (1966), Avidov & Harpaz (1969) and Halperin & Sauter (1992). Altogether, the aforementioned authors recorded the following five Yponomeutoid species from Israel: *Prays oleae* (Bernard, 1788), *P. citri* (Millière, 1873), *Plutella xylostella* (Linnaeus, 1758), *Ypsolopha eremella* Amsel, 1933, and *Y. sculpturella* (Herrich-Schäffer, 1854).

At the beginning of the 21st century, Gershenson *et al.* (2001, 2002) and Gershenson & Pavlíček (2002) recorded an additional 22 species for Israel and described one species new to science. Published and unpublished data of these species are revised in the present book, which is the direct result of the collaboration between the Institute of Evolution, University of Haifa (E. Nevo and T. Pavlíček), the Schmalhausen Institute of Zoology, National Academy of Sciences, Kiev, Ukraine (Z. Gershenson), and the Department of Zoology, Tel Aviv University, Israel (V. Kravchenko). In short, the presented book describes 25 species representing 6 genera and 3 families collected from 12 localities in Israel (Fig. 1) and includes keys to

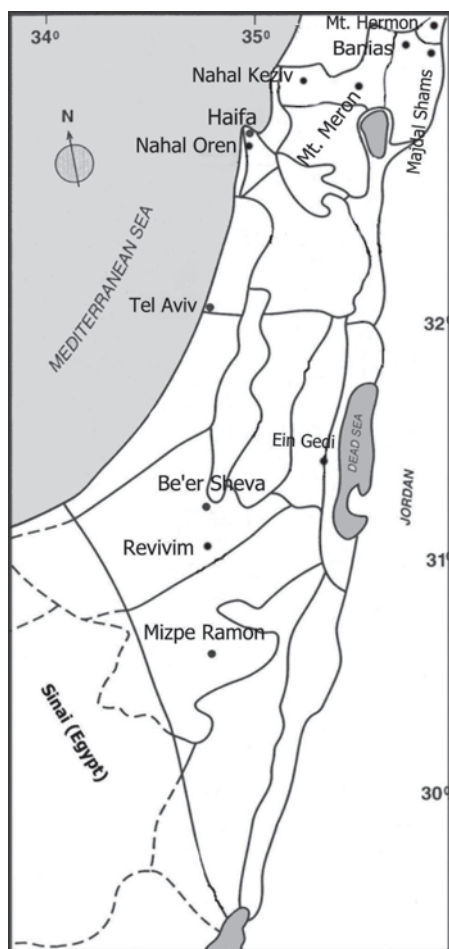


Fig. 1. Collection sites of Yponomeutoid moths in Israel.

the identification of the Yponomeutoid moths in Israel to families, genera, and species. Specific information is given about general distribution, regional distribution, and host plants of each species. The classification of moths is given according to Heppner (1998). The drawings and photographs were prepared by Z. S. Gershenson, unless otherwise stated.

3. General Points

3.1. Biology of Yponomeutoid moths

3.1.1. Egg and embryonic development

A freshly laid egg (Fig. 2), oval or elliptic, consists of a homogenous fine-grained yolk that is consumed during the embryonic development. Eggs are laid by a female, usually in batches, and protected by a mucous “shield”. In many species (*e.g.*, in most of the *Yponomeuta* species) two dark spots appear marking the eye part of the head after 1-2 weeks. When the head capsule is formed, the larval segmentation of the embryo becomes discernible. The egg’s incubation period differs interspecifically, and it is temperature- and humidity-dependent. For example, in species of the genus *Paraswammerdamia* Friese, 1960 development of the embryo lasts 17-22 days in the laboratory with an average temperature of 18-20 °C, while in nature their development can be lengthened up to four weeks without hibernation (Otto 1964). In contrast to *Paraswammerdamia*, the development of the embryo in the majority of Yponomeutoids varied in nature from 4-to-14 days. Egg hibernation is known, for example, in *Yponomeuta plumbellus* (Den. & Schiff.), *Paraswammerdamia iranella* Friese, and in the majority of species of the genus *Argyresthia* Hbn. In general, egg hibernation is less frequent in Yponomeutoid moths than larval hibernation.



Fig. 2. Egg of cherry fruit moth – *Argyresthia pruniella* (Cl.).

3.1.2. Larval development and behaviour

The newly formed larva (Figs. 3, 4), possessing the hypognathous head, gnaws through the egg envelope and usually stays for a limited period under the protective mucous “shield”, produced by the “mother”. Under the “shield”, larvae are protected against desiccation, predators, and parasites and feed on soft tissues of stems and twigs of the food plants. Small larvae of the 1st and 2nd instars mine buds, leaves (or needles of conifers), or stems of the host plants (*e.g.*, *Yponomeuta malinellus* Zell., *Y. orientalis* Zag., *Y. rorrellus* (Hbn.),

Y. plumbellus (Den. et Schiff.), *Y. irrorellus* (Hbn.), *Paraswammerdamia conspersella* (Tngstr.), *Euhyponomeutoides ribesiella* (Joann.), *Cedestis gysseleniella* (Zell.), *C. farinatella* (Dup.), *Plutella xylostella* (L.), *Ocnerostoma piniariellum* Zell., and *O. friesei* Svenss.) or make gossamer galleries inside bird nests, flower buds, fruits, branches, barks, stems, and leaves of host plants (e.g., majority of species in the family Argyresthiidae).

The mines are usually located in the parenchyma of the upper side of the leaf, and they are visible as numerous transparent spots on the leaves because larvae do not destroy the epidermis. Numerous larvae can be found inside one leaf and even inside the same mine. Probably, the record is 50-70 larvae of *Y. malinellus* Zell. per mine reported from Azerbaijan (Kurbanova 1967). During the mining, larvae of Yponomeutoid moths also cut the leaf veins and thus deprive certain regions of leaf water and nutritive substances. It is possible to identify certain Yponomeutoid moth species according to the shape of the damaged area on the leaf. For example, in diamondback moth larvae the damaged area of the leaf has the shape of a “win-



Fig. 3. Larvae of apple ermine moth – *Yponomeuta malinellus* Zell.



Fig. 4. Larvae of apple ermine moth – *Yponomeuta malinellus* Zell.



Fig. 6. Nests of pupae of willow ermine moth – *Yponomeuta rorrellus* (Hbn.) hanging in the silk web on a willow trunk (cocoons are absent).



Fig. 5. Nest with cocoons of apple ermine moth - *Yponomeuta malinellus* Zell.

dow”. As a consequence of mining, injured leaves become brown, dry, and inhospitable for future development and the larvae of 2nd (e.g., *Y. padellus* (L.)) or 3rd (e.g., *Y. rorrellus* (Hbn.), *Y. malinellus* Zell.) instars have to exit the mines and begin an open feeding on the twigs of the food plants; around them they often form protective feeding web nests from interwoven silk threads (Fig. 5). These nests might contain numerous larvae often from different instars, pupae (Fig. 6), cocoons (Fig. 8) (e.g., *Yponomeuta* species), or only one larva (e.g., *Paraswammerdamia ornicbella* Friese). On the one hand, silk nests help to protect larvae against predators, parasites (Lawrence 1990), and insecticides and

contribute to larvae development by improvement of the local microclimate (Alonso 1997, Gershenson 1978, Knapp & Casey 1986). On the other hand, gregarious larvae might be exposed to increased intraspecific competition (Damman 1991) and a higher rate of disease transmission (Hochberg 1991).

If all leaves inside one nest are consumed, the larvae are forced to search for a new feeding ground, where they usually form numerous new silk nests around leafy twigs of food plants. If numerous larvae are present, the web threads often entwine the trunks and branches of the food plants as well as nearby herbae varia. Interestingly, in contrast to the mining larvae of *Yponomeuta sedellus* Tr. that dispose of excrements inside mines, the larvae of the same species show "hygienic behaviour" inside the nests (Kooi 1988a). Larvae of this species deposit their excrements at a distance from the feeding place and reach the "toilet" using silk threads as a guide. The production of silk threads could also help larvae to escape from a threat. Harcourt (1957) described the following behaviour in *Plutella xylostella* (L.): "When disturbed, the larva wriggles backwards very rapidly or drops from the leaf on a fine silken thread, frequently to the surface of a lower leaf. Often the larva merely remains suspended on the thread. When the disturbance has passed, the larva grasps the thread between its mandibles, and arching its body, brings its head close to the metathorax. Moving its head in a counter-clockwise direction, the larvae loops the thread around the bases of the metathoracic legs. This process is repeated until the larva reaches the surface of the leaf. It then cuts the thread and crawls away, leaving a minute coil of silk on the surface of the leaf. This process lasts only a matter of seconds". In *Yponomeuta padellus* threatened larvae readily parachute towards the ground on lifelines and later come back up (Brackenbury 1996).

In hot and dry climates, as found in the Middle East, larvae usually feed during twilight hours and at night, whereas in moderate climates Yponomeutoid larvae feed also during daylight. Exceptions in hot climate are larvae of *Y. sedellus* Tr. that feed during daylight when the tissues of the host plant, *Sedum telephium* L., contain a lesser amount of the toxic malate than during the night (Kooi 1988b).

The larvae of the majority species in Yponomeutoid moths have five instars, and the fifth instar is followed by a prepupal stage. The larval stage of development, including the prepupal stage but excluding hibernation, takes about 45-50 days in Yponomeutidae (Gershenson 1974), 45-70 days in Argyresthiidae (Sinev 1994), and 20-40 days in Plutellidae (Zagulajev 1994). However, in the majority of Yponomeutoids, the first instar larvae hibernate, hidden under a shield, where they can survive frost up to -30 °C (Kuusik 1970). The length of the prepupal stage varies from several hours to 2-3 days, and, during this brief period, a mature larva does not eat and is not mobile. At the same time, thoracic parts as well as head structures begin their transformation to enter into the pupal developmental stage.

3.1.3. Pupa

Larvae of Yponomeutoid moths usually pupate (Fig. 7) in cocoons composed of one silk layer, either thickly (e.g., *Yponomeuta malinellus* Zell., *Y. cagnagellus* (Hbn.), *Y. evonymellus* (L.) or thinly transparent (e.g., *Yponomeuta sedellus* Tr., *Y. padellus* (L.)). Rather exceptionally, pupation takes place inside the silk web without making cocoons (e.g., *Y. rorrellus* (L.) (Fig. 6). Cocoons, usually attached to the host plants, protect the non-feeding and more or less defenseless pupa against desiccation (Nowbahari & Thibout 1990), parasites, and predators (Hieber 1992).

Solitary cocoons are present, for example, in *Yponomeuta sedellus* Tr. and *Paraswammerdamia ornicbella* Friesse whereas other species are characterized by groups of up to several hundred cocoons (e.g., *Yponomeuta evonymellus* (L.), *Y. malinellus* Zell., and *Y. cagnagellus* (Hbn.) (Fig. 8). The pupal stage without hibernation is usually short. Pupal hibernation in Yponomeutoidea is less frequent than the larval one, but it is known, for example, in *Yponomeuta sedellus* Tr. and *Paraswammerdamia ornicbella* Friesse.



Fig. 7. Pupa of *Yponomeuta polystigmellus* C. et Feld. Photo of V. Efremov.



Fig. 8. Nest with cocoons belonging to the spindle ermine moth – *Yponomeuta cagnagellus* (Hbn.).

As judged from the studies on *P. xylostella* (L.) (Uematsu & Morikawa 1997), females develop faster than males (seasonal protogyny). This probably adaptive feature helps to prevent inbreeding.

3.1.4. Adults

Shortly before eclosion, it is possible to observe a pharate adult inside of the pupa. The pharate adult usually needs 3-5 minutes to make its way out from the pupa through the pupal shell. The freshly emerged moth spreads its wings for nearly half an hour, and, after about one hour, it can fly. In comparison with many other moths, Yponomeutoidea are small and very small. The average lifespan of the Yponomeutoid moth (Figs. 9, 10) is about 20 days with a recorded maximum of about 70 days (Kurbanova 1966, Gershenson 1995). Adults of the Yponomeutid moths never hibernate, in contrast to their eggs, larvae, and pupae. Adults are usually active in

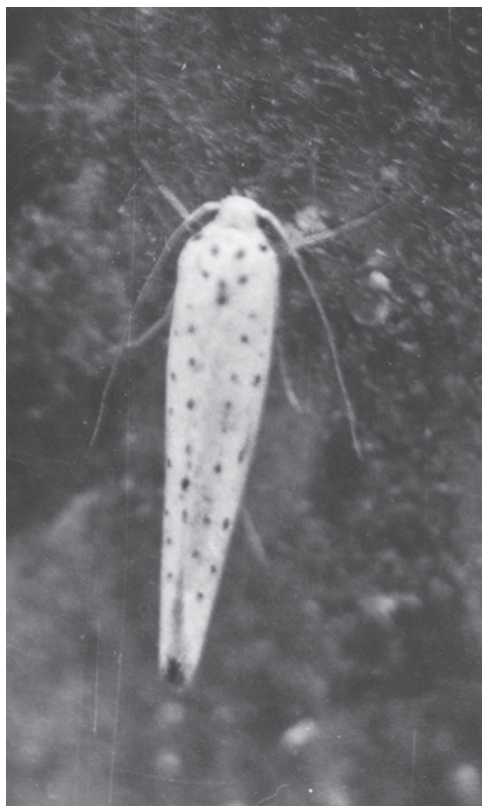


Fig. 9. Adult moth - *Yponomeuta meridionalis* Gersh.

twilight and during daylight hide, particularly in shade, among the foliage of trees and bushes or in a dense herbae varia. When moths are disturbed, they crawl along the twigs of the food plants, hiding from danger on the lower side of leaves, in the densest place of the foliage or fly low above the plants in search for a shelter. On a windless day their flight appears hesitant; the moths are seldom rising more than 1.5 m (five feet) above the ground, and they usually do not travel more than 3 to 3.7 m horizontally (Harcourt 1957). Their low dispersal ability also indicates the fact that inside of the relatively homogeneous cauliflower and broccoli fields, 99.9% of the *Plutella xylostella* (L.) moths remained within 300 m of their point of release (Mo *et al.* 2003). In spite of their weak flying ability, some of them are, however, capable of a long-range migration, helped by suitable agents. For example, *Plutella xylostella* (L.) crossed 800 km from W. Russia to the Arctic island Svalabrd in less than 48 h with help from a warm

south-easterly air mass (Coulson *et al.* 2002). The severe 1958 and 1996 outbreaks of this species in the U.K. have been attributed to the enormous influx of moths from the area around the eastern Baltic Sea, crossing more than 2,000 km (Shaw & Hurst 1969).

In natural habitats, it is often difficult to find Yponomeutoid moths due to their scarcity and because of their hiding mode of life. It is possible to attract them by UV light-traps; however, Yponomeutoid moths almost momentarily hide among the nearby plants. In spite of their hiding mode of life, Yponomeutoids, as well as the majority of other nocturnal moths, developed a tympanal organ (ear) responding to high-frequency sounds produced by insectivorous Microchiroptera (Hasenfuss 1997). In addition, larvae, pupae, and adults synthesize or accumulate toxic or bitter substances from the host plants such as coumarins (*Y. mahalebella*: Fung & Herrebout 1987), cyanoglucosides (*Y. megurionis* Mat.: Nishida 1994/1995), and butenolides (*Y. cagnagellus* + 6 other *Yponomeuta* species: Fung *et al.* 1988) as a means of protection against predators.

As a rule, adults of Yponomeutoid moths, provided with a proboscis, need additional nutrition (nectar of flowers in nature or sugar syrup in the laboratory) (Gershenson 1974, 1990a) or rather exceptionally, honeydew of aphids (*e.g.*, *Yponomeuta orientalis* Zag., *Y. polystigmellus* C. et Felder) (Efremov 1969) to lengthen adult life and flight-terms, and to maximize achieved fecundity.

3.1.4.1. Sexual behaviour, oviposition, and fecundity

Emerged adult females already possess underdeveloped eggs in their ovarioles, but the eggs ripen almost exclusively after additional female feeding. In *Yponomeuta* species copulation takes place after emergence from several days up to 3-4 weeks (Hen-



Fig. 10. Adults of the willow ermine moth – *Yponomeuta rorrellus* (Hbn.). Photo: Z. S. Gershenson.

drikse 1979), and it is almost invariably mediated by multicomponent sex pheromones produced by a female when she becomes receptive to mating. A male can detect a female, guided by pheromones, from a considerable distance away. Since the blending and isomeric ratios of the sex pheromones are species-specific (Roelofs & Cardé 1974, Pers & Otter 1978), they prevent interspecific mating. Six species of the genus *Yponomeuta* (*Y. evonymellus*, *Y. cagnagellus*, *Y. padellus*, *Y. irrorellus*, *Y. plumbellus*, and *Y. sedellus* Tr.) use different mixtures of (E)-11- and (Z)-11-tetradecenyl acetate as their primary sex pheromone component, with combinations of tetradecyl acetate, (Z)-9-tetradecenyl acetate, (Z)-11-hexadecenyl acetate, and the corresponding alcohols of the acetates as additional pheromone components (Löfstedt *et al.* 1991). Interestingly enough, the minor components of the sex pheromone may be repellent to sympatric species, *e.g.*, (Z)-11-hexadecenyl acetate produced by *Y. padellus*. The mating itself is influenced by ambient temperatures, and it can take rather a long time, for example, about one hour in the cabbage moth, *Plutella xylostella* (L.). Both mating and oviposition usually begin after sunset; however, during a period of low nighttime temperatures, the daylight oviposition was also observed in *P. xylostella* (L.) (Uematsu & Yoshikawa 2002a,b).

Male paternal investment in Lepidoptera is limited to accessory gland secretions deposited into the female during copulation. On one hand, this investment could guarantee a degree of paternal certainty and higher fecundity; but, on the other hand, it might be costly and limit the male's ability to mate again (Marshall 1982). Indeed, it was observed that females of the cabbage moth mate only once, while males can mate as many as three times (Harcourt 1957).

Before oviposition, females search for a suitable host plant for the progeny. The search is mediated by a presence of chemical attractants released by host plants and/or by an absence of repellent substances (Qiu *et al.* 1998, Reddy *et al.* 2004). The chemical response of adults also depends on chemical experience acquired by larvae, called the Hopkins host selection principle. Hopkins (1917) mentioned that in the endopterygote insects chemical experience acquired by larvae influence the chemical responses of adults, *i.e.*, that insects, of which larvae are trophically connected with a certain group of food plants, would prefer just the same plant to lay their eggs on. The Hopkins host selection principle has been proven in many insects including, for example, Yponomeutoid moths as well as the apple maggot fly (*Rhagoletis pomonella*) (Schilthuizen 2001).

Once the host plant is chosen the female then searches for a suitable place on the plant surface for oviposition. For example, females of *Plutella xylostella* (L.) run up and down on the twigs and probe the chosen surface for oviposition using their tarsi or antennae, and if they encounter an oviposition stimulant they also touch

the surface by an ovipositor (Spencer 1996). Apart from chemical stimulants or deterrents, mechanical properties of the surface are also important. For example, females of *Y. cagnagellus* show strong preference for depositing the eggs near buds, side shoots, or any other irregularities on the twig's surface (Bremner *et al.* 1997). In general, females rarely deposit eggs on the stems and petioles (*e.g.*, Plutellidae), but some species lay eggs on fruits (*e.g.*, *Argyresthia conjugella* Zell. lay eggs upon the apple fruits). Usually, the chosen place is near a source of food for their larvae.

The plant quality of the chosen host (*e.g.*, health, the contents of carbon, defensive metabolites, physical properties of the plant surface, presence of conspecifics, and microclimate) influences the larval development and survival, the fitness characteristics of adults, and also population characteristics. For example, *Plutella xylostella* (L.) preferably oviposits on injured cabbage plants than on healthy ones (Uematsu & Sakanoshita 1993), increases its population density parallels with an increase of the host plant nitrogen contents (Fox *et al.* 1990), and the presence of wax bloom on leaves of otherwise attractive leaves of *Brassica oleracea* L. and *B. napus* L. can suppress oviposition (Justus *et al.* 2000; Uematsu & Sakanoshita 1989). Interestingly, the feeding by small ermine moths, *Yponomeuta evonymellus*, on the bird cherry (*Prunus padus* L.), results in reduced egg laying by another herbivore, the aphid *Rhopalosiphum padi* (Leather 1993).

After locating a suitable place, females move convulsively on their abdomen and begin to oviposit. Females deposit eggs on one another in tile-like clusters, probably to increase realized fecundity (Courtney 1984, but see Stamp 1980), and cover the eggs with the protective mucus "shield". The round or elongated-oval "shield" protects eggs against desiccation, extreme temperatures, and might act as camouflage. The colour of the "shields" is light yellow immediately after they are secreted; later they become reddish and gradually obtain a brown colour resembling the colour of the bark.

Achieved fecundity in fertilized Yponomeutoid females depends, apart from genetic factors, mainly on the amount of phytomass eaten as larvae and on additional imaginal feeding. Larval under-nourishment leads to retarded growth, followed by pupation during a brief term, and emergence of under-sized imagines. In most species of the family Yponomeutidae, females usually deposit 20-50 eggs (in some cases of mass reproduction-up to 300 eggs) arranged in several clusters, but in absence of imaginal feeding they deposit a maximum of ten eggs (Hora & Roesigh 1996). In the family Plutellidae the oviposition range is between 120 to 180 eggs per female, but decreases to 40 eggs in females without imaginal feeding (Adashkevich 1972). In the family Argyresthiidae the females lay about 30 eggs per female and in absence of imaginal feeding, only about five eggs (Beloselskaya 1952).

3.2. Distribution and consortive connections of Yponomeutoid moths

3.2.1. Distribution and habitats

Yponomeutoid moths are generally adapted to arboreous-bushy plants in almost all landscape zones. However, the majority of species prefer mixed habitats of young trees and flowering plants in forests, forest-steppes, and steppes (*e.g.*, *Paraswammerdamia ornichella* Friese, *Yponomeuta rhannellus* Gersh.). The presence of flowering plants is important since the nectar of flowers is a source of additional nutrition for imagines. In Israel, we observed adults of Yponomeutoid moths feeding in the twilight hours mainly on flowers of species representing plants from the families Boraginaceae, Brassicaceae, Asteraceae, and Verbenaceae (*Lantana camara* L.). Most of the Yponomeutoid species are widely distributed and some of them [*e.g.*, *Plutella xylostella* (L.)] are cosmopolitan. In regard to altitude, some species live and develop in mountains at an altitude of up to 3,000 m above sea level (*e.g.*, some species of the genus *Kessleria* Nowicki, 1864; Friese 1960, Huemer & Tarmann 1991). In Israel, *Yponomeuta albonigratus* Gersh., *Ocnerostoma friesei* Svenss., *Ypsolopha mucronella* (Sc.), *Y. scabrella* (L.), and *Y. sequella* (Clerck) were recorded at Mt. Hermon at elevations between 1,400 m and 1,600 m asl. (Gershenson *et al.* 2002). Inter- and intraspecific population abundance of the Yponomeutoid moths are very variable in natural habitats. For example, in the steppe of the southern-east area of the Ukraine, disposed on the water-side plain near the Azov Sea, 40 to 60 larval and later pupal individuals per 100 m² of *Paraswammerdamia ornichella* Friese were recorded, from 50 to 65 individuals/100 m² of *Yponomeuta rorrellus* (Hbn.), from 150 to 200 individuals/100 m² of *Y. padellus* (L.), and from 60 to 600 individuals/100 m² of *Y. cagnagellus* (Hbn.) (Gershenson 1978). There is also an indication that the interpopulation properties might be density-dependent. For example, in *Plutella xylostella* (L.), highly dense populations had a broader and more similar diet, whereas low-density populations exhibited opposing preferences for particular host plant species (Bigger & Fox 1997).

3.2.2. Taxonomic diversity of the Yponomeutoid moths in Israel and in “Evolution Canyon”, lower Nahal Oren, Mt. Carmel, Israel

One important question of modern biology is whether there are similarities between the global pattern of biodiversity distribution and the local one. Our preliminary results indicate that local distribution also depends primarily on the distribution of host plants of these species, and distribution of Yponomeutoid moths depends on the distribution of their host plant along the ecological gradient at the microsite. We carried out a preliminary analysis of Yponomeutoid moth distribution in the microsite “Evolution Canyon” I (“EC” I), lower Nahal Oren, Mt. Carmel, Israel, and in the microsite “Evolution Canyon” II

(“EC” II), lower Nahal Keziv, Upper Galilee, Israel. Both microsites are the subject of a long-term research program established by the Institute of Evolution, University of Haifa, Israel, in order to evaluate biodiversity evolution patterns, focusing primarily on interslope adaptive radiation and incipient sympatric speciation from bacteria to mammals along a strong ecological and microclimatic gradient (Nevo 1995, 1997, 2001; Finkel *et al.* 2002). We collected 15 (58%) species at “EC” I and at “EC” II-5 species (19%) were collected out of 26 already known for Israel (Table 1). However, it is not known

Table 1. Taxonomic diversity of Yponomeutoidea moths in Israel

Families	Species	Localities
Yponomeutidae	<i>Yponomeuta cagnagellus</i> (Hb.)	“EC” I, “EC” II
	<i>Y. meridionalis</i> Gersh.	“EC” I, forest park near Haifa University, Majdal Shams
	<i>Y. albonigratus</i> Gersh.	“EC” I, Mt. Meron, Mt. Hermon, Banias
	<i>Y. plumbellus</i> (Den. & Schiff.)	“EC” I, Mt. Hermon
	<i>Ocnerosstoma friesei</i> Svenss.	Forest park near Haifa University, Mt. Hermon, Mt. Meron, botanical garden of Tel Aviv University
	<i>Kessleria saxifragae</i> (St.)	“EC” I
Plutellidae	<i>Ypsolopha instabilella</i> (Mn.)	“EC” I, “EC” II, Mitzpe Ramon
	<i>Yps. persicella</i> (P.)	“EC” I, Mt. Meron, Be’er-Sheva, botanical garden of Tel Aviv University
	<i>Yps. mucronella</i> (Sc.)	“EC” I, Mt. Hermon
	<i>Yps. trichonella</i> (Mn.)	“EC” I, Mitzpe Ramon
	<i>Yps. scabrella</i> (L.)	Mt. Hermon, Ein Gedi
	<i>Yps. asperella</i> (L.)	Revivim, “EC” I, Mt. Hermon, Mt. Meron, forest park near Haifa University
	<i>Yps. sequella</i> (Gl.)	Mt. Hermon, botanical garden of Tel Aviv University
	<i>Yps. sylvella</i> (L.)	Mt. Hermon
	<i>Yps. vittella</i> (L.)	“EC” I, “EC” II, forest park near Haifa University, Mt. Meron, Mt. Hermon, botanical garden of Tel Aviv University, Ein Gedi
	<i>Yps. dentella</i> (F.)	Mt. Hermon: Lower cable station
	<i>Yps. parentbesella</i> (L.)	Mt. Hermon: Lower cable station
	<i>Yps. albiramella</i> (Mn.)	“EC” I
	<i>Yps. nevoi</i> Gersh. & Pavl.	“EC” I
	<i>Plutella xylostella</i> (L.)	“EC” I, “EC” II, forest park near Haifa University, Mt. Meron, Mt. Hermon, Arava Valley, Majdal Shams, Banias, Mitzpe Ramon, botanical garden of Tel Aviv University, Ein Gedi
	<i>P. porrectella</i> (L.)	“EC” I, “EC” II
Argyresthiidae	<i>Argyresthia curvella</i> (L.)	Mt. Hermon
	<i>A. brockeella</i> (Hb.)	Mt. Hermon, Majdal Shams, Mt. Meron
	<i>A. pruniella</i> (Cl.)	“EC” II, Mt. Hermon, Majdal Shams, Mt. Meron
	<i>A. goedartella</i> (L.)	Mt. Hermon, Mt. Meron
	<i>A. conjugella</i> Zell.	Mt. Hermon, Mt. Meron, Majdal Shams

if the difference in number of Yponomeutoid moths between both microsites is real. On the one hand, 58% of all species known from Israel collected in “EC” I is extraordinary, and on the other hand, five species at “EC” II might be underestimated, partly due to unequal collections at both microsites. Moths were collected at both microsites always at the valley bottom, on the “European” north-facing slope (NFS) and the “African” south-facing slope (SFS) by netting with the same effort on each slope. At “EC” I more species were not significantly (Binomial test, expected interslope proportion = 0.5, $p = 0.30$) present at the “European” NFS (9 species) than at the “African” SFS (5 species). However, this trend is opposite to the general interslope pattern showing that the “African” SFS is a more speciose slope than the “European” NFS when compared to many terrestrial major taxa across phylogeny (Nevo 1995, 1997, 2001). In fact, there are interslope differences at “EC” I according to studied families. All five species of the family Yponomeutidae from “EC” I were collected exclusively at the NFS (significant interslope difference by the Binomial test, expected interslope proportion = 0.5, $p = 0.031$), whereas in the family Plutellidae five-out-of-nine species were present at the SFS (nonsignificant interslope difference by the Binomial test, $p = 0.75$) (Table 2). However, it might not be a coincidence that three species of Plutellidae (*Ypsolopha instabilella*, *Yps. trichonella*, and *Plutella xylostella*) were collected in the desert southern regions of Israel but not of species from families Argyrethiidae and Yponomeutidae. As we show later, these interslope differences might be due to the fact that arboreal species prefer the “European” NFS and herbaceous species of the savannoid open park forest prefer the “African” SFS. The SFS/NFS proportion of species of different geographic distributions (Table 2) does not show any significant interslope difference. However, it is not possible to exclude that this result is due to a loss of statistical power amid the small sample size.

Table 2. The proportion of Yponomeutoidea species of different geographic distribution between SFS and NFS slopes at the “EC” I microsite.

Geographic distribution	Species	SFS/NFS proportion at “EC” I
Euro-Asiatic	<i>Yponomeuta plumbellus</i> , <i>Y. cagnagellus</i> , <i>Kessleria saxifragae</i> , <i>Ypsolopha instabilella</i> , <i>Yps. mucronella</i> , <i>Yps. trichonella</i> , <i>Yps.</i> <i>asperella</i> , <i>Yps. albiramella</i>	3/5
E. Mediterranean-Central Asiatic	<i>Yponomeuta meridionalis</i> , <i>Y. albonigratus</i>	0/2
Palearctic	<i>Yps. vittella</i> , <i>Plutella porrectella</i>	1/1
Cosmopolitan	<i>Plutella xylostella</i>	1/0
Unknown	<i>Ypsolopha nevoi</i>	0/1
Total		5/9

In contrast to the general species distribution, the larval food plants are more indicative of general species distribution in “EC” I. The larval food plants of the “European” NFS species comprise arboreal species such as the genera *Crataegus*, *Quercus*, and *Lonicera* that are present on the NFS but not on the SFS (Nevo *et al.* 1999). However, also noteworthy is that the larval food plants of *Yponomeuta albonigratus* are unknown (the recorded larval host plants from the genus *Salix* are absent in “EC” I), and the larval food plants of *Kessleria saxifragae*, collected only on the “European” NFS, grow exclusively on the “African” SFS (*Saxifraga hederacea* (L.): Gershenson *et al.* 2002, Pavlíček, unpublished). Larvae of *Ypsolopha instabilella*, collected only on the “European” NFS, feed on *Ephedra foemina* Forssk., were recorded from both slopes (Nevo *et al.* 1999).

The “African” SFS species complex consists of species (*Plutella xylostella* and *Plutella porrectella*) whose larvae develop on herbaceous larval food plants from the family Brassicaceae that are more abundant on the “African” SFS than on the “European” NFS. Larvae of *Ypsolopha albiramella* and *Yps. trichonella* feed on the climber species *Ephedra foemina* Forssk. The larval food plants of *Ypsolopha asperella* are mostly trees, but one of its food plants, *Crataegus*, is rarely present on the “African” SFS. In spite of some uncertainties (*Yponomeuta albonigratus*, *Kessleria saxifragae*) it is possible to conclude that the two different slope adaptive complexes are connected with larval food plants of their larvae. This claim is supported by the statistically significant (Binomial test, expected interslope proportion = 0.5, $p = 0.039$) higher presence of arboreal species on the “European” NFS (7 species) than on the “African” SFS (one species). Therefore, it is possible to conclude that the “European” NFS is preferred by species with larvae feeding on leaves of trees than the SFS where trees are scarce. However, due to a small number of collected species it is not possible to report on interslope differences in species with herbaceous host plants or feeding on a perennial climber, *E. foemina*.

Northern shift between “EC” I and “EC” II

No representatives of the family Argyresthiidae are known from “EC” I, and only one species (*A. pruniella* (Cl.)) was recorded in “EC” II (Table 3). The pattern of presence of this family, only in cooler regions in Israel, might be more general since an additional three species of the same family were recorded on Mt. Meron (Table 3), not far from N. Keziv. In fact, N. Keziv is draining Mt. Meron. This fact might indicate a “northern shift” due to differences in climate between “EC” I and “EC” II that are 45 km apart. However, there is a possibility that this “northern shift” in Argyresthiidae species distribution is indirectly connected to the climate and not to the distribution of their host plants in Israel. In fact, larvae of these species feed on leaves of temperate, primarily deciduous trees from genera such as *Malus*, *Pru-*

Table 3. Species diversity of Yponomeutoid moths in "EC" I, "EC" II and Mt. Meron

Species	"EC" I SFS	"EC" I NFS	"EC" II SFS	"EC" II NFS	Mt. Meron
Family: Yponomeutidae					
<i>Yponomeuta meridionalis</i> Gersh.	-	+	-	-	-
<i>Y. plumbellus</i> (Den. & Schiff.)	-	+	-	-	-
<i>Y. albonigratus</i> Gersh.	-	+	-	-	+
<i>Y. cagnagellus</i> (Hbn.)	-	+	-	-	-
<i>Kessleria saxifragae</i> (St.)	-	+	-	-	-
<i>Ocnerostoma friesei</i> Svenss.	-	-	-	-	+
Family: Plutellidae					
<i>Ypsolopha persicella</i> (F.)	-	-	-	-	+
<i>Yps. mucronella</i> (Sc.)	-	+	-	-	-
<i>Yps. trichonella</i> (Mn.)	+	-	-	-	-
<i>Yps. asperella</i> (L.)	+	-	-	-	+
<i>Yps. nevoi</i> Gersh. & Pavl.	-	+	-	-	-
<i>Yps. instabilella</i> (Mn.)	-	+	-	+	-
<i>Yps. albiramella</i> (Mn.)	+	-	-	-	-
<i>Ypsolopha vittella</i> (L.)	-	+	-	+	-
<i>Plutella xylostella</i> (L.)	+	-	+	+	+
<i>P. porrectella</i> (L.)	+	-	-	-	-
Family: Argyresthiidae					
<i>Argyresthia pruniella</i> (Cl.)	-	-	-	+	+
<i>A. brockeella</i> (H.)	-	-	-	-	+
<i>A. goedartella</i> (L.)	-	-	-	-	+
Total	5	9	1	4	8

nus, *Sorbus*, and *Quercus* that, with an exception of *Q. calliprinos*, do not grow (*Sorbus*, *Malus*) or are extremely rare (*Prunus*) at "EC" I. In regard to *Q. calliprinos*, only deciduous oaks were described as a host plant of *A. goedartella*, and there is no evidence that this evergreen species can also be a host plant.

3.2.3. Characteristics of Yponomeutoid moths as components of biocenoses

The functional structure units of biocenoses are the consortiums¹, which are the basis of the transmission process of matter and energy for food chains and of guaranteeing normal functioning of biocenoses (Rabotnov 1969). Common (obligatory) elements of many cenoses are the entomocomplexes consisting of very numerous insect species. Here, a characteristic of their consortive connections of Yponomeu-

¹ The term "consortium" is defined by Rabotnov (1969) - "Consortiums are elementary energetic systems of which consist biocenoses - they are groups of organisms united by common food chains (streams of energy)".

toid moths will be given based on the results of field observations made by the senior author of this publication in different landscapes of Russia, the Ukraine, and Israel. Since all Yponomeutoid moths are phytophagous (chiefly narrow oligophagous or monophagous), using the energy of living plants always connects the centres of the investigated consortiums. The scheme of consortium connections can be characterized in the following way (Fig. 11): In the center of a generalized consortium is the producer (the host plant of concrete moth species); radially from the producer - the consumer (a consort of the first order) is located, then the consorts of the second order (entomophages of this moth, *e.g.*, parasites, predators, viruses, and fungi) follow and, lastly, the consorts of the third order - secondary parasites (parasites of primary parasites) (Friese 1963, Dijkerman 1990).

According to types of consortive connections, all investigated species of Yponomeutoid moths belong to the following three groups. 1. Monophagous moths, larvae that are trophically connected with only a single species of the host plant (*e.g.*, *Yponomeuta rhannellus* Gersh.).

2. Oligophagous moths; larvae are trophically adapted to plant species belonging to one genus or family (*e.g.*, *Yponomeuta padellus* (L.), *Plutella xylostella* (L.)). A lot of species of palaearctic Yponomeutoid moths have larvae feeding on food plants belonging to one plant genus (*e.g.*, *Yponomeuta orrellus* (Hbn.) feeding on *Salix* spp., *Y. malinellus* Zell. feeding on *Malus* spp., and *Cedestis gyssele-niella* (Zell.) feeding on *Pinus* spp., *etc.*). The majority of the Yponomeutoid species belongs to this group.

3. Polyphagous moths; larvae are trophically adapted to plant species from different families. For example, larvae of *Swammerdamia pyrella* (Vill.) feed on leaves of *Pyrus* (Rosaceae) and *Betula* (Betulaceae).

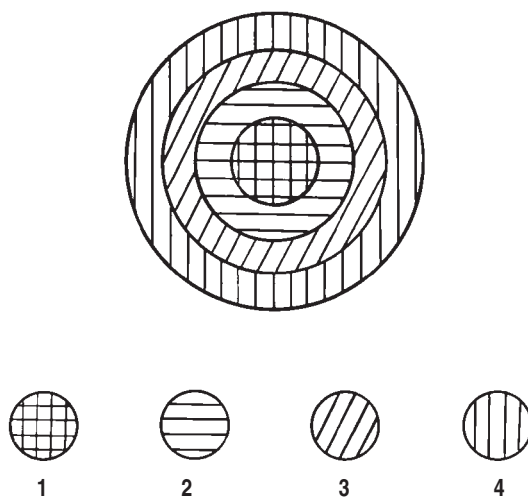


Fig. 11. Scheme of consortium with *Yponomeuta padellus* (L.) as an example in the phyto-association of *Prunus stepposa* Klok. (Ukraine, Near - Azov area). 1 - producer (determinant): host plant - blackthorn *Prunus stepposa* Klok. 2 - consumer (consort of the first order): fruit ermine moth *Yponomeuta padellus* (L.). 3 - consorts of the second order: entomophages of *Yponomeuta padellus* (L.). 4 - consorts of the third order: parasites of primary parasites.

According to the characteristic of nourishment, all species of the Yponomeutoid moths are phyllophagous, *i.e.*, they feed on green parts of plants, on leaves of certain host plants, therefore, appearing as trophoconsorts (actively feeding consortive components). In contrast to moths, the producers (food plants) are passive and dependent. Representatives of the examined group of Microlepidoptera as trophoconsorts exert a direct influence on the productivity of the food plant, during their mass reproduction, by decreasing the overall amount of the phytomass. For example, at the beginning of the development of larvae of *Yponomeuta cagnagellus* (Hbn.), *Y. rorrellus* (Hbn.) and *Y. malinellus* Zell., the damage of the leaf surface is low (up to 10%), but the larvae of the 5th instar damage is up to 70% (Gershenson 1978). Such consortive connections have a positive significance for the small ermine moth, which exerts a negative influence on the primary productivity of their food plants.

Yponomeutoid moths are always connected to a certain story (layer) of the biocenosis. The most prolonged phase of development of these Microlepidoptera - the larval phases - passes in phytobia that is on the surface or inside the tissues of the food plant. Most larvae of the first instar live concealed - in the buds or in mines of leaves or stems. Such a life habit is necessary in the beginning of development for the protection of larvae against unfavourable external influences; it guarantees them a good cover and optimal microclimatic conditions. Adult larvae feed only on the assimilating parts of plants-leaves, but they often twine leaves together with a silk thread and make silk nests. The majority of species pupate also in phytobia; however, if a moth hibernates in the pupal phase (for example, *Yponomeuta sedellus* Tr., *Paraswammerdamia ornichella* Friese), such hibernating pupae develop in the litter, that is to say, in the stratobia; the eggs are laid mostly on the stems of the food plant. Adults need additional nutrition for the ripening of their egg products, and they use the nectar of different flowering plants; thus, they often temporarily become transposed out of initial plant associations.

In the studied group of Yponomeutoid moths the evolution of consortive relations is closely linked with the evolution of trophic connections of these phytophagous insects expressed in particular with a transition from polyphagy ((*Swammerdamia pyrella* (Vill.)) to oligophagy (*Yponomeuta rorrellus* (Hbn.)) or to monophagy (*Yponomeuta rhamnellus* Gersh.).

As a result of agriculture and gardening practices, the abundance of fruit and decorative bushes and trees increased. In such an alternated phytocenoses the role of phytophagous Microlepidoptera increase. The latter, in such cases, often are transformed from potential to predominant pests and are found widespread in orchards (*Yponomeuta padellus* (L.), *Y. malinellus* Zell. *Y. mabalebellus* Guenée, 1845) and forest-parks (*Y. cagnagellus* (Hbn.), *Y. evonymellus* (L.)). These

facts convincingly support the action of the basic biocenotical law according to which ecologically optimal biocenoses can be characterized by an abundance of species consisting of a relatively small number of individuals. In contrast, the disturbed biocenoses are inhabited by a few species with numerous representatives (Thienemann 1925).

Consequently, a decoding of the nature and specific action of consortive connections of such a worldwide distributed group as Yponomeutoid moths, is necessary to prevent the reproduction of injurious species in order to protect and preserve agrocenoses and natural phytocenoses under anthropogenic pressure.

3.3. Economic Significance

Porchinsky (1886) described injuries of cultivated orchard trees in the Crimea (Ukraine) in detail, *e.g.*, apple (*Malus domestica* Borkh.), pear (*Pyrus communis* L.), cherry, and plum (*Prunus* spp.) by the apple moth (*Yponomeuta malinellus* Zell.), and by the fruit moth (*Yponomeuta padellus* (L.)). Moreover, abundant injuries caused by these moths in many gardens, parks, forest trees, and bushes such as spindle tree (*Evonymus* sp.), bird cherry (*Prunus padus* L.), pine (*Pinus* sp.), birch (*Betula* sp.), willow (*Salix* sp.), blackthorn (*Prunus spinosa* L.), hawthorn (*Crataegus* sp.), and others were recorded, *e.g.*, by Ksenzhopolsky (1913, 1915); Krulikovsky (1926); Sovinsky (1938); Karasev (1968); Pozmogova (1969); Efremov (1975); Gershenson (1988); and Sinev (1994). In Ireland, the larvae of *Y. padellus* (L.) nearly completely striped hawthorn hedges of leaves on a large area (Conway 1984), whereas in Denmark the same species strongly defoliated and considerably damaged the blackthorn (Münster-Swendsen 1982). Defoliation of the bird-cherry tree by the larvae of *Yponomeuta evonymellus* (L.) has been observed in Hungary (Šáringer *et al.* 1983), England (Conway 1984; Leather 1986), Austria, and Finland (Leather & Lehti 1982). In France, larvae of *Yponomeuta malinellus* Zell. caused much damage in agriculture for so many years that it had been recommended to destroy old injured orchards to avoid the moths spreading to young trees (Nenon & Meirleire 1972). Numerous losses in production have been noted all over western Europe due to the injury of fruit trees by species of the Yponomeutoid complex “*padellus*” (Kagan & Lewartowski 1977, Reichholf 1972, Menken 1989). It should be noted that in the years of mass reproduction, the tree injuries by miners caused a decrease in the growth of wood biomass from 50% to 80% (Pozmogova 1969). There is a possibility that the outbreaks of some *Yponomeuta* species are driven, at least in part, by climate (Tenow *et al.* 1999). If this is correct, the frequency of outbreaks might increase and therefore might be dangerous in a parallel trend with global warming.

In Israel, the most common pest is probably the cabbage moth, *Plutella xylostella* (L.), the well known cosmopolite pest of cruciferous crops. The main host plants of its larvae are cabbage, cauliflower, broccoli, brussels sprouts (different subspecies or varieties of *Brassica oleracea* L.), turnip (*Brassica* sp.), radish (*Raphanus sativus* L.), and also a number of weeds belonging to the same family (e.g., *Capsella bursa-pastoris* (L.) and *Lepidium densiflorum* Schrad.) (Harcourt 1957). In particular, the larvae of *Plutella xylostella* (L.), except those feeding on the leaves, may attack other parts of the host plants as well. Most injury is done to the host plants by larvae of the final instar. However, injury might also occur on the florets of cauliflower and broccoli, or larvae can bore into the heads of sprouts of cabbage and brussels sprouts. The wild host plants permit survival of this species during the period when no crucifers are cultivated. There is renewed interest in alternatives to insecticides, such as biological control and development of resistant plants, since this species has developed resistance to numerous insecticides (Thomas & Waage 1996).

Another important pest species in Israel is the olive moth, *Prays oleae* (Bernard), the principal pest of olive trees. This pest has three generations per year, of which the anthophagous one attacks the floral buttons, and the larvae of the carpophagous ones develop inside the olive stone and cause premature falling off of the fruits.

4. Classification of the Yponomeutoid moths

4.1. A way of classification

More than thirty years ago, Mayr (1969) rightly emphasized that the most contemporary principles of classification should be regarded as subjective ones because they are not quantitative. In order to ascertain relationships of systematic groups, an application of classical methods of phylogenetics (*i.e.*, data on comparative-morphology, physiology, biochemistry, and autecology connected with biogeographical data) are, unfortunately, insufficient for precisely tracing the real origin of many taxa because the studied phenotypical characters usually have a complicated polygenic basis. Characteristics that are, at first sight, similar can be determined in various taxa by combinations of different genes. Such convergences and parallelisms are sometimes difficult to discover by comparative morphological and physiological methods and thus results in the need to resort to molecular biology.

Today, the possibility to complement conclusions drawn in classical phylogenetic analysis with new kinds of data in molecular biology exists. In this case, molecular biology, dealing with phylogenetic problems, is enriched by data helping to understand the origin of molecular-biological structures and processes. Moreover, for the first time, a phylogenetic tree of 14 Palaearctic *Yponomeuta* species based on sequence data from the 16S ribosomal RNA gene has been constructed (Menken 1995). Therefore, Menken's consideration that *Yponomeuta* Latr. coevolved with its host plants would require that this moth genus be virtually as old as the Angiosperms.

Not surprisingly, many discrepancies appeared between results of molecular genetic analysis and the ranks of taxa based on the classical phylogenetic systems (Mednikov 1977). In particular, many phenotypically very similar taxa showed genomes at different stages of divergence. As an example, sibling species characteristic for a series of Yponomeutidae species are genetically distant and clearly different in the peculiarities of their biology, but phenotypically are nearly identical. The phenomenon of an existence of such species is stipulated by the disparity of the levels of their genetic and phenotypic divergence. That is why during the process of the origin of these species, if the process goes on longer than a single generation, the existence of individuals with mixed characteristics will be inevitable. Certainly, the nucleotide sequence of the ancestor species disintegrate during the process of evolution into numerous discrete parts, linked by hierarchical relations. This allows us to consider that any system, which may be regarded as a natural one, should be constructed on a hierarchical principle because such a system has deep evolutionary significance. Thus, any natural system of living organisms should be a hierarchical one (of the Linnaean type), and it is very desirable for systematists to know the genetic value of characteristics used.

4.2. Relationship between higher taxonomic units of Yponomeutoid moths

From the historical perspective, Yponomeutidae *s. lat.* was examined more intensively in the second-half of the 20th century. Many of the group reviewers (Frieese 1960, 1966; Zagulajev 1963, 1989; Brock 1971; Gershenson 1967a, 1974, 1990a; Heppner 1977, 1998; Common 1990) recognized, among these moths, the following three separated families: Yponomeutidae, Argyresthiidae, and Plutellidae. In contrast with this opinion, a Japanese entomologist, Moriuti (1977), who significantly contributed to the knowledge of phylogeny and classification of Yponomeutidae *s. lat.*, concluded that Yponomeutidae and Argyresthiidae deserve a family status as originally proposed (Frieese 1960) and that Plutellidae must be lowered to the rank of subfamily only. Later, Kyrki (1984, 1990) made a tentative reclassification of Holarctic Yponomeutoidea, based on the investigation of the most Holarctic, Yponomeutoid genera and on some exotic ones. He left the families Yponomeutidae and Plutellidae as independent, but lowered Argyresthiidae to the rank of subfamily. In fact, the same taxonomic change, *i.e.*, lowering Argyresthiidae to Argyresthiinae, was proposed earlier by Russian entomologists, Kuznetsov & Stekolnikov (1976, 1977, 1987), based on analyses of the interrelationships in the musculature and of the functioning of the male genital system within the Yponomeutoidea.

New and fundamental contributions to the reassessment of relationships in Yponomeutoid and other Lepidoptera families have been carried out by Heppner (1977, 1996, 1998). He evaluated, in particular, sternal and abdominal articulation, larval chaetotaxy, and pupal behaviour during adult ecdysis. As a result, Heppner (1998) proposed a new modified system of Ditrysian Microlepidoptera (Dit-

Table 4. Classification of the families YPONOMEUTIDAE, ARGYRESTHIIDAE, and PLUTELLIDAE (according to Heppner 1998)

Yponomeutidae Stephens, 1829 - Ermine Moths

 Saridoscelinae Moriuti, 1977

 Yponomeutinae Stephens, 1829

 Cedestinae Kloet et Hincks, 1945

Argyresthiidae Bruand, 1850 - Shiny Head-Standing Moths

Plutellidae Guenée, 1845 - Diamondback Moths

 Ypsolophinae Guenée, 1845

 Plutellinae Guenée, 1845

 Scythropiinae Frieese, 1966

 Praydinae Moriuti, 1977

rysia represent a subset of the infraorder Heteroneura, suborder Glossata of the order Lepidoptera, and are characterized by a separate sexual opening in the female in contrast to Monotrysia that have only one opening in the female) where in the superfamily Yponomeutoidea nine distinct families are recognized: Ochsenheimeriidae Heinemann, 1870, Glyphipterigidae Stainton, 1854, Plutellidae Guenée, 1845, Attevidae Mosher, 1916, Yponomeutidae Stephens, 1829, Argyresthiidae Bruand, 1850, Lyonetiidae Stainton, 1854, Acrolepiidae Heinemann, 1870, and Heliodinidae Heinemann & Wocke, 1876 .

As a matter of fact, the subdivision of families proposed by Heppner (1998) represents a most agreeable classification system with the results of morphobiological studies, particularly in diagnostic characteristics of the different Yponomeutoid taxa (Gershenson 1974, 1990a, 1997). Therefore, based on Heppner's system, the families of Yponomeutidae, Plutellidae, and Argyresthiidae were recognized in this book (Table 4).

5. Systematics

The results of taxonomic studies as well as of a comparative analysis of the diagnostic characteristics are essentially significant, especially in providing keys for classification. Yponomeutoid moths contain a number of sibling species that are very difficult to recognize because of their morphological similarity. For example, due to the long-existing insufficient knowledge about the complex “*padellus*”, which contains sibling species, a clear specific differentiation of these moths has been elucidated only in a few works (Kozhanchikov 1955; Kurbanova 1966, 1967; Sherniyazova 1975; Herrebout *et al.* 1976; Moriuti 1977; Povel 1983, 1984, 1986, 1987a,b; Water *et al.* 1982; Gershenson 1988; Menken 1989; Sinev 1994; Zagulajev 1994). The main diagnostic characteristics of the mentioned moths are given below and are arranged in the following keys based on external characteristics of imago and male genitalia.

5.1. Key to the families Yponomeutidae, Argyresthiidae, and Plutellidae

1. Abdominal tergites distinctly spined. Moths in repose sit parallel to the substratum (Fig. 12) with antennae compressed **Yponomeutidae**
- Abdominal tergites without spines 2
2. Maxillary palpi single-segmented. In male genitalia: socii (performing function of gnathos) covered with piliform scales (Fig. 13). Moths in repose form oblique angles with substratum because tip of abdomen is directed upward (Fig. 14) **Argyresthiidae**
- Maxillary palpi 3 - 4 segmented. In male genitalia: gnathos and socii separate, the latter without scales (Fig. 15). Moths in repose with roof-shaped wings; antennae extend forward (Fig. 16) **Plutellidae**

5.2. Keys to subfamilies of the families Yponomeutidae and Plutellidae

5.2.1. Key to subfamilies of the family Yponomeutidae Stephens, 1829

1. 8th abdominal sternite strongly sclerotized-forming a large sclerotized plate in males. Uncus rudimentary **Saridoscelinae** Moriuti, 1977²
- 8th abdominal sternite does not form a large sclerotized plate. Uncus developed 2

² The peculiar subfamily Saridoscelinae Moriuti, 1977, which occurred in Japan and India, has been unrecorded in Israel fauna till now. For its general characteristics see Moriuti, 1977.

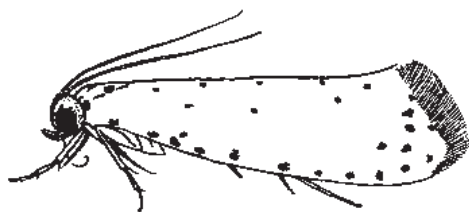


Fig. 12. Resting posture - *Yponomeuta malinellus* Zell.

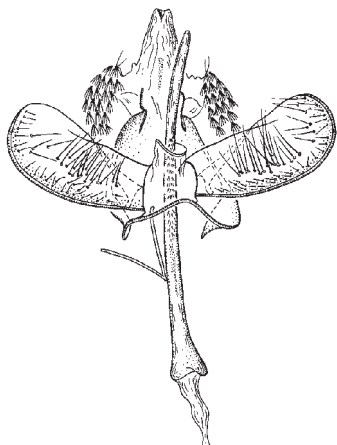


Fig. 13. Male genitalia - *Argyresthia curvella* (L.).

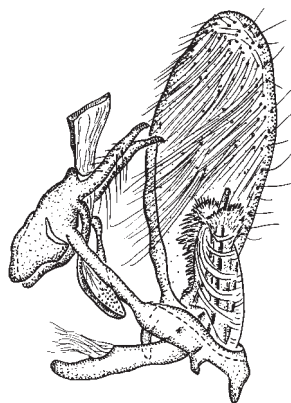


Fig. 15. Male genitalia - *Ypsolopha sylvella* (L.).



Fig. 16. Resting posture - *Plutella xylostella* (L.).



Fig. 14. Resting posture - *Argyresthia pruniella* (Cl.).

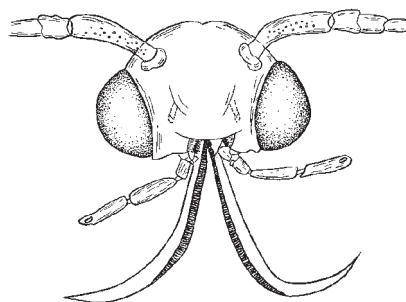


Fig. 17. Head - subfamily Cedestinae (*Cedestis gysseleniella* (Zell.)).

2. Galea without spiral bend (Fig. 17) **Cedestinae** Kloet et Hincks, 1945
- Galea with spiral bend (Fig. 18) **Yponomeutinae** Stephens, 1829

5.2.2. Key to subfamilies of the family Plutellidae Guenée, 1845

1. Maxillary palpus 3-4 segmented 2
- Maxillary palpus rudimentary or 1-2 segmented **Praydinae** Moriuti, 1977

2. 8th abdominal sternite forming well expressed sclerite. Uncus developed
 **Scythropiinae** Friese, 1966
- 8th abdominal sternite not modified. Uncus undeveloped or ill-defined 3

3. In hindwings R and M₁ long stalked. Gnathos present
 **Ypsolophinae** Guenée, 1845
- In hindwings R and M₁ not stalked. Gnathos absent **Plutellinae** Guenée, 1845

6. Family *Argyresthiidae* Bruand, 1850

Minute moths. Wingspan: 6-15 mm. Head with appressed hairs on frons and tuft setae on occiput (Fig. 19). Ocelli absent. Antennae piliform, longer than half-length of forewings. Labial palpus of moderate length, somewhat curved and ascending. Maxillary palpus 1-segmented. Forewings lanceolate; Sc generally merges into anterior margin of wing before its midpoint; R with five branches that originate independently (*Argyresthia* Hbn.) (Fig. 20) or R_4 stalked with R_5 (*Blastotere* Ratz.) (Fig. 21). In hindwings M_1 stalked with M_2 while M_3 and Cu_1 either originate separately or connate.

Male genitalia (e.g., Fig. 33). Anal tube sometimes with sclerotization, usually fused with gnathos forming wide subcaphium. Uncus undeveloped. Valva rounded, elongated, oval, or pyriform. Species of Japanese genus *Parargyresthia* Mrt. character-

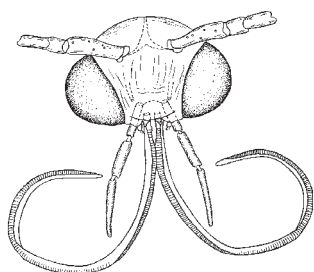


Fig. 18. Head - subfamily Yponomeutinae (*Yponomeuta malinellus* Zell.).

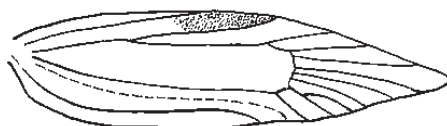


Fig. 20. Forewing venation of cherry fruit moth - *Argyresthia pruniella* (Cl.).

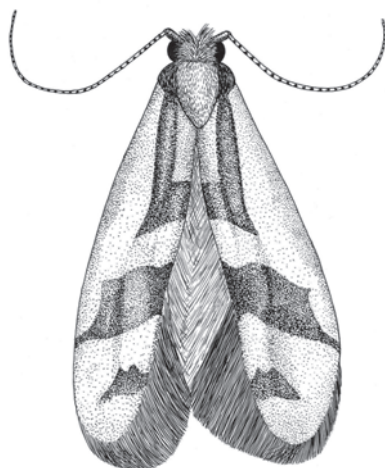


Fig. 19. Adult moth - *Argyresthia goedartella* (L.).



Fig. 21. Forewing venation - *Blastotere arceuthina* (Zell.).

ized by a darkly pigmented edge of saccus (Moriuti 1977). Socii (performing function of gnathos) covered with piliform scales. Aedeagus longer than valva; vesica with cornuti. The eighth abdominal sternite forms a small sclerotized plate.

Female genitalia (*e.g.*, Fig. 34). Lobes of vaginal plate low. Apophysis posterior equal or longer than apophysis anterior, the latter usually bifurcate. Ductus bursae distinct and long (except species of *Parargyresthia* Mrt. (Moriuti 1977)). Bursa copulatrix with signum.

Larvae: Larvae live in gossamer galleries inside bird nests, flowers, fruits, or among leaves of host plants. Pupae of most species possess setae on cremaster. Eggs (*e.g.*, *Argyresthia pruniella* (Clerck)), larvae (most species), or pupae (*e.g.*, *A. conjugella* Zell.) hibernate.

Taxonomic richness: About 80 species of the three genera (*Argyresthia* Hübner, 1826; *Blastotere* Ratz., 1840; *Parargyresthia* Moriuti, 1969) of this family are distributed in the Palearctic region. Host plants of their larvae are connected with the following plant families: Pinaceae, Cupressaceae, Rosaceae, Betulaceae, Fagaceae, Salicaceae, Grossulariaceae, Ulmaceae, Ericaceae (Moriuti 1977, Gershenson & Vasiljeva 1996).

Species richness in Israel. In Israel the following species were recorded: *A. curvella* (Linnaeus, 1761); *A. brockeella* (Hübner, 1810-1813), *A. pruniella* (Clerck, 1759), *A. goedartella* (Linnaeus, 1758) (Gershenson *et al.* 2001), and *A. conjugella* Zeller, 1839. The last species is recorded here for the first time in Israel.

Key to genera of the family Argyresthiidae based on external characteristics of imago

1. In forewings R_4 stalked with R_5 ***Blastotere*** Ratz.
- In forewings R_4 and R_5 separate ***Argyresthia*** Hbn.

Key to species of the *Argyresthia* Hbn. of the Israeli fauna based on the external characteristics of imago

1. Head pale ochreous 1 ***conjugella*** Zell.
- Head white 2
2. Forewings with one transverse band 3
- Forewings with several transverse bands 4
3. Band does not reach costal edge of forewings (Fig. 22) 2 ***curvella*** (L.)
- Band reaches costal edge of forewings (Fig. 23) 3 ***pruniella*** (Cl.)

4. Fourth transverse band (from wing base) usually not connected by longitudinal golden stripe with third transverse band. If it is connected, seven or eight white spots on forewings are present (Fig. 32) 4 *goedartella* (L.)
- Fourth transverse band (from wing base) connected, with third band by longitudinal golden stripe; six white spots on forewing (Fig. 40) 5 *brockeella* (Hbn.)

Key based on male genitalia

1. Gnathos with long spines at distal end (Fig. 37) 1 *conjugella* Zell.
- Gnathos without such spines 2
2. Saccus noticeably elongated (Figs. 33, 41) 4
- Saccus slightly elongated (Figs. 25, 29) 3
3. Valva almost 4 times shorter than aedeagus (Fig. 25) 2 *curvella* (L.)
- Valva less than 4 times (about 3.5 times) shorter than aedeagus (Fig. 29) 5 *pruniella* (Cl.)
4. Valva about 2 times shorter than aedeagus (Fig. 41) 4 *brockeella* (Hbn.)
- Valva about 3 times shorter than aedeagus (Fig. 33) 3 *goedartella* (L.)

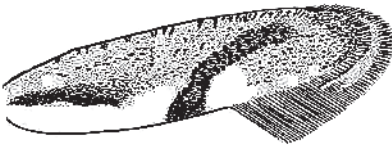


Fig. 22. Forewing pattern -
Argyresthia curvella (L.).

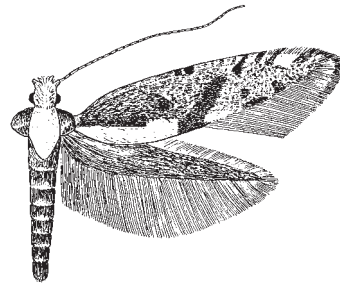


Fig. 24. Total view of the wings -
Argyresthia conjugella Zell.



Fig. 23. Forewing pattern -
Argyresthia pruniella (Cl.).

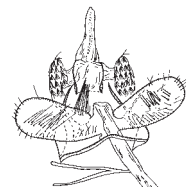


Fig. 25. Male genitalia -
Argyresthia curvella (L.).

Argyresthia curvella (Linnaeus, 1761)*Phalaena Tinea curvella*, Linnaeus 1761: 389.*Argyresthia curvella* (Linnaeus, 1761), Gershenson 1974: 115-116, Figs. 127-129.

- *curvella* (Linnaeus, 1761), Friese 1969: 702, 739, Fig. 31-32. Farbt. Abb. 18.
- *curvella* (Linnaeus, 1761), Agassiz 1987: 16-17, Pl. 1, Fig. 20.
- *curvella* (Linnaeus, 1761), Agassiz 1996: 40.
- *curvella* (Linnaeus, 1761), Agassiz & Friese 1996: 58.
- *curvella* (Linnaeus, 1761), Gershenson *et al.* 2001: 150.

Description

Imago (♀ and ♂). Wingspan: 9-12 mm. Head, thorax, and labial palps white, tegulae white or ochreous. Forewings white with brown longitudinal stripe in the base of wing and with a transverse oblique stripe of the same colour (Fig. 22). Wing apex covered with brown dots. Forewing cilia fuscous-gray. Hindwings of the same colour with somewhat lighter cilia. Legs white, mixed with fuscous scales on tarsi.

Male genitalia (Fig. 25). Valva of pear-like shape. Saccus not elongated. Aedeagus more than 3 times longer than valva.

Female genitalia (Fig. 26). Apophyses posterior about 1.5 times longer than apophyses anterior. Dorsal branch of apophyses anterior longer than their common stem. Bursa copulatrix with distinct signum.

Remarks. Externally resembles *A. pruniella* (Cl.), from which it differs by the above-mentioned wing pattern and genital structures. Larvae feed inside buds of *Prunus* (Gershenson 1990a) and eat flowering shoots of *Malus* (Agassiz 1987).

General distribution: Common in the western part of the Palearctic region.

Distribution in Israel: Mt. Hermon (1,400 m asl.) (Fig. 27).

Argyresthia pruniella (Clerck, 1759) – *Cherry fruit moth**Tinea pruniella*, Clerck 1759: Pl. 11, Fig. 4.*Argyresthia pruniella* (Clerck, 1759), Friese 1969: 702, 738-739, Fig. 8.

- *pruniella* (Clerck, 1759), Gershenson 1974: 114-115, Figs. 125-126.
- *pruniella* (Clerck, 1759), Agassiz 1987: 10-11, Pl. 1, Fig. 26.
- *pruniella* (Clerck, 1759), Agassiz 1996: 40.
- *pruniella* (Clerck, 1759), Agassiz & Friese 1996: 58.
- *pruniella* (Clerck, 1759), Gershenson *et al.* 2001: 151.

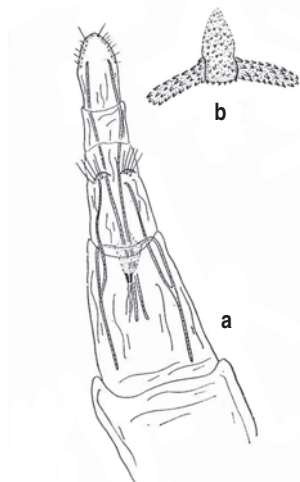


Fig. 26. Female genitalia - *Argyresthia curvella* (L.). a) ventral view, b) signum.

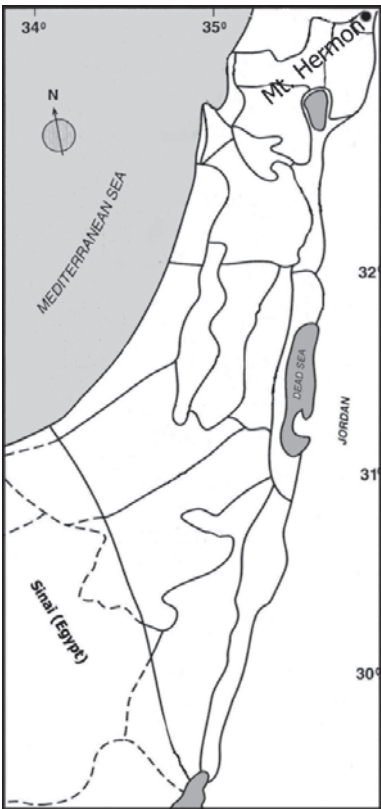


Fig. 27. Collection sites of *Argyresthia curvella* (L.) in Israel.

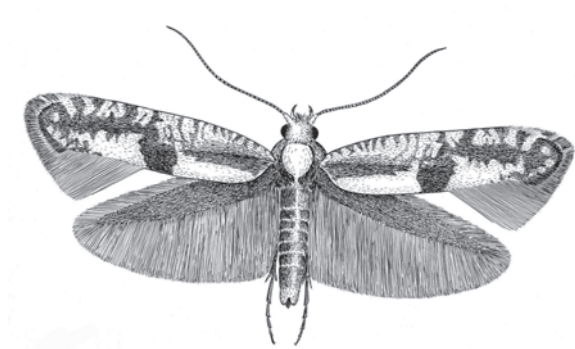


Fig. 28. Adult of the Cherry Fruit Moth - *Argyresthia pruniella* (Cl.). Drawing: V. P. Slovokhotov.

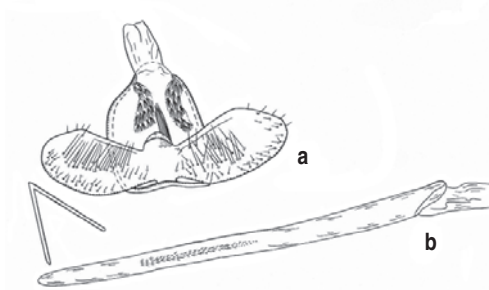


Fig. 29. Male genitalia - *Argyresthia pruniella* (Cl.). a) without aedeagus, b) aedeagus.

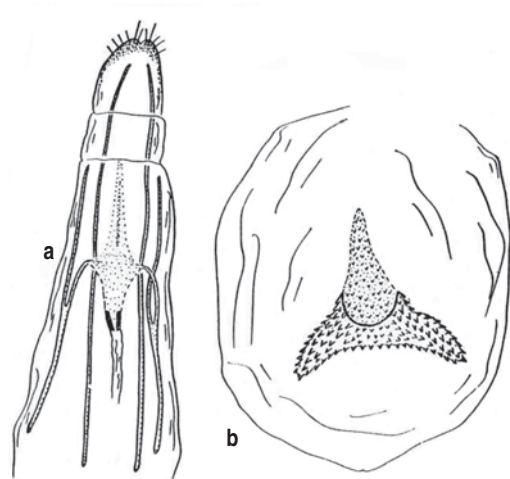


Fig. 30. Female genitalia - *Argyresthia pruniella* (Cl.). a) ventral view, b) bursa copulatrix with signum.

Description

Imago (♀ and ♂) (Fig. 28). Wingspan: 10-13 mm. Head, thorax, labial palpa white, tegulae rusty-brown. Forewings, ochreous-white, is very suffused with brown scales, forewing pattern consists of transverse oblique brown stripe nearly reaching costal margin of the wing, and strongly distinct white longitudinal stripe extends along posterior margin (Fig. 23, 28). Forewings cilia fuscous-gray. Hindwing fuscous-gray with more pale cilia. Legs white, tarsi mixed with fuscous scales.

Male genitalia (Fig. 29). Valva of pear-like shape. Saccus short and broadened. Aedeagus exceeds more than three times the length of valva.

Female genitalia (Fig. 30). Apophyses posterior about 1.5 times longer than apophyses anterior. Dorsal branch of apophyses anterior somewhat longer than their common stem. Bursa copulatrix with distinctly sclerotized signum.

Remarks. Externally resembles *A. mendica* (Haw.) from which it mainly differs by the male genitalia, in particular, by the correlation of aedeagus and valva length. Larvae feed inside buds, stems, and ripening fruits (Gershenson 1990a). Host plants: dwarf-cherry (*Prunus cerasus* L.), wild cherry (*P. avium* L.), plum (*P. domestica* L.), peach (*P. persica* (L.) Batsch.), and blackthorn (*P. spinosa* L.) (Gershenson 1974, Agassiz 1987).

General distribution. Common in Europe, Israel.

Distribution in Israel: Mt. Hermon (altitude: 1,400 m asl.), Mt. Meron, N. Keziv (= "EC" II) (Fig. 31).

Argyresthia goedartella (Linnaeus, 1758)

Tinea goedartella, Linnaeus 1758: 541.

Argyresthia goedartella (Linnaeus, 1758), Friese 1969: 701, 726-727, Figs. 23-26, Colour plate, Fig. 1.

- *goedartella* (Linnaeus, 1758), Gershenson 1974: 103-104, Figs. 107-109.
- *goedartella* (Linnaeus, 1758), Agassiz 1987: 7-8, Pl. 1, Figs. 16-17.
- *goedartella* (Linnaeus, 1758), Agassiz 1996: 40.
- *goedartella* (Linnaeus, 1758), Agassiz & Friese 1996: 58.
- *goedartella* (Linnaeus, 1758), Gershenson *et al.* 2001: 151.

Description

Imago (♀ and ♂) (Figs. 19, 32). Wingspan: 9-12 mm. Head and labial palpa white with a touch of yellow, thorax golden white. Forewings white with four transverse oblique stripes of golden colour; second and third stripes fused at the posterior margin of forewing forming V-shaped pattern in the middle of forewing surface

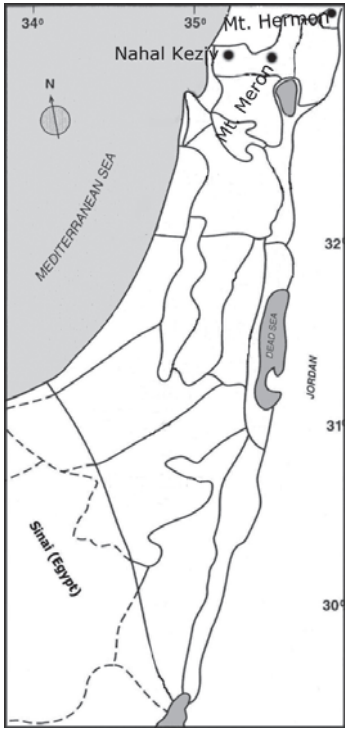


Fig. 31. Collection sites of *Argyresthia pruniella* (Cl.) in Israel.

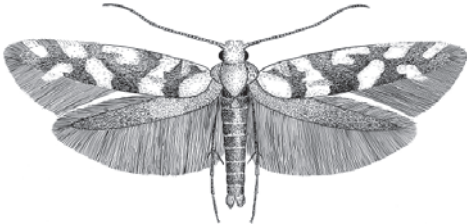


Fig. 32. Adult moth - *Argyresthia goedartella* (L.).

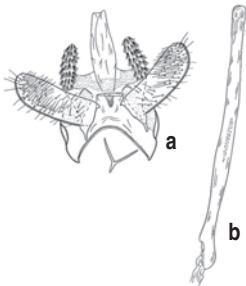


Fig. 33. Male genitalia - *Argyresthia goedartella* (L.).
a) without aedeagus, b) aedeagus.

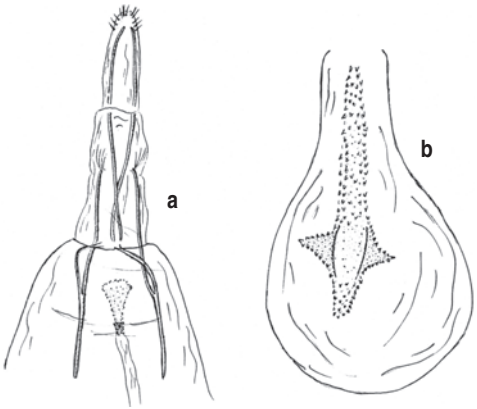


Fig. 34. Female genitalia - *Argyresthia goedartella* (L.). a) ventral view, b) bursa copulatrix with signum.

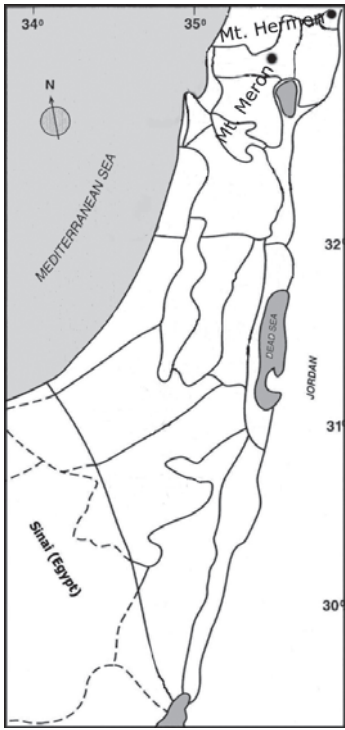


Fig. 35. Collection sites of *Argyresthia goedartella* (L.) in Israel.

(Fig. 32). Forewing cilia fuscous-gray. Hindwings pale fuscous with fuscous-gray cilia. Legs white, tarsi mixed with fuscous scales.

Male genitalia (Fig. 33). Valvae of nearly oval or oval-elongated shape. Saccus elongated. Aedeagus more than 2.5 times longer than valva.

Female genitalia (Fig. 34). Apophyses posterior as long as or somewhat longer than apophyses anterior. Dorsal branch of apophyses anterior longer than their common stem. Bursa copulatrix with elongated signum.

Remarks. Externally resembles *A. brockeeella* (Hbn.), differing from the latter by the wing pattern and genital structures. Trophically connected with *Quercus*, *Ulmus* (Fries 1969), *Betula* and *Alnus* (Agassiz 1987).

General distribution. Transpalearctic species.

Distribution in Israel: Mt. Hermon (altitude: 1,400 m asl.), Mt. Meron (Fig. 35).

***Argyresthia conjugella* Zeller, 1839 – Apple Fruit Moth**

Argyresthia conjugella, Zeller 1839: 204.

- *conjugella* Zeller, 1839, Fries 1969: 702, 741-742, Figs. 33-34, Colour Plate, Fig. 16.
- *conjugella* Zeller, 1839, Gershenson 1974: 118-119, Figs. 132-134.
- *conjugella* Zeller, 1839, Moriuti 1977: 267-270, Figs. 98, 148, 158, 353, 458, 483, 538, 583.
- *conjugella* Zeller, 1839, Agassiz 1987: 9-10, Pl. 1, Figs. 22-24.
- *conjugella* Zeller, 1839, Agassiz 1996: 40.
- *conjugella* Zeller, 1839, Agassiz & Fries 1996: 58.
- *conjugella* Zeller, 1839, Gershenson 1997: 457, Fig. 321.

Description

Imago (♀ and ♂). Wingspan: 9-14 mm. Head and labial palps pale ochreous or yellowish white, thorax white with fuscous tegulae. Forewings (Figs. 24, 36) purplish fuscous with white apical spot and white streak along hind margin interrupted by a oblique brown transversal stripe. Forewing surface dotted with white scales. Hindwings gray. Legs yellowish white with fuscous tarsus. Forelegs with fuscous tibia and tarsus outside.

Male genitalia (Fig. 37). Valva with a bunch of stiff hairs. Modified gnathos with long spines at distal end. Saccus with distinct curve. Aedeagus more than twice as long as valva.

Female genitalia (Fig. 38). Apophyses posterior about 1.5 times longer or less than apophyses anterior. Dorsal branch of apophyses anterior almost as long as their common stem. Bursa copulatrix with elongated signum.

Remarks. This species can be easily recognized by external characters and genital structures. Trophically connected with *Sorbus aucuparia* (Agassiz 1987) and fruits of apple (*Malus domestica* Borkh.) (Gershenson 1974, Moriuti 1977).

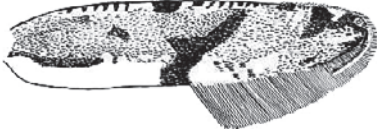


Fig. 36. Forewing pattern - *Argyresthia conjugella* Zell.

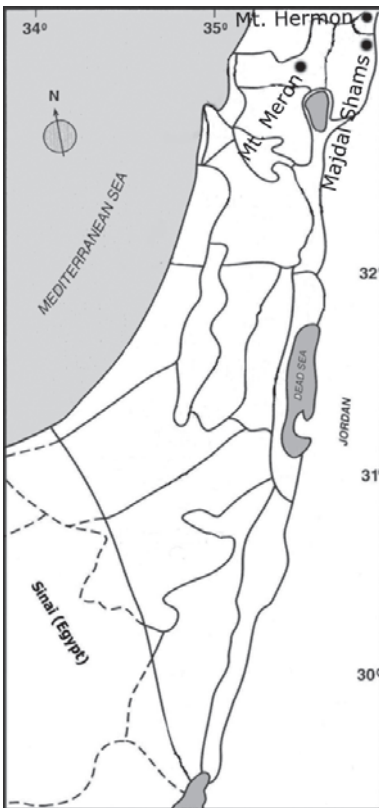


Fig. 39. Collection sites of *Argyresthia conjugella* Zell. in Israel.

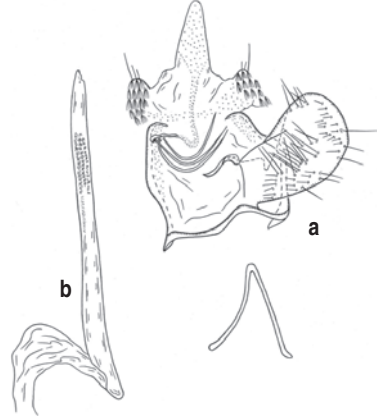


Fig. 37. Male genitalia - *Argyresthia conjugella* Zell. a) without aedeagus, b) aedeagus.

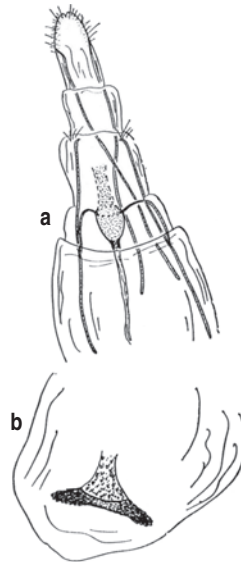


Fig. 38. Female genitalia - *Argyresthia conjugella* Zell. a) ventral view, b) bursa copulatrix with signum.

General distribution. Transpalearctic species.

Distribution in Israel: Mt. Meron, Mt. Hermon, Golan Heights (garden in the Centrum for Agricultural Services in Majdal Shams) (Fig. 39). Newly recorded for Israel.



Fig. 40. Adult moth - *Argyresthia brockeella* (Hbn.).
Drawing: V. P. Slovokhotov.

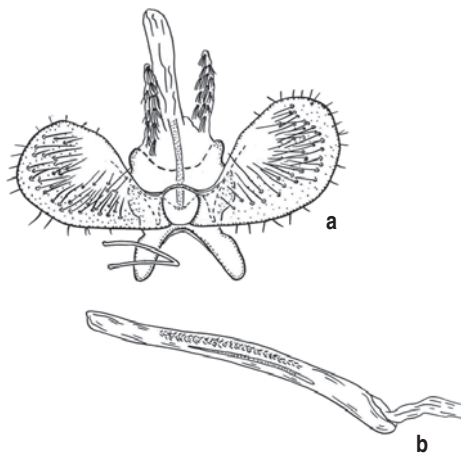


Fig. 41. Male genitalia - *Argyresthia brockeella* (Hbn.).
a) without aedeagus, b) aedeagus.

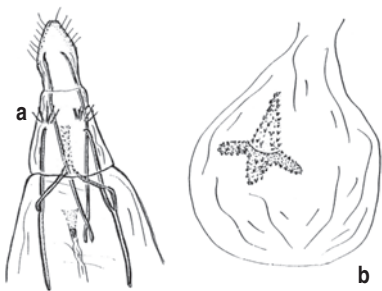


Fig. 42. Female genitalia - *Argyresthia brockeella* (Hbn.).
a) ventral view, b) bursa copulatrix with signum.

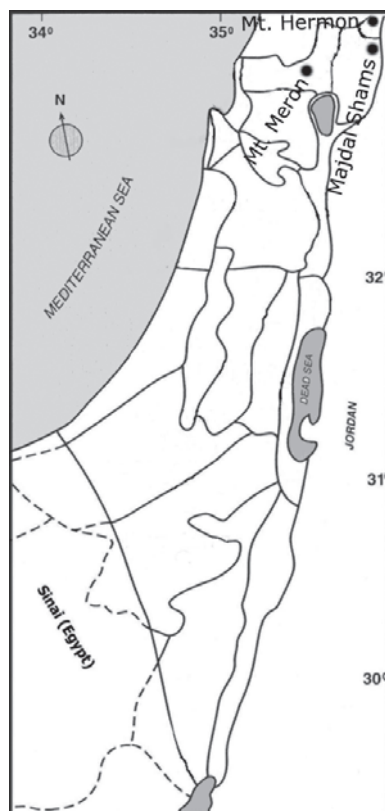


Fig. 43. Collection sites of *Argyresthia brockeella* (Hbn.) in Israel.

Argyresthia brockeella (Hübner, 1810-1813)

Tinea brockeella, Hübner 1813: 53, Fig. 262.

Argyresthia brockeella (Hübner, 1810-1813), Friese 1969: 701, 728-730, Figs. 27-30, Colour Plate, Fig. 2.

- *brockeella* (Hübner, 1810-1813), Gershenson 1974: 105-106, Figs. 110-112.
- *brockeella* (Hübner, 1810-1813), Moriuti 1977: 275-276, Figs. 101, 102, 358, 463, 488.
- *brockeella* (Hübner, 1810-1813), Agassiz 1987: 7, Pl. 1, Figs. 13-15.
- *brockeella* (Hübner, 1810-1813), Agassiz 1996: 40.
- *brockeella* (Hübner, 1810-1813), Agassiz & Friese 1996: 58.
- *brockeella* (Hübner, 1810-1813), Gershenson 1997: 457, Figs. 319, 320.
- *brockeella* (Hübner, 1810-1813), Gershenson *et al.* 2001.

Description

Imago (♀ and ♂) (Fig. 40). Wingspan: 10-13 mm. Head white with golden pubescence on vertex, labial palpus yellowish white, antennae of the same colour, tegulae rings are golden and fuscous. Thorax and tegulae white. Forewings (Fig. 40)-white with shining pattern, which consists of transversal stripes mixed with six white spots. Hindwings fuscous-gray with somewhat lighter cilia. Forelegs light yellow with fuscous scales on the inner side, mid- and hindlegs with fuscous scales on tibia and tarsus.

Male genitalia (Fig. 41). Valva of pear-shape, roundish. Saccus elongated, less than twice as long as valva, the latter about twice shorter than aedeagus.

Female genitalia (Fig. 42). Apophyses anterior shorter than apophyses posterior. Dorsal branch of apophyses anterior almost as long as their common stem. Bursa copulatrix with distinct signum.

Remarks. This species is similar to *A. goedartella* (L.) differing by the forewing pattern and genital structures (particularly by shape of saccus and signum). In Europe it is trophically connected with species of the family Betulaceae (Friese 1969, Gershenson 1974, Agassiz 1987). In Israel host plants are unknown.

General distribution: Transpalearctic species.

Distribution in Israel: Mt. Hermon (1,600 m asl.), Golan Heights (garden in the Centrum for Agricultural Services, Majdal Shams), Mt. Meron (Fig. 43).

7. Family Yponomeutidae Stephens, 1829

Minute or moderate-sized moths. Wingspan: 6-30 mm. Head (Fig. 18) covered with piliform scales, compressed on frons, directed forward in the form of a peak on the vertex and forming a tuft on the occiput. Ocelli absent or indistinct. Second segment of labial palpus shorter than 3rd, without tuft of scales. Forewings lanceolate-oval. Most species with pattern on forewings: dots (*Yponomeuta* Latr.) or transverse bands (*Cedestis* Z.), sometimes forewings uniform (*Ocnerostoma* Zeller, 1847). In forewings R_1 - R_5 mostly originate independently (except in *Ocnerostoma* Z.) (Fig. 44). In hindwings M_3 and Cu_1 fused (Fig. 45).

Male genitalia (e.g., Figs. 48a, 50a, 53a). Valva mostly bean-like or pyriform. Socius ending with one or several claws; claws are rarely absent. Length of aedeagus varies in different species and has diagnostic significance. Vesica carries cornuti, which are needle-like or in the form of spines.

Female genitalia (e.g., Figs. 48b, 50b, 53b). Lobes of vaginal plate well-developed, anterior apophyses usually bifurcate, ductus often sclerotized, ovipositor short, almost scarcely developed. Bursa copulatrix mostly without signum.

Larvae and pupae. Larvae live in gossamer galleries among leaves and feed on leaf tissue. Larvae of first and second instars often mine leaves and stems of food plants. Pupae of most species possess 4-6 setae on a cremaster. These setae are of diagnostic significance. Larvae pupate in compact groups or solitary. Most species make cocoons but, for example, *Yponomeuta rorrellus* (Hbn.), pupate without them (Fig. 6). In species of family Yponomeutidae, larvae of the first instar usually hibernate. The hibernation takes place on branches of food plants under a "shield".

Taxonomic richness: Recently, over 130 species from 22 genera of this family were found in the Palearctic region with larvae trophically connected with about 20 plant families (Gershenson & Ulenberg 1998). Many species, particularly from the genus *Yponomeuta* Latr., are known as pests of forests and orchards.

Species richness in Israel: In Israel, the following species of the above-mentioned family were recorded: *Ocnerostoma friesei* Svensson, 1966; *Kessleria saxifragae* (Stainton, 1868); *Yponomeuta albonigratus* Gershenson, 1972; *Y. cagnagellus* (Hübner, 1813) and *Y. meridionalis* Gershenson, 1972 (Gershenson *et al.* 2001, 2002). *Y. plumbellus* (Denis & Schiffermüller, 1775) and *Y. sedellus* Treitschke, 1832 are recorded here for the first time in Israel.

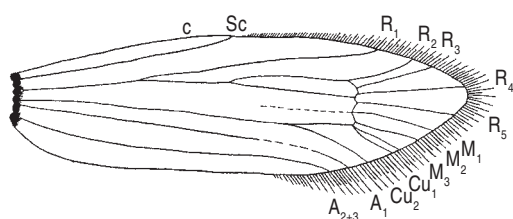


Fig. 44. Forewing venation - *Yponomeuta* Latr. (*Yponomeuta malinellus* Zell.). C – coastal vein, Sc – subcostal vein; R₁-R₅ – radial veins, Cu₁-Cu₂ – cubital veins, M₁-M₃ – medial veins, A₁-A₂ – anal veins.

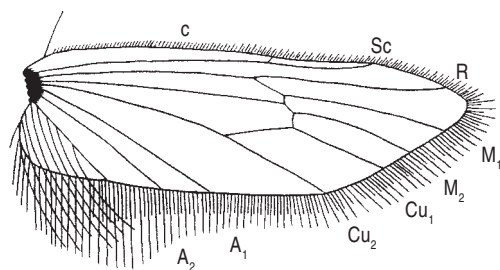


Fig. 45. Hindwing venation - *Yponomeuta* Latr. (*Yponomeuta malinellus* Zell.). C – coastal vein, Sc – subcostal vein; R₁-R₅ – radial veins, Cu₁-Cu₂ – cubital veins, M₁-M₃ – medial veins, A₁-A₂ – anal veins.

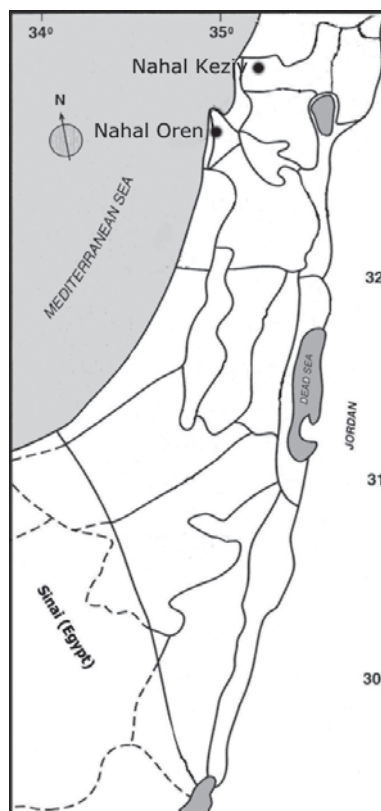


Fig. 47. Collection sites of *Yponomeuta cagnagellus* (Hbn.) in Israel.



Fig. 46. Spindle Ermine Moth - *Yponomeuta cagnagellus* (Hbn.). Drawing: V. P. Slovokhotov.

Key to Israel genera of the family Yponomeutidae

1. Galea are not curved spirally ***Ocnerostoma*** Z.
- Galea are curved spirally (Fig. 18) 2
2. Forewing pattern consists of distinct black dots arranged in irregular rows (*e.g.*, Figs. 46, 52, 57), stripes absent ***Yponomeuta*** Latr.
- Forewing pattern consists of stripes mixed with dots and speckles ***Kessleria*** Now.

Key to the *Yponomeuta* Latreille, 1796 species of Israel based on external characters

1. Head, thorax, and tegulae ash-gray 1 ***sedellus*** Tr.
- Head, thorax, and tegulae white 2
2. Black dots on forewings arranged in four irregular rows (Fig. 49) 2 ***plumbellus*** (Den. & Schiff.)
- Black dots on forewings arranged in three irregular rows 3
3. Tegula with one black dot 3 ***albonigratus*** Gershenson
- Tegula with two black dots 4
4. Hindwing with white cilia 4 ***cagnagellus*** (Hbn.)
- Hindwing with gray cilia (Fig. 52) 5 ***meridionalis*** Gersh.

Key to the *Yponomeuta* species of Israel based on male genitalia

1. Socius with two claws (Fig. 50a) 2
- Socius with one claw (Figs. 48a, 53a, 55a) 3
2. Valva of pear-like shape (Fig. 50) 1 ***plumbellus*** (Den. & Schiff.)
- Valva of bean-like shape (Fig. 58) 2 ***sedellus*** Tr.
3. Sacculus exceeds the width of socius by almost 5 times (Fig. 48a) 3 ***cagnagellus*** (Hbn.)
- Sacculus exceeds width of socius less than 5 times 4

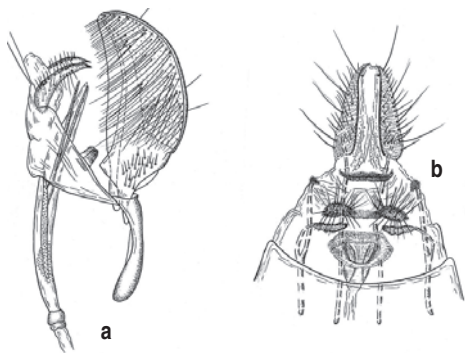


Fig. 48. Male and female genitalia - *Yponomeuta cagnagellus* (Hbn.). a) male, b) female.

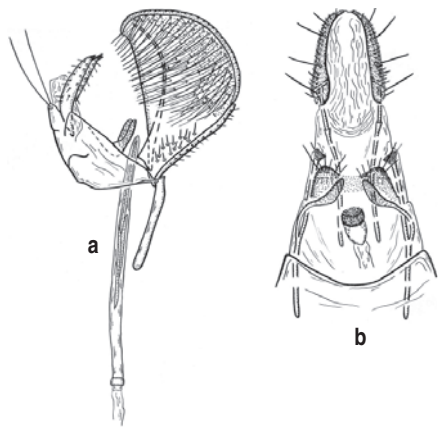


Fig. 50. Male and female genitalia - *Yponomeuta plumbellus* (Den. et Schiff.). a) male (lateral view), b) female (ventral view).

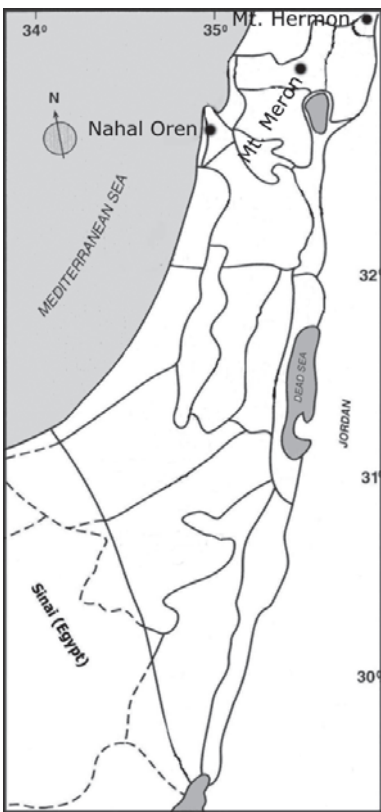


Fig. 51. Collection sites of *Yponomeuta plumbellus* (Den. et Schiff.) in Israel.



Fig. 49. Imago - *Y. plumbellus* (Den. et Schiff.). Drawing: V. P. Slovokhotov.

4. Gnathos less than 4 times shorter than sacculus (Fig. 53a) 4 ***meridionalis*** Gersh.
- Gnathos not less than 4 times shorter than sacculus (Fig. 55a) 5 ***albonigratus*** Gersh.

Key to the *Yponomeuta* species of Israel based on female genitalia

1. Membranous folds between papillae analis without denticles (Fig. 50b) 1 ***plumbellus*** (Den. & Schiff.)
- Membranous folds between papillae analis denticulated (Fig. 58b) 2
2. Antrum small (Fig. 58b) 2 ***sedellus*** Tr.
- Antrum large (*e.g.*, Fig. 55b) 3
3. Common stem of apophyses anterior more than twice as long as apophyses posterior 4
- Common stem of apophyses anterior less than twice as long as apophyses posterior (Fig. 55b) 3 ***albonigratus*** Gersh.
4. Common stem of apophyses anterior nearly as long as intersegmental sclerite (Fig. 48b) 4 ***cagnagellus*** (Hbn.)
- Common stem of apophyses anterior exceeds the length of intersegmental sclerite almost 1.5 times (Fig. 53b) 5 ***meridionalis*** Gersh.

Yponomeuta cagnagellus (Hübner, 1813) (Fig. 46)

Tinea cagnagella, Hübner 1813: Taf. 58, Figs. 391, 392.

Yponomeuta cagnagellus (Hübner, 1810-1813), Hannemann 1977: 138-139, Fig. 66, Pl. 9, Fig 3.

- *cagnagellus* (Hübner, 1810-1813); Gershenson 1990a: 335, 338, 342, Figs. 314 (3,4), 342 (5).
- *cagnagellus* (Hübner, 1810-1813), Aggasiz 1996: 39, 46-47, Pl. 9, Fig. 4.
- *cagnagellus* (Hübner, 1810-1813), Menken 1996: 302-303.
- *cagnagellus* (Hübner, 1810-1813), Gershenson *et al.* 2002: 77-80.



Fig. 52. Moth without abdomen. Paratype - *Yponomeuta meridionalis* Gersh.

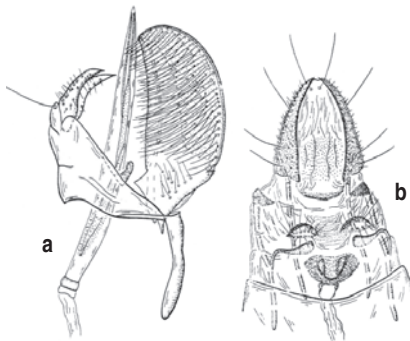


Fig. 53. Male and female genitalia - *Yponomeuta meridionalis* Gersh. a) male, b) female.

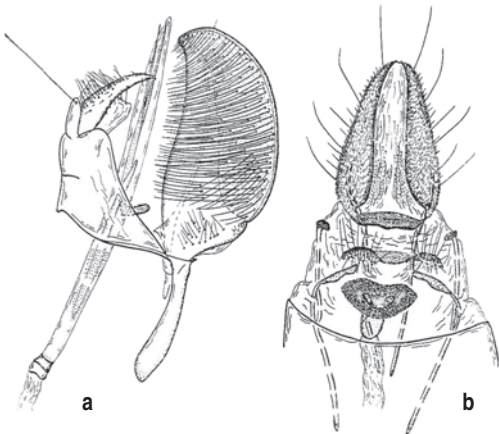


Fig. 55. Male and female genitalia - *Yponomeuta albonigratus* Gersh. a) male, b) female.

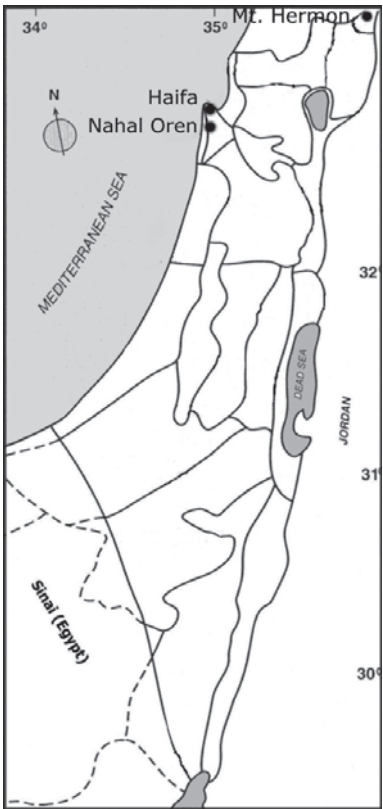


Fig. 54. Collection sites of *Yponomeuta meridionalis* Gersh. in Israel.

Synonyms

Phalaena Tinea evonymella, Linnaeus, 1758: 246.

Nygmia cognatella, Hübner 1825: 412.

Yponomeuta cognatella, Treitschke 1832: 111.

Description

Imago (♀ and ♂). Wingspan: 18-27 mm. Head and thorax white. There are 5 black thoracic dots, 2 on each tegula. Forewings white with pattern that consists of 17-20 moderate black dots arranged in 3 irregular rows (Fig. 46), cilia also white. Hindwings gray with white or whitish cilia, colour especially noticeable on the wing apex. Legs white or dirty white with blackish scales on the fore tibia and tarsus.

Male genitalia (Fig. 48a). Valva of bean shape, sacculus almost equal to shorter than saccus. Socii each ending with the claw. Saccus about twice shorter than valva. Aedeagus in 1.25-1.5 times longer than valva.

Female genitalia (Fig. 48b). Folds between papillae anales denticulated. Intersegmental sclerite present. Lobes of vaginal plate moderate and hardly spaced. Apophyses posterior longer than apophyses anterior. Ductus and bursa membranous, signum is absent.

Remarks. This species is most similar to *Y. mahalebells* Guenée by white cilia of the hindwings. In fact, it is also very difficult to distinguish this species from sibling species: *Y. malinellus* Zell., *Y. padellus* (L.), *Y. rhamnells* Gersh., and *Y. mahalebells* Guenée. This species is common on spindle (*Evonymus* sp.) in Europe and also widespread in Caucasus region.

General distribution: Europe, Ciscaucasia, Transcaucasia, Israel.

Distribution in Israel: Lower Nahal Oren (north-facing slope), Nahal Keziv (Fig. 47).

Yponomeuta plumbellus (Denis & Schiffermüller, 1775)

Tinea plumbellus, Denis & Schiffermüller 1775: 139.

Yponomeuta plumbellus (Denis & Schiffermüller, 1775), Kurbanova 1966: 94-100, Figs. 1-3.

- *plumbellus* (Denis & Schiffermüller, 1775), Hannemann 1977: 133-134, Figs. A-20 (c-d), 62, Pl. 8, Fig. 7.
- *plumbellus* (Denis & Schiffermüller, 1775), Gershenson 1990a: 331, Fig. 310 (2).
- *plumbellus* (Denis & Schiffermüller, 1775), Aggasiz 1996: 48-49, Pl. 9(7), Map 8.
- *plumbellus* (Denis & Schiffermüller, 1775), Menken 1996: 303.

Description

Imago (♀ and ♂). Wingspan: 15-18 mm. Head and thorax dirty white; the latter with 5 black dots (each tegula with one dot). Forewings dirty white with black apex. Forewing pattern consists of 25-30 black dots arranged in 4 irregular rows and a distinct black spot located between 3rd and 4th rows of black dots (Fig. 49, Plate 1c)). Cilia of both wings dark gray. Legs blackish gray.

Male genitalia (Fig. 50a). Valva of pear-like shape, distinctly narrowed near the base, nearly 1.5 times as long as it is broad and $1\frac{1}{4} - 1\frac{1}{5}$ times shorter than aedeagus. Socii broadened, each ending with 2 claws. Gnathos long, almost 2 times shorter than socii. Aedeagus almost 2.5-3 times longer than saccus.

Female genitalia (Fig. 50b). Folds between papillae anale non-denticulated. Inter-segmental sclerite indistinct. Lobes of vaginal plates hardly spaced. Apophyses posterior nearly equal or a little shorter than apophyses anterior. Ductus and bursa copulatrix membranous, signum is absent.

Remarks. Externally similar to vicarious species *Y. bipunctellus* Matsumura, 1931 distributed in Oriental region of the Palearctic. It can be easily distinguished from the latter by the absence of black dots on the head and by the forewing pattern, which consists of 25-36 black dots instead of 45-58 identical dots in *Y. bipunctellus* Mats. Host plants: spindle (*Evonymus europaeus* L., *E. verrucosus* Scop.) (Friese 1960, Kurbanova 1966, Gershenson 1974, Agassiz 1987, Menken 1995). In southern regions of East Europe larvae of this species were observed feeding on leaves of a pedunculate oak (*Quercus robur* L.) (Gershenson, unpublished).

General distribution: Europe, Caucasus region, Israel.

Distribution in Israel: Lower Nahal Oren, Mt. Hermon, Mt. Meron. Newly recorded from Israel (Fig. 51).

Yponomeuta meridionalis Gershenson, 1972

Yponomeuta meridionalis, Gershenson 1972: 635-636, Figs. 3, 4.

- *meridionalis* Gershenson, 1972, Gershenson *et al.* 2002: 77-80.
- *meridionalis* Gershenson, 1972, Sherniyazova 1975: 187-190.

Description

Imago (♀ and ♂). Wingspan: 18-20 mm. Head white. Thorax white with 5 black dots, tegulae of the same colour with two black dots on each one. Forewings white, sometimes with gray dusting on the apex. Forewing pattern consists of 12-19 dots

arranged in 3 irregular rows and of 6-10 minute black dots located apically (Fig. 52, Plate 1a). Cilia, mostly white, sometimes slightly dusted with gray. Hindwings and their cilia ash-gray. Legs white, forelegs with blackish scales.

Male genitalia (Fig. 53a). Valva of bean shape, almost exceeds 2.5 times its width, its costal margin is slightly concave. Socii with one claw on the end, broadened at the base. Saccus nearly 1.5 times shorter than saccus. Saccus shorter than aedeagus 2.5-3.0 times.

Female genitalia (Fig. 53b). Folds between papillae anales denticulated. Intersegmental sclerite distinct. Lobes of vaginal plate of moderate size and hardly spaced. Dorsal branches of apophyses anterior almost as long as its common stem and nearly twice as short as apophyse posterior. Ductus without sclerotization, bursa copulatrix without signum.

Remarks. Externally similar to *Y. padellus* (L.), which can be recognized mainly from the structure of genitalia, in particular by the disproportion of saccus length and width of valva in males and of the length of posterior and anterior apophyses in females. According to the literature data, this species trophically connected with hawthorns (*Crataegus* sp.) (Sherniyazova 1975).

General distribution: Tajikistan, Israel.

Distribution in Israel: Lower Nahal Oren ("EC" I), Haifa (University forest park), garden in the Centre for Agricultural Services, Majdal Shams (Golan Heights) (Fig. 54).

Yponomeuta albonigratus Gershenson, 1972

Yponomeuta albonigratus, Gershenson 1972: 635-636, Figs. 3, 4.

- *albonigratus* Gershenson, 1972, Gershenson *et al.* 2002: 77-80.

Description

Imago (♀ and ♂). Wingspan: 17-20 mm. Head white. Thorax white with 5 black dots, tegulae of the same colour with one black dot. Forewings white with slight grayish dusting and with black apex. Forewing pattern consists of 18-25 black dots arranged in 3 irregular rows and of 12-17 minute dots located apically (Plate 1e). Cilia dark gray. Hindwings and their cilia ash-gray. Legs white, tarsus forelegs with blackish scales.

Male genitalia (Fig. 55a). Valva is bean-shaped, nearly twice as long as saccus. Socii with one claw on the end, broadened towards base. Aedeagus nearly 1.5 times longer than valva.

Female genitalia (Fig. 55b). Folds between papillae anales denticulated. Intersegmental sclerite well-defined. Lobes of vaginal plate of moderate size and hardly spaced. Apophyses posterior almost equal or somewhat longer than apophyses anterior. Common stem of apophyses anterior shorter than apophyses posterior more than 1.5 times. Ductus without sclerotization, bursa copulatrix without signum.

Remarks. Externally and by the genital structures similar to *Yponomeuta rorrellus* (Hbn.). *Yponomeuta albonigratus* can be recognized by its black apex of the forewing. Larvae trophically connected with willows (*Salix* sp.) (Gershenson 1972, Sherniyazova 1975). In Israel five willow species are known (Zohary 1966).

General distribution: Israel, Tajikistan, Uzbekistan, Kyrgyzstan.

Distribution in Israel: Mt. Hermon, Mt. Meron, Banias, lower Nahal Oren (= "EC" I) (north-facing slope) (Fig. 56).

Yponomeuta sedellus Treitschke, 1832

Yponomeuta sedellus, Treitschke 1832: 223.

- *sedellus* Treitschke, 1832, Agassiz 1987: 16-17, Pl. II, Fig. 8.
- *sedellus* Treitschke, 1832, Agassiz 1996: 49, Pl. 9 (8), Map 9.
- *sedellus* Treitschke, 1832, Agassiz & Friese 1996: 55.

Synonyms

Phalaena viginti punctata, Retzius 1783: 52 (not the binominal name: Agassiz, 1996: 49, Pl. 9 (8), Map 9).

Yponomeuta vigintipunctatus (Retzius, 1783), Hannemann (1977): 134-135, Figs. A 21 (a-b), 61, Pl. 8, Fig. 8.

- *vigintipunctatus* (Retzius, 1783), Gershenson 1990a: 334.
- *vigintipunctatus* (Retzius, 1783), Menken 1996: 302-303.

Description

Imago (♀ and ♂) (Fig. 57). Wingspan: 13-18 mm. Head and thorax gray; the latter with 5 black dots (each tegula with one black dot). Forewings and their cilia ash-gray. Forewing pattern consists of 13-18 black dots arranged in 3 irregular rows (Fig. 57). Hindwings as well as their cilia are gray. Legs gray with blackish scales.

Male genitalia (Fig. 58a). Valva, bean-like, nearly 1.5 times shorter than aedeagus and not less than twice as long as saccus. Socii broad, each ending with two claws. Saccus narrow, about $3\frac{1}{4}$ – 3.5 times shorter than aedeagus.

Female genitalia (Fig. 58b). Fold between papillae analis distinctly denticulated. Intersegmental sclerite well-defined. Apophyses posterior somewhat shorter than apophyses anterior. Bursa copulatrix without signum.

Remarks. Can be easily recognized from the other species of this genus by the external morphological characteristics and specific structure of genitalia. Larvae were recorded as feeding on an orphine (*Sedum telephium* L.) in Europe (Friesse 1960, Gershenson 1974, Moriuti 1977, Agassiz 1987, Menken 1995).

General distribution. Transpalearctic species.

Distribution in Israel: Tel Aviv (botanical garden of Tel Aviv University), Mt. Hermon (lower cable station), Mitzpe Ramon (forest-garden of the Desert Institute) (Fig. 59). New record for Israel.

***Ocnerostoma friesei* Svensson, 1966**

Ocnerostoma friesei, Svensson 1966: 196, Figs. 30, 32, Pl. 4, Figs. 1, 2.

- *friesei* Svensson, 1966, Friesse 1966: 197, Fig. 1.
- *friesei* Svensson, 1966, Hannemann 1977: 164, Pl. 11, Figs. 5, 86.
- *friesei* Svensson, 1966, Moriuti 1977: 251-253, Figs. 93, 147, 157, 209, 348, 453, 536, 578.
- *friesei* Svensson, 1966, Gershenson 1990a: 346, Figs. 317 (3, 4), 323 (3).
- *friesei* Svensson, 1966, Agassiz 1996: 65-66, Figs. 22(c), 22(d), Pl. 9, Figs. 25, 26, Map 24.
- *friesei* Svensson, 1966, Gershenson *et al.* 2001: 147-153.

Description

Imago (♀ and ♂). Wingspan: 4-10 mm. Head, thorax, and forewings shiny white or light gray; forewing cilia paler. Forewings without pattern. Hindwings and their cilia are gray. Legs white or grayish.

Male genitalia (Fig. 60a,b). Valva elongated, less than twice as long as saccus. Socii as long as saccus or somewhat shorter. Saccus parallel-sided. Aedeagus nearly twice as long or less as valva, vesica with several minute basal scape about $\frac{3}{4}$ length of aedeagus.

Female genitalia (Fig. 60c). Folds between papillae analis non-denticulated. Intersegmental sclerite indistinct. Lobes of vaginal plates hardly spaced. Apophyses anterior nearly equal or shorter than apophyses posterior. The ventral arms of apophyses anteriors are united into an arch-shaped plate. Ductus bursae membranous. Bursa copulatrix without signum.

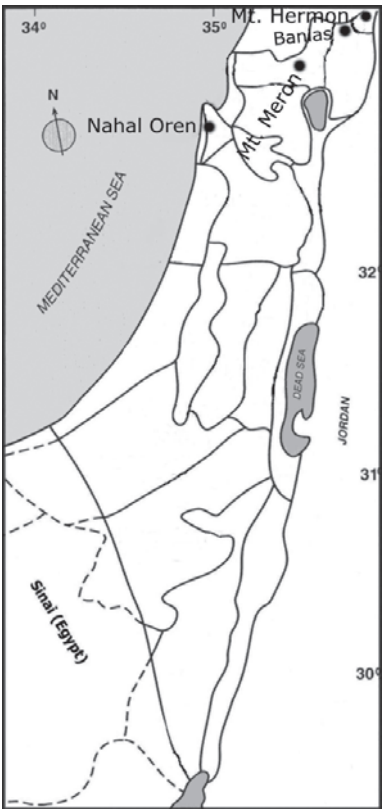


Fig. 56. Collection sites of *Yponomeuta albonigratus* Gersh. in Israel.



Fig. 57. Adult moth - *Yponomeuta sedellus* Tr.

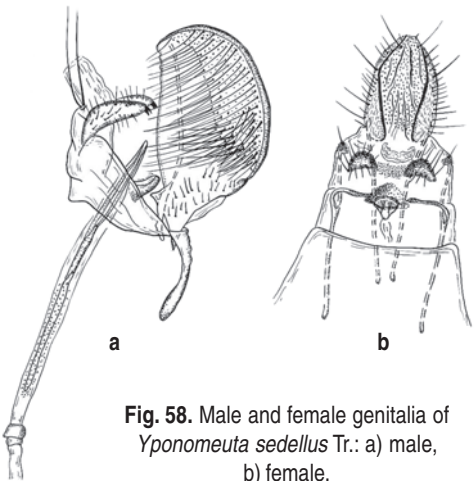


Fig. 58. Male and female genitalia of *Yponomeuta sedellus* Tr.: a) male, b) female.

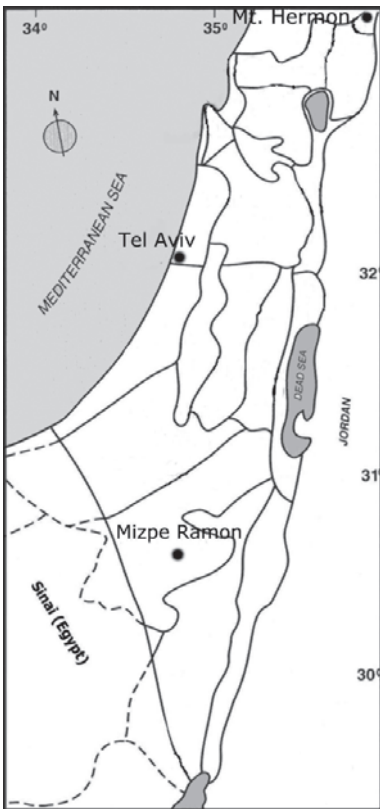


Fig. 59. Collection sites of *Yponomeuta sedellus* Tr. in Israel.

Remarks. Externally, resembles *O. piniariellum* Zeller, 1847; differs by the absence of whitish rings on antennae, by distinctly stouter spines of sacculus in the male genitalia, and faintly spined near the ostium ductus bursae in the female genitalia. Larvae trophically connected with pine tree (*Pinus sylvestris* L.) (Agassiz 1987, Gershenson 1988).

General distribution. Europe, Japan, Israel.

Distribution in Israel: Forest park near Haifa University, Mt. Hermon, Mt. Meron, Tel Aviv (botanical garden of Tel Aviv University) (Fig. 61).

Kessleria saxifragae (Stainton, 1868)

Zelleria saxifragae, Stainton 1868: 137-139.

Kessleria saxifragae (Stainton, 1868), Friese 1960: 82-83, Figs. 52, 53.

- *saxifragae* (Stainton, 1868), Agassiz 1987: Pl. 2, Fig. 13.

- *saxifragae* (Stainton, 1868), Huemer & Tarmann 1991: 51-54, Figs. 47-50, 66, 67, 197-202, 236, 247.

- *saxifragae* (Stainton, 1868), Agassiz 1996: 51-52, Pl. 9, Figs. 11.

Hofmannia saxifragae (Stainton, 1868), Agassiz & Friese 1996: 55-63.

Kessleria saxifragae (Stainton, 1868), Gershenson *et al.* 2002: 77-80.

Description

Imago (♀ and ♂). Wingspan: 10-17 mm. Head white with brownish scales. Thorax and tegulae white, mixed pale fuscous. Forewing white, suffused brownish dots with curved transversal brownish stripe.

Male genitalia (Fig. 62a,b). Valva of bean shape, almost 3 times shorter than aedeagus. Socii with one claw on the end, curved at the base. Saccus short and broadened, almost 3 times shorter than valva.

Female genitalia (Fig. 62c,d). Folds between papillae analis spined. Intersegmental sclerite indistinct. Lobes of vaginal plates clearly defined and moderately spaced. Dorsal branches of apophyses anterior almost as long as their common stem and almost twice as short as apophyses posterior. Bursa copulatrix without signum.

Remarks. Externally resembles *K. fasciapennella* (Stainton, 1849), which can be distinguished by wing pattern and genital structures. Larvae feed on *Saxifraga oppositifolia* L., *S. spathularis* Brot., *S. paniculata* P. Mill., *S. aizoides* L., *S. grisebachii* L. (Huemer & Tarmann 1991, Agassiz 1987). In Israel, a presumed host plant is *S. bederacea* L., which is the only native species of this genus present.

General distribution: Western Europe, Israel.

Distribution in Israel: Lower Nahal Oren (Fig. 63).

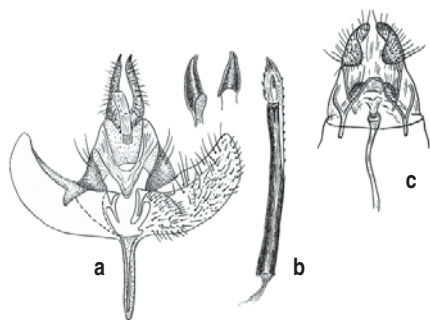


Fig. 60. Male and female genitalia - *Ocnerosstoma friesei* Svenss.: a) male without aedeagus, b) aedeagus, c) female.

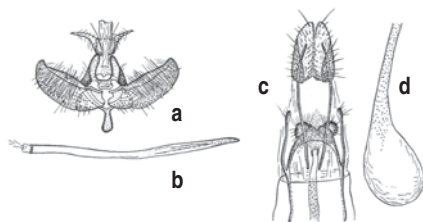


Fig. 62. Male and female genitalia - *Kessleria saxifragae* (Stt.): a) male without aedeagus, b) aedeagus, c) female, d) bursa copulatrix.

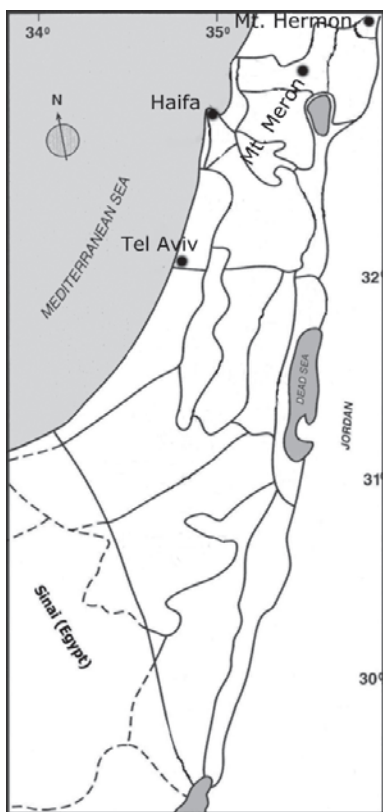


Fig. 61. Collection sites of *Ocnerosstoma friesei* Svenss. in Israel.

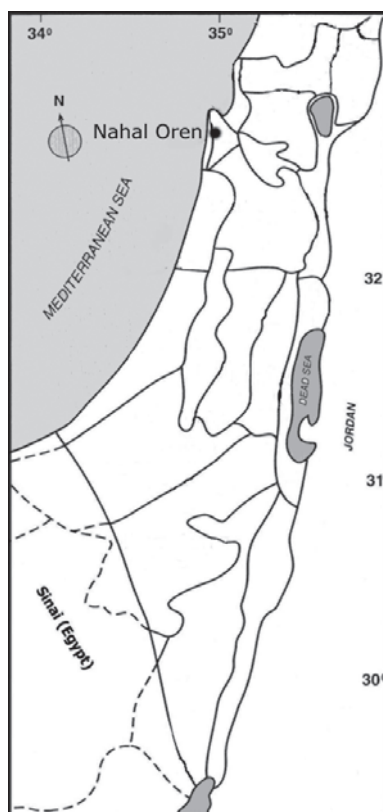


Fig. 63. Collection sites of *Kessleria saxifragae* (Stt.) in Israel.

8. Family Plutellidae Guenée, 1845

Moths of small and moderate size. Wingspan: 13-30 mm. Head mostly with appressed scales. Ocellus present in Plutellinae, whereas in Praydinae and Scythropiinae ocellus absent. Maxillary palpus rudimentary or 1-2 segmented in Praydinae and 3-4 segmented in the other subfamilies. Second segment of labial palpus with scale brush (Plutellinae, Ypsolophinae partly) (Fig. 64) or without it (Praydinae, Ypsolophinae partly) (Fig. 65). Haustellum developed. Forewings elongated, sometimes falcate at apical angle (Fig. 66). In hindwings R and M_1 separate (Plutellinae, Praydinae, Scythropiinae (Fig. 67)) or stalked (Ypsolophinae) (Fig. 68). 8-th abdominal sternite normal or reduced (Plutellinae, Ypsolophinae) or sclerotized (Praydinae, Scythropiinae).



Fig. 64. Labial palpus - *Ypsolopa parenthesesella* (L.).



Fig. 66. Forewing - *Ypsolopa asperella* (L.).

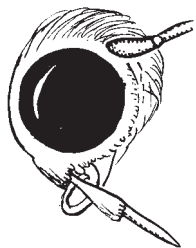


Fig. 65. Labial palpus - *Prays fraxinella* (Bjerk.).

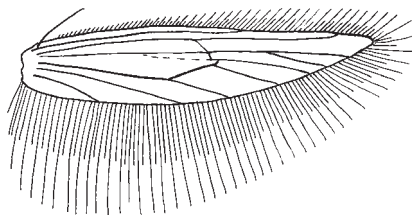


Fig. 67. Hindwing - *Plutella xylostella* (L.).

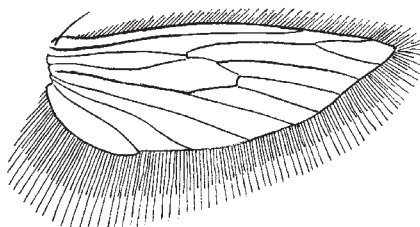


Fig. 68. Hindwing - *Ypsolopa scabrella* (L.).

Male genitalia. Gnathos present (Praydinae, Scythropiinae, Ypsolophinae) (Fig. 69) or absent (Plutellinae) (Fig. 70); tegumen normal (Praydinae, Ypsolophinae), extremely narrow or rudimentary (Scythropiinae, Plutellinae).

Female genitalia. Papillae anale and intersegmental membrane between papillae anale and 8th abdominal segment distinct. Apophysis anterior is branched. Bursa copulatrix mostly with one or two signa (Fig. 71).

Larvae. Larvae fusiform, often mine leaves in initial instars. Mature larvae usually feed on leaves or twigs of host plants in webnets. Overwintering occurs in different stages of development: eggs (*e.g.*, *Ypsolopha persicella* (F.)), larvae (*e.g.*, *Prays oleae* (Bernard)), or adults (*e.g.*, *Plutella* Schrank).

Taxonomic richness. Recently, about 180 species of this family are known from the Palearctic region (Friese 1966, Moriuti 1977; Zagulajev 1990, 1994; Karsholt & Razowski 1996; Gershenson 1997; Leraut 1997). Larval food plants are from the following plant families: Salicaceae, Betulaceae, Fagaceae, Ulmaceae, Brassicaceae, Caprifoliaceae, Taxodiaceae, Celastraceae, Juglandaceae, Oleaceae, Ericaceae, and Rosaceae (Moriuti 1977; Zagulajev 1990, 1994).

Species richness in Israel. In Israel, during the 19th and 20th centuries, the following species were recorded: *Plutella xylostella* (Linnaeus, 1758), *P. porrectella* (Linnaeus, 1758), *Prays citri* (Millière, 1873), *P. oleae* (Bernard, 1788), *Ypsolopha sculpturella* (Herrich-Schäffer, 1854); *Y. eremella* Amsel, 1933 (Amsel 1933; Avidov & Harpaz 1969; Bodenheimer 1937; Bytinski-Salz 1966; Halperin & Sauter 1992). Recently, the species named below have been found in Israel: *Ypsolopha albiramella* (Mann, 1861); *Y. asperella* (Linnaeus, 1761); *Y. dentella* (Fabricius, 1775); *Y. instabilella* (Mann, 1866), *Y. mucronella* (Scopoli, 1763); *Y. nevoi* Gershenson & Pavlíček, 2002; *Y. parenthesella* (Linnaeus, 1761); *Y. sequella* (Clerck, 1759); *Y. sylvella* (Linnaeus, 1767); *Y. trichonella* (Mann, 1861) (Gershenson *et al.* 2001, 2002; Gershenson & Pavlíček 2002); *Y. vittella* (Linnaeus, 1758).

Key to Israel genera of the family Plutellidae based on external characteristics of imago

1. 8th abdominal sternite as a large plate *Prays* Hbn.
- 8th abdominal sternite not modified 2
2. In Hindwings R_s not stalked with M₁ (Fig. 67) *Plutella* Schrank
- In Hindwings R_s long-stalked with M₁ (Fig. 68) *Ypsolopha* Latr.

Key to the *Plutella* Schrank, 1802 species of Israel based on external characteristics of imago and male genitalia

1. Posterior margin of forewings with light-coloured (dirty white, dirty yellow, or light brownish) longitudinal sinuous stripe (Fig. 109). In male genitalia, apex of valva without narrow process (Fig. 110) *Plutella xylostella* (L.)
- Posterior margin of forewings without longitudinal sinuous strip (Fig. 106a). In male genitalia apex of valva forms a narrow process (Fig. 106b) *Plutella porrectella* (L.)

Key to the *Ypsolopha* Latr.³ species of Israel based on external characters of imago

1. Terminal segment of labial palpus noticeably shorter than middle segment.. 2
- Terminal segment of labial palpus longer or as long as middle segment 7
2. Second segment of labial palpi equal to combined length of head and thorax *Y. mucronella* (Scop.)
- Second segment of labial palpi shorter than combined length of head and thorax ... 3
3. Forewings unicolorous mostly light fuscous *Y. instabilella* (Mann)
- Forewings not unicolorous 4
4. Forewings coloration distinctly divided on upper and lower half 5
- Forewing coloration mixed 6
5. Forewings ochreous-yellow in the upper dorsal half and whitish yellow in the lower one..... *Y. nevoi* Gersh. & Pavl.
- Forewings brown in the upper dorsal half and yellow in the lower one (Fig. 97) *Y. dentella* (F.)
6. Forewings with diffuse dark triangular spot (Fig. 103) *Y. albiramella* (Mann)
- Forewings with ochreous spot in the base *Y. trichonella* (Mann)
7. Head, thorax, and general background of forewings white 8
- Head, thorax, and general background of forewings different colour 9
8. Forewings with distinct triangular spot *Y. asperella* (L.)
- Forewings without triangular spot (Fig. 91) *Y. sequella* (Clerck)

³*Ypsolophus* Fabricius, 1798 is an unjustified emendation of *Ypsolopha* Latreille, 1796.

9. Forewings with apical notch (Fig. 83) *Y. scabrella* (L.)
- Forewings without apical notch 10
10. Forewings with oblique bands 11
- Forewings without oblique bands 12
11. Forewings greenish (Fig. 76) *Y. persicella* (F.)
- Forewings ochreous-brown (Fig. 94) *Y. sylvella* (L.)
12. Costal margin of forewings with whitish longitudinal spot (Fig. 100)
- *Y. parenthesella* (L.)
- Posterior margin of forewings with dark spots, which sometimes fuse looking like bands (Fig. 88) *Y. vittella* (L.)

Key to the *Ypsolopha* species of Israel based on male genitalia

1. Valva in basal part with oval light area (Fig. 79a) *Y. mucronella* (Sc.)
- Valva in basal part without light area 2
2. Saccus equal or shorter than socius 3
- Saccus longer than socius 8
3. Valva elongated, more narrow at the apex 4
- Valva pyriform with broadened apex (Fig. 72a) *Y. nevoi* Gersh. & Pavl.
4. Saccus more than 5.0 times shorter than valva (Fig. 95) *Y. sylvella* (L.)
- Saccus less than 5.0 times shorter than valva 5
5. Saccus about 4.0 times shorter than valva (Fig. 101) *Y. parenthesella* (L.)
- Saccus less than 3.0 times shorter than valva 6
6. Aedeagus slender, its width slightly exceeds or is equal to width of saccus (Fig. 81)
- *Y. trichonella* (Mann)
- Aedeagus stout, its width, 2.5 times or more, exceeds width of saccus 7
7. Valva of pear-like shape (Fig. 92) *Y. sequella* (Cl.)
- Valva nearly oval (Fig. 89) *Y. vittella* (L.)
8. Valva almost as long as aedeagus 9
- Valva and aedeagus of different lengths 10

9. Saccus more than two times shorter than aedeagus (Fig. 84) *Y. scabrella* (L.)
 - Saccus less than two times shorter than aedeagus (Fig. 77) *Y. persicella* (F.)
10. Saccus about 3.0 times shorter than aedeagus (Fig. 74) *Y. instabilella* (Mann)
 - Saccus less than 3.0 times shorter than aedeagus 11
11. Saccus nearly as long as socius (Fig. 98) *Y. dentella* (F.).
 - Saccus longer than socius 12
12. Saccus more than two times shorter than valva (Fig. 104) *Y. albiramella* (Mann)
 - Saccus less than two times shorter than valva (Fig. 86) *Y. asperella* (L.)

Ypsolopha nevoi Gershenson & Pavlíček, 2002

Ypsolopha nevoi, Gershenson & Pavlíček 2002: 125-129, Fig. 1.

Description.⁴ Imago (♂ and ♀). Wingspan: 16-18 mm. Head white. Antenna white-ringed and blackish. Labial palpus ochreous-yellow. Thorax white with yellow tegula. Legs white mixed with gray; tarsi gray with whitish scales. Abdomen whitish ochreous. Forewing falcated apically, ochreous-yellow in the upper dorsal half and whitish yellow in the lower one, with small brownish spots in the middle of wing surface. Hindwing whitish gray. Cilia of both wings whitish-ochreous with fuscous scales on the wing apex.

Male genitalia (Fig. 72). Valva of pear-like shape with broadened apex. Saccus slender, more than 2.5 times shorter than aedeagus. Vesica with cornutus.

Remarks. Closely allied to the European *Ypsolopha falcella* (Hübner, 1796), but differs from it by the genitalia structure, particularly by broadened and curved aedeagus, which is more than 2.5 times longer than saccus.

Larval food plant is unknown. The larvae of similar species to the one mentioned above are trophically connected with *Lonicera* (Zagulajev 1990).

Distribution in Israel: Lower Nahal Oren (Fig. 73).

Ypsolopha instabilella (Mann, 1866)

Cerostoma instabilella, Mann 1866: 351, Pl. 1, Figs. 5-7.

Ypsolopha instabilella (Mann, 1866), Friese 1966: 453.

⁴ We did not incorporate the description of female genitalia here because of insufficient insight into their diagnostic features. Usually, for the determination of plutellids, the external characteristics of imago as well as the structure of male genitalia are used.

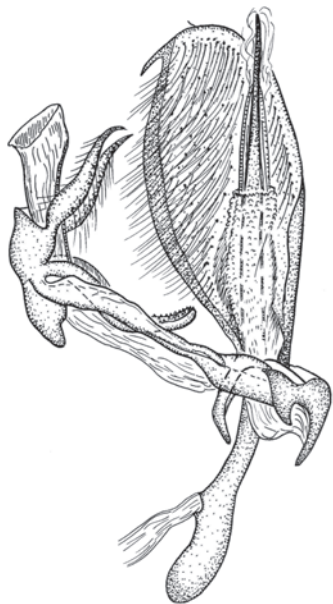


Fig. 69. Male genitalia - *Ypsolopha ustella* (Clerck).

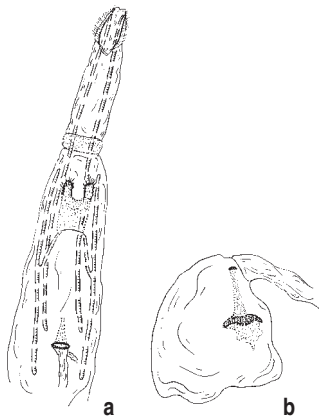


Fig. 71. Female genitalia - *Ypsolopha nevoi* Gersh. & Pavl.: a) without bursa copulatrix, b) bursa copulatrix with signum.

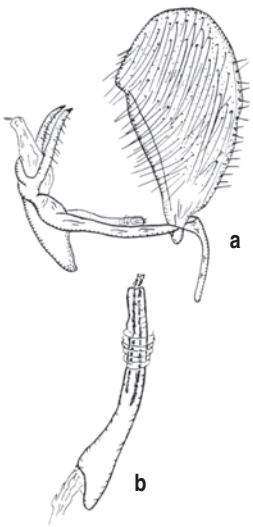


Fig. 72. Male genitalia - *Ypsolopha nevoi* Gersh. & Pavl.: a) lateral view without aedeagus; b) aedeagus.

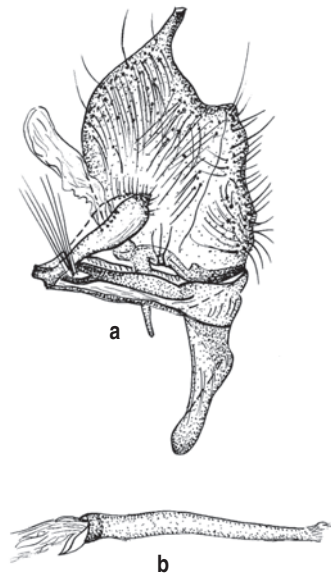


Fig. 70. Male genitalia - *Plutella porrectella* (L.). a) lateral view without aedeagus; b) aedeagus.

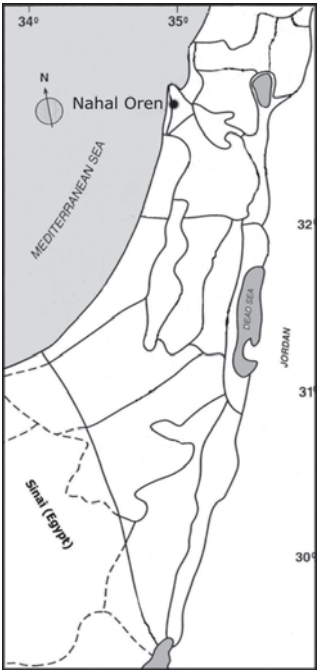


Fig. 73. Collection sites of *Ypsolopha nevoi* Gersh. & Pavl. in Israel.

- *instabilella* (Mann, 1866), Zagulajev 1990: 490, 502, Figs: 348(3), 355(5).
- *instabilella* (Mann, 1866), Zagulajev 1994: 263.
- *instabilella* (Mann, 1866), Agassiz & Fries 1996: 59.
- *instabilella* (Mann, 1866), Gershenson *et al.* 2002: 78.

Description. Imago (♀ and ♂). Wingspan: 20-22 mm. Third segment of labial palpi distinctly shorter than the second. Forewings unicolorous, mostly light fuscous, with acuminate apical angle.

Male genitalia (Fig. 74). Saccus narrow, about 3.0 times shorter than aedeagus. Tergal side of tegumen almost two times longer than saccus. Aedeagus somewhat longer than valva.

Remarks. Externally resembles *Y. nemorella* (L.), but differs by the light brown colour of the forewings and by the absence of dark dots in middle of forewings. In male genitalia, aedeagus longer than valva, whereas in similar species, valva is as long as aedeagus or exceeds its length. According to the literature data (Zagulajev 1994) larvae are trophically connected with *Ephedra equisetina* Bunge, *E. intermedia*, Schrenk ex C.A. Meyer, and *E. distachya* L.

General distribution. Southern part of eastern Europe, Uzbekistan, Tajikistan, Kyrgyzstan, Asia Minor (Zagulajev 1990), Israel.

Distribution in Israel: Lower Nahal Oren, Nahal Keziv, Negev Desert (near Mitzpe Ramon) (Fig. 75).

***Ypsolopha persicella* (Fabricius, 1787)**

Tinea persicella, Fabricius 1787: 255.

Ypsolopha persicella (Fabricius, 1787), Fries 1966: 455.

- *persicella* (Fabricius, 1787), Zagulajev 1990: 488, Figs. 345 (3), 353 (4, 5).
- *persicella* (Fabricius, 1787), Zagulajev 1994: 263.
- *persicella* (Fabricius, 1787), Agassiz & Fries 1996: 59.
- *persicella* (Fabricius, 1787), Gershenson *et al.* 2002: 79.

Synonyms

Tinea sulphurella, Hübner 1793: 17.

Description (♀ and ♂). Wingspan: 19-21 mm. Third segment of labial palpi almost equal to second segment. Forewings greenish mixed with yellow scales with two oblique rows of monochromatic scales (Fig. 76).

Male genitalia (Fig. 77). Valva oval-shaped and almost as long as aedeagus. The latter less than two times longer than saccus. Tergal side of tegumen almost two times shorter than saccus.

Remarks. This species can be easily recognized by the forewing pattern and coloration as well as by the structure of the male genitalia. Larval host plants were recorded for the family Rosaceae, such as almond (*Prunus dulcis* (Mill.) Webb.), peach (*Prunus persica* (L.) Batsch.), and apricot (*Prunus armeniaca* L.) (Zagulajev 1994).

General distribution. Central and southern Europe, Caucasus, Asia Minor, Israel.

Distribution in Israel: Lower Nahal Oren, Mt. Meron, Be'er-Sheva (town park), Tel Aviv (botanical garden of Tel Aviv University) (Fig. 78).

Ypsolopha mucronella (Scopoli, 1763)

Phalaena Tinea mucronella, Scopoli 1763: No. 643.

Ypsolopha mucronella (Scopoli, 1763), Friese 1966: 454.

Theristis mucronella (Scopoli, 1763), Zagulajev 1990: 502, Figs. 339(4), 357(1), 358(1), 359 361.

Ypsolopha mucronella (Scopoli, 1763), Agassiz 1996: 40.

- *mucronella* (Scopoli, 1763), Agassiz & Friese 1996: 58.

- *mucronella* (Scopoli, 1763), Gershenson *et al.* 2002: 79.

Synonyms

Phalaena Tinea caudella, Linnaeus 1767: 894.

Description. Imago (♂ and ♀). Wingspan: 26-32 mm. Forewing gray or brownish ochreous with a dark fuscous longitudinal stripe and with an acutely produced apex. Second segment of labial palpi equal to combined length of head and thorax.

Male genitalia (Fig. 79). Valva with light-coloured area in its basal half. Saccus more than two times shorter than valva. Aedeagus somewhat longer than valva.

Remarks. This species can be easily recognized according to the abovementioned external characteristics and male genitalia structure. Larvae trophically connected with spindle-tree (*Evonymus* sp.) (Zagulajev 1990).

General distribution. Western Europe except Trans-Polar region, Asia Minor (Zagulajev 1990), Israel.

Distribution in Israel: Lower Nahal Oren "EC" I, Mt. Hermon (Fig. 80).

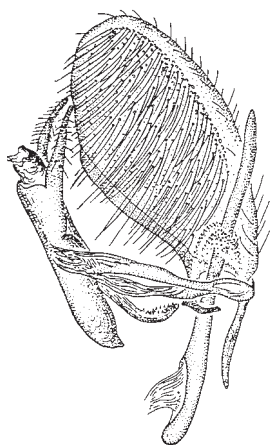


Fig. 74. Male genitalia - *Ypsolopha instabilella* (Mann).



Fig. 76. Forewing - *Ypsolopha persicella* (F.).

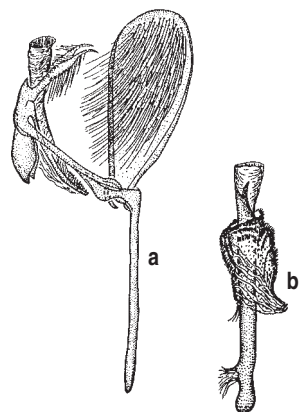


Fig. 77. Male genitalia - *Ypsolopha persicella* (F.): a) lateral view without aedeagus, b) aedeagus.

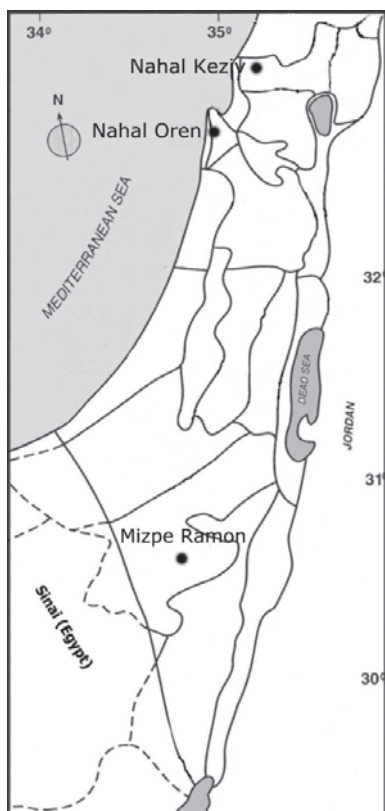


Fig. 75. Collection sites of *Ypsolopha instabilella* (Mann) in Israel.

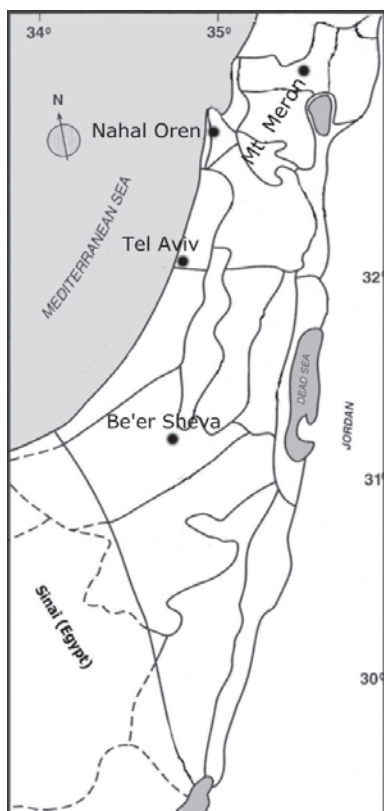


Fig. 78. Collection sites of *Ypsolopha persicella* (F.) in Israel.

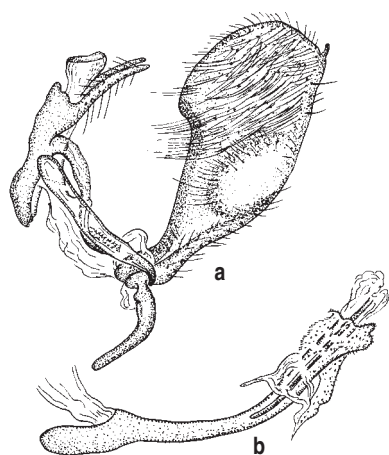


Fig. 79. Male genitalia - *Ypsolopha mucronella* (Sc.). a) lateral view without aedeagus, b) aedeagus.

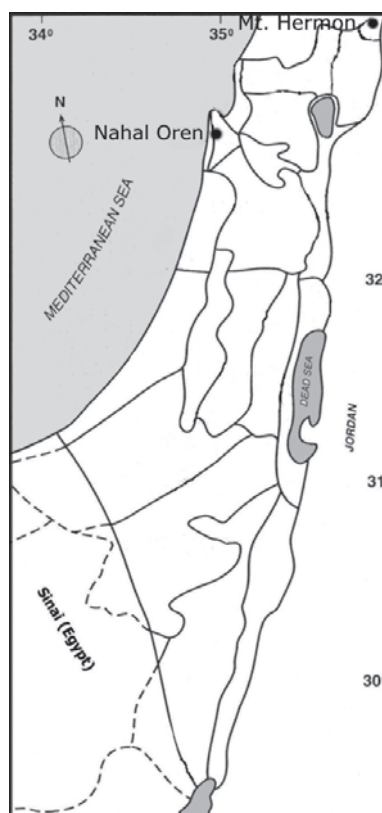


Fig. 80. Collection sites of *Ypsolopha mucronella* (Sc.) in Israel.

Ypsolopha trichonella (Mann, 1861)

Cerostoma trichonella, Mann 1861: 189, Pl. 3, Fig. 5.

Ypsolopha trichonella (Mann, 1861), Friese 1966: 456.

- *trichonella* (Mann, 1861), Zagulajev 1990: 491, 492, Figs 346 (3), 351 (5,6).
- *trichonella* (Mann, 1861), Zagulajev 1994: 265.
- *trichonella* (Mann, 1861), Agassiz & Friese 1996: 59.
- *trichonella* (Mann, 1861), Gershenson *et al.* 2001: 149.

Description. Imago (♂ and ♀). Wingspan: 18-21 mm. Forewings with admixtures, ochreous scales, and a distinct ochreous spot near the base.

Male genitalia (Fig. 81). Valva almost oval-shaped, nearly as long as aedeagus. Saccus slender; its width slightly less or equal to the width of aedeagus. The latter about 2.5 times longer than saccus.

Remarks. This species is similar to *Y. mucronella* (Scop.) with whom it shares the following characteristics: terminal segment of labial palpus shorter than the middle one, forewing apex produced; R_4 and R_5 stalked. Larval host plants: *Ephedra equisetina* Bunge, *E. intermedia* Schrenk ex C.A. Meyer, and *E. distachya* L. (Zagulajev 1994).

General distribution. Southern part of western Europe; Caucasus, Asia Minor, Central Asia (Zagulajev 1990, 1994), Israel.

Distribution in Israel: Lower Nahal Oren, Negev Desert (near Mitzpe Ramon) (Fig. 82).

Ypsolopha scabrella (Linnaeus, 1761)

Phalaena Tinea scabrella, Linnaeus 1761: No. 1446.

Ypsolopha scabrella (Linnaeus, 1761), Friese 1966: 455.

- *scabrella* (Linnaeus, 1761), Zagulajev 1990: 487, 501, Figs. 345 (2), 348 (1), 354 (2).
- *scabrella* (Linnaeus, 1761), Zagulajev 1994: 264.
- *scabrella* (Linnaeus, 1761), Agassiz 1996: 40.
- *scabrella* (Linnaeus, 1761), Agassiz & Friese 1996: 58.
- *scabrella* (Linnaeus, 1761), Gershenson *et al.* 2001: 150.

Synonyms

Tinea pterodactylella, Hübner 1793: 102.

Description. Imago (♂ and ♀). Wingspan: 19-28 mm. Forewing apex acutely produced (Fig. 83). Forewings whitish, sprinkled fuscous, with one or two dark brown streaks.

Male genitalia (Fig. 84). Valva almost oval-shaped, almost two times longer than saccus. Saccus slender and slightly curved, more than two times shorter than aedeagus.

Remarks. Close to *Y. parenthesella* (L.) with whom it shares the same important specific diagnostic characteristics - third segment of labial palpi straight and nearly equal to second segment (group *parenthesella*) (Zagulajev 1994). Larval food plants: pear (*Pyrus communis* L.), plum (*Prunus domestica* L.), apple (*Malus* sp.), hawthorn (*Crataegus* sp.), and rowan-tree (*Sorbus aucuparia* L.).

General distribution. Central and southern Europe (Zagulajev 1994), Israel.

Distribution in Israel: Mt. Hermon, Ein Gedi (Fig. 85).

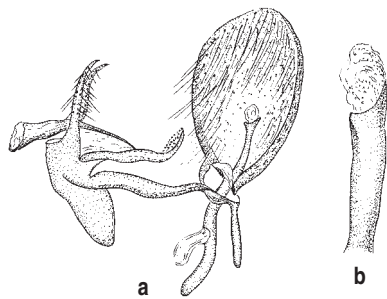


Fig. 81. Male genitalia - *Ypsolopha trichonella* (Mann): a) male genitalia, b) basal part of aedeagus.

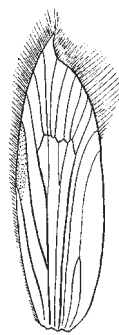


Fig. 83. Forewing - *Ypsolopha scabrella* (L.).

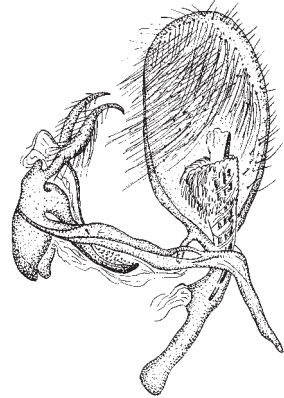


Fig. 84. Male genitalia - *Ypsolopha scabrella* (L.).

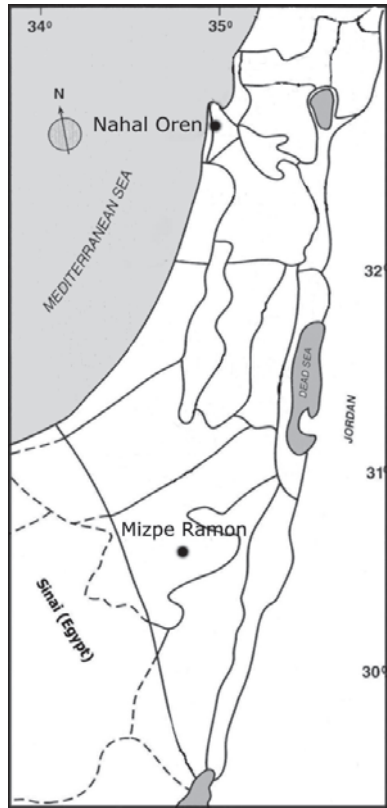


Fig. 82. Collection sites of *Ypsolopha trichonella* (Mann) in Israel.

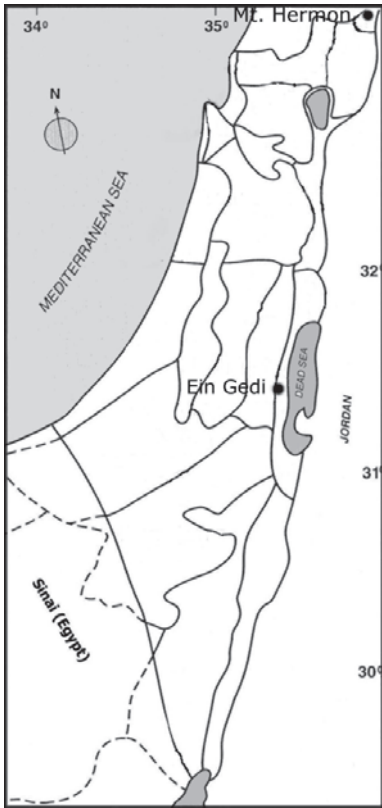


Fig. 85. Collection sites of *Ypsolopha scabrella* (L.) in Israel.

Ypsolopha asperella (Linnaeus, 1761)*Phalaena Tinea asperella*, Linnaeus 1761: No. 1447.*Ypsolopha asperella* (Linnaeus, 1761), Friese 1966: 452.

- *asperella* (Linnaeus, 1761), Zagulajev 1990: 487, 502 Figs. 344(4), 355(1).
- *asperella* (Linnaeus, 1761), Zagulajev 1994: 262-263.
- *asperella* (Linnaeus, 1761), Agassiz 1996: 40.
- *asperella* (Linnaeus, 1761), Agassiz & Friese 1996: 58.
- *asperella* (Linnaeus, 1761), Gershenson 1997: 438, Fig. 301(1).
- *asperella* (Linnaeus, 1761), Gershenson *et al.* 2002: 78.

Description. Imago (♂ and ♀). Wingspan: 18-21 mm. Head, thorax, and general background of forewings white. Apical angle of forewings acuminate. Each forewing with distinct triangular grayish or fuscous spot (Plate 1b).

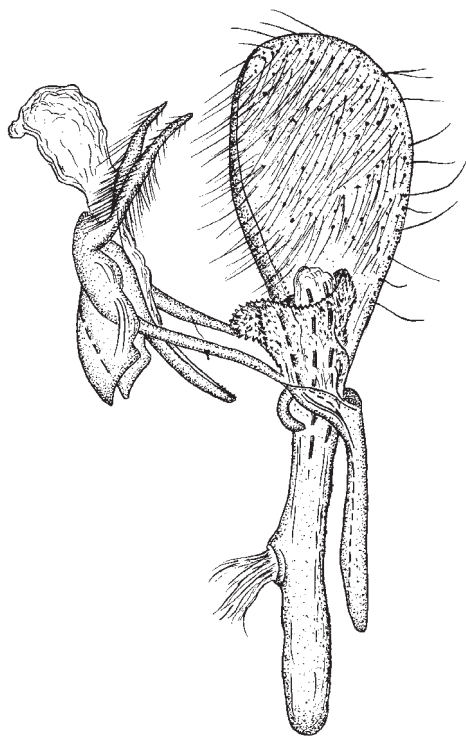


Fig. 86. *Ypsolopha asperella* (L.). Male genitalia.

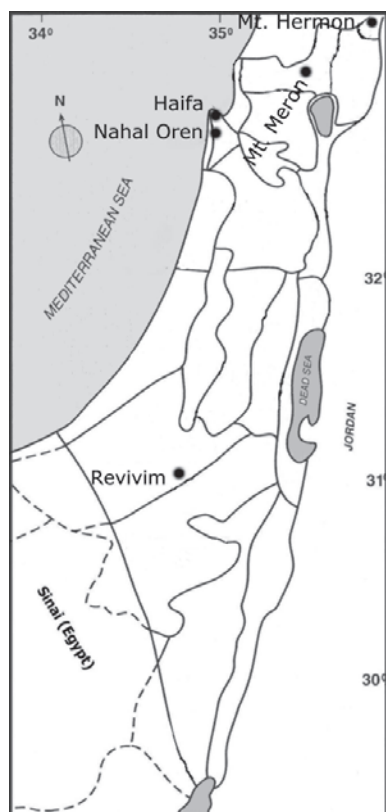


Fig. 87. Collection sites of *Ypsolopha asperella* (L.) in Israel.

Male genitalia (Fig. 86). Valva almost oval, longer than saccus. Saccus straight; aedeagus stout. Saccus less than two times shorter than valva.

Remarks. This species can be easily recognized by the forewing pattern and structure of male genitalia. Larvae feed on rosaceous plants: apple (*Malus*), sour cherry (*Prunus cerasus* L.), pear (*Pyrus*), and hawthorn (*Crataegus*) (Zagulajev 1994).

General distribution. Europe, southern Siberia, Russian Far East, Kazakhstan, Asia Minor (Zagulajev 1994), Israel.

Distribution in Israel: Revivim, lower Nahal Oren, Mt. Hermon, Mt. Meron, forest park near Haifa University (Fig. 87).

Ypsolopha vittella (Linnaeus, 1758)

Phalaena Tinea vittella, Linnaeus 1758: 538, No. 64.

Alucita vittella (Linnaeus, 1758), Fabricius, 1775: 668.

Ypsolopha vittella (Linnaeus, 1758), Friese 1966: 456.

- *vittella* (Linnaeus, 1758), Moriuti 1977: 78-80, Figs. 7, 130, 159, 182, 226, 380 (see therein for more references on this species).
- *vittella* (Linnaeus, 1758), Zagulajev 1990: 486, 487, 501, Figs. 344 (1), 353 (2, 3).
- *vittella* (Linnaeus, 1758), Agassiz 1996: 41.
- *vittella* (Linnaeus, 1758), Agassiz & Friese 1996: 59.

Synonyms

Tinea sisymbrella, Denis & Schiffermüller 1775: 140.

Tinea maurella, Denis & Schiffermüller 1775: 142.

Alucita dorsella, Fabricius 1794: 336.

Ypsolopha dorsata, Fabricius 1798: 507.

Ypsolopha unguiculata, Fabricius 1798: 508.

Cerostoma dorsimaculella, Kearfoot 1907: 211.

Description. Imago (♂ and ♀). Wingspan: 17-21 mm. Head light gray. Forewings gray, mainly mixed with whitish gray, brownish, or blackish scales. Posterior margin of forewings with dark spots, which sometimes fuse looking like a band (Fig. 88, Plate 1d). Hindwings gray.

Male genitalia (Fig. 89). Valva nearly oval, saccus almost straight and about two times shorter than valva. Aedeagus stout, its width noticeably exceeds width of saccus.

Remarks. Close to *Y. sequella* (Cl.), which shares the main specific diagnostic characteristics – third segment of labial palpi slightly curved and longer than second

segment (group “vittelus”). Larvae feed on elm (*Ulmus* sp.), beech (*Fagus* sp.), oak (*Quercus* sp.), and honey-suckle (*Lonicera* sp.) (Zagulajev 1990).

General distribution. Europe (except Trans-Polar region), northern Caucasus, Central Asia, Asia Minor, Russian Far East, Japan (Moriuti 1977, Zagulajev 1990), Israel.

Distribution in Israel: Lower Nahal Oren (= EC I), Nahal Keziv (= EC II), forest park near Haifa University, Mt. Meron, Mt. Hermon, botanical garden of Tel Aviv University, Tel Aviv, Ein Gedi (Fig. 90). This species represents a new record for Israel.

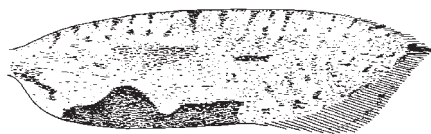


Fig. 88. Forewing pattern - *Ypsolopha vittella* (L.).

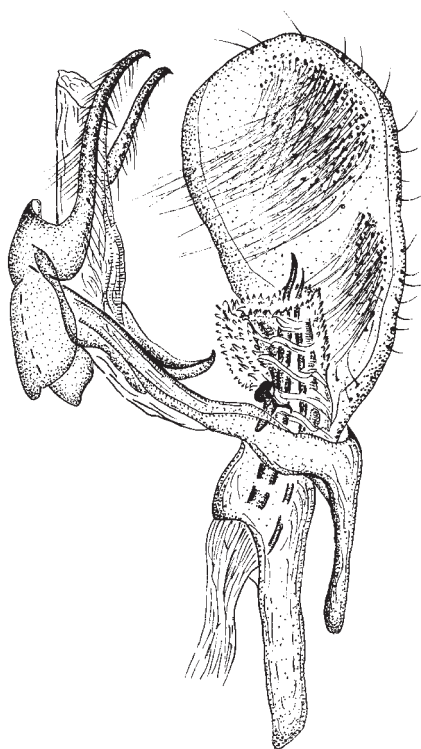


Fig. 89. Male genitalia - *Ypsolopha vittella* (L.).



Fig. 90. Collection sites of *Ypsolopha vittella* (L.) in Israel.

Ypsolopha sequella* (Clerck, 1759)Phalaena sequella*, Clerck 1759: Pl. 10, 14.*Ypsolopha sequella* (Clerck, 1759), Friese 1966: 455.

- *sequella* (Clerck, 1759), Zagulajev 1990: 486, 492, 501, Figs. 344 (2), 350 (4).
- *sequella* (Clerck, 1759), Agassiz 1996: 41.
- *sequella* (Clerck, 1759), Agassiz & Friese 1996: 59.
- *sequella* (Clerck, 1759), Gershenson *et al.* 2001: 150.

Description. Imago (♂ and ♀). Wingspan: 17-22 mm. Head, thorax, and general background of forewings white. Costal margin with a few black strigulae, posterior margin with pattern of dark spots and stripes (Fig. 91, Plate 1f).

Male genitalia (Fig. 92). Valva of pear-like shape, more than two times longer than saccus. The latter slender and slightly curved. Aedeagus longer than valva less than 1.5 times.

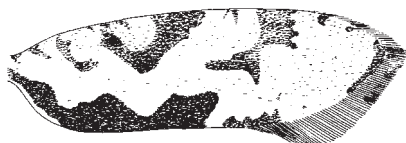


Fig. 91. Forewing - *Ypsolopha sequella* (Cl.).

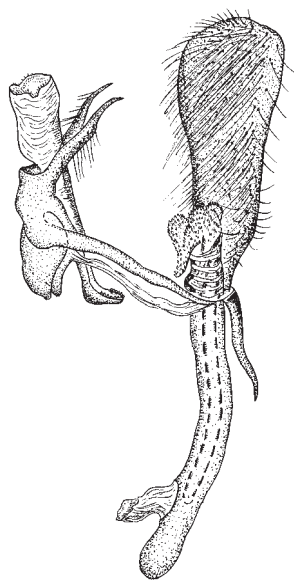


Fig. 92. Male genitalia - *Ypsolopha sequella* (Cl.).

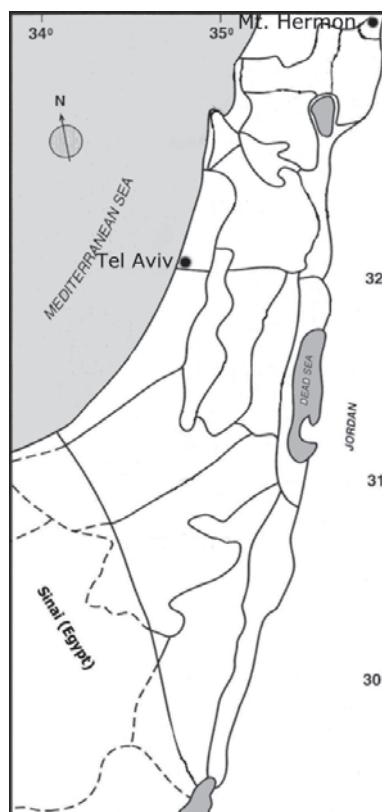


Fig. 93. Collection sites of *Ypsolopha sequella* (Cl.) in Israel.

Remarks. This species can be included in the group “*vitellus*” by the following diagnostic characteristics: third segment of labial palpi slightly curved and longer than the second segment. Food plants of larvae recorded by Zagulajev (1990) – linden (*Tilia* sp.), maple (*Acer* sp.), and willow (*Salix* sp.).

General distribution. Europe (except Trans-Polar region), Asia Minor (Zagulajev 1990), Israel.

Distribution in Israel: Mt. Hermon, botanical garden of Tel Aviv University, Tel Aviv (Fig. 93).

Ypsolopha sylvella (Linnaeus, 1767)

Phalaena Tinea sylvella, Linnaeus 1767: 893.

Ypsolopha sylvella (Linnaeus, 1767), Friese 1966: 455.

- *sylvella* (Linnaeus, 1767), Zagulajev 1990: 488, 492, Figs. 345 (4), 351 (1).
- *sylvella* (Linnaeus, 1767), Agassiz 1996: 41.
- *sylvella* (Linnaeus, 1767), Agassiz & Friese 1996: 59.
- *sylvella* (Linnaeus, 1767), Gershenson *et al.* 2001: 150.

Description. Imago (♂ and ♀). Wingspan: 17-25 mm. Head and thorax pale ochreous. Forewings ochreous-brown or golden ochreous with two oblique fuscous strigulae usually interrupted near costal margin (Fig. 94).

Male genitalia (Fig. 95). Valva oval-elongated. Saccus very short, more than 5.0 times shorter than valva. Aedeagus noticeably curved.

Remarks. Close to *Y. sequella* (Clerck), having, above all, such a good diagnostic characteristic as slightly curved third segment of labial palpi, which is longer than the second segment. Larval host plant is an oak (*Quercus* sp.) (Zagulajev 1990).

General distribution. Europe (except Trans-Polar region), Kazakhstan (Zagulajev 1990), Israel.

Distribution in Israel: Mt. Hermon (lower Cable Station at 1,400 m asl.) (Fig. 96).

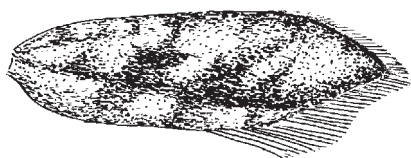


Fig. 94. Forewing - *Ypsolopha sylvella* (L.).

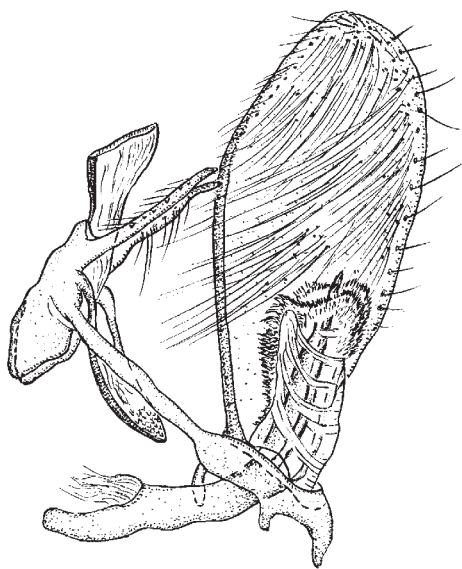


Fig. 95. Male genitalia - *Ypsolopha sylvella* (L.).

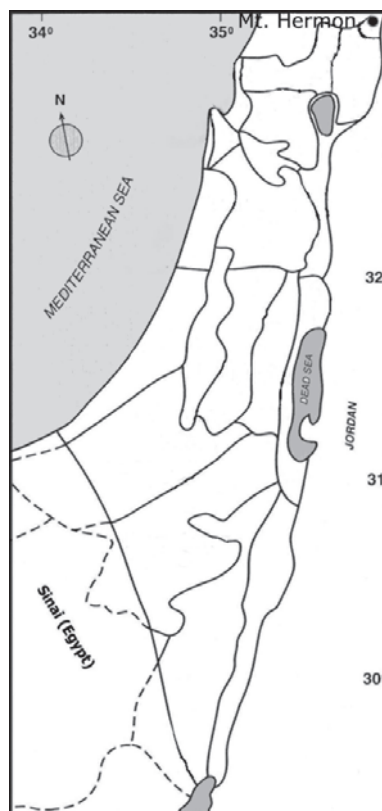


Fig. 96. Collection sites of *Ypsolopha sylvella* (L.) in Israel.

Ypsolopha dentella (Fabricius, 1775)

Alucita dentella, Fabricius 1775: 667.

Ypsolopha dentella (Fabricius, 1775), Zagulajev 1990: 490, 502, Figs. 338(2), 346(2), 356(2).

- *dentella* (Fabricius, 1775), Agassiz 1996: 40.
- *dentella* (Fabricius, 1775), Agassiz & Friese 1996: 58.
- *dentella* (Fabricius, 1775), Gershenson 1997: 438, Fig. 301 (5, 6).
- *dentella* (Fabricius, 1775), Gershenson *et al.* 2002: 78.

Description. Imago (♂ and ♀). Wingspan: 17-21 mm. Forewings apex noticeably falcate, dark brown in the upper half and yellow in the lower one (Fig. 97).

Male genitalia (Fig. 98). Valva of elongated oval shape, about 2.0 times longer than saccus. Aedeagus curved and noticeably broader than saccus. Saccus nearly as long as socius.

Remarks. This species can be easily recognized by forewing colour and male genitalia structure. Larvae trophically connected with honeysuckle (*Lonicera* sp.) (Zagulajev 1990).

General distribution. Europe (except Trans-Polar region), Siberia, Russian Far East, the Caucasus, Japan (Zagulajev 1990, Gershenson 1997), Israel.

Distribution in Israel: Ein Gedi (Fig. 99).

***Ypsolopha parenthesella* (Linnaeus, 1761)**

Phalaena Tinea parenthesella, Linnaeus 1761: 367, No. 1435.

Tinea parenthesella (Linnaeus, 1761), Fabricius 1775: 661.

Ypsolopha parenthesella (Linnaeus, 1761), Friese 1966: 454.

- *parenthesella* (Linnaeus, 1761), Moriuti 1977: 90-94, Figs. 15, 16, 233, 388, 510, 548 (see therein for more references on this species).
- *parenthesella* (Linnaeus, 1761), Zagulajev 1990: 488, 491, 492, Fig. 350 (4).
- *parenthesella* (Linnaeus, 1761), Zagulajev 1994: 263-264.
- *parenthesella* (Linnaeus, 1761), Agassiz 1996: 41.
- *parenthesella* (Linnaeus, 1761), Agassiz & Friese 1996: 59.
- *parenthesella* (Linnaeus, 1761), Gershenson *et al.* 2001: 149.

Synonyms

Alucita costella, Fabricius 1775: 668.

Tinea ochrella, Hübner 1793: Fig. 50.

Ypsolopha takamukui, Matsumura 1931: 1103, No. 2297.

Description. Imago (♂ and ♀). Wingspan: 16-20 mm. Head white or ochreous-whitish. Forewings golden-ochreous, sometimes suffused bronzy-fuscous with whitish longitudinal spot along costal margin (Fig. 100).

Male genitalia (Fig. 101). Valva elongated, length about 3.0 times the width, with pointed apex. Saccus short, nearly 4.0 times shorter than the valva. Aedeagus curved about the middle.

Remarks. Similar to the western European and eastern Mediterranean *Y. lucella* (F.), (Zagulajev 1990). It differs from the latter by not having monochromatic forewings and by the structure of male genitalia. Basal process of aedeagus in *Y. parenthesella* (L.) is not less than 5.0 times shorter than aedeagus, while in *Y. lucella* (F.) this relation is not more than 3.5 times. Larval food plants: beech (*Fagus* sp.), oak (*Quercus* sp.), elm (*Ulmus* sp.), aspen (*Populus* sp.), hornbeam (*Carpinus* sp.), and hawthorn (*Crataegus* sp.) (Zagulajev 1990, 1994).

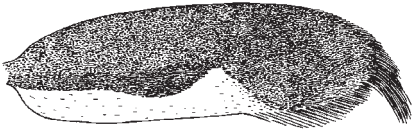


Fig. 97. Forewing - *Ypsolopha dentella* (F.).

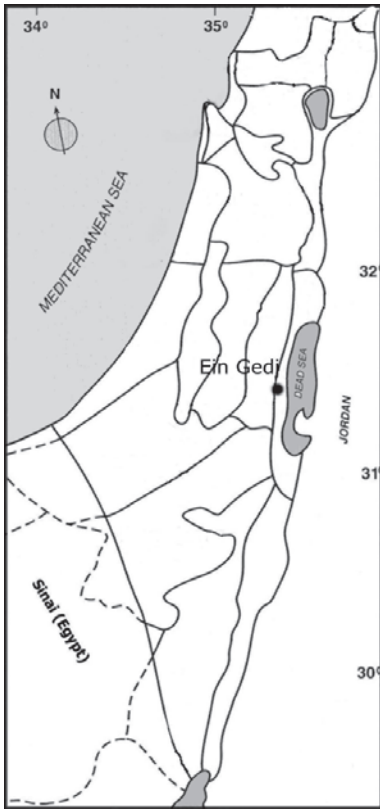


Fig. 99. Collection sites of *Ypsolopha dentella* (F.) in Israel.

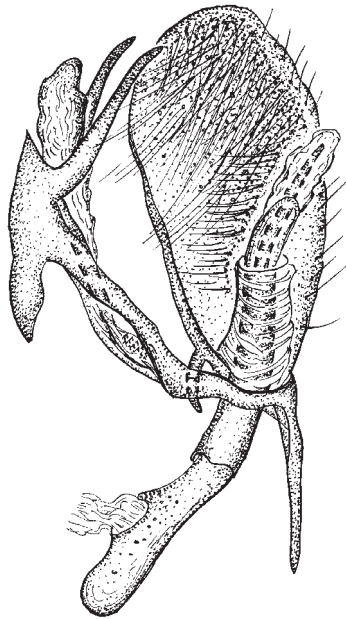


Fig. 98. Male genitalia - *Ypsolopha dentella* (F.).

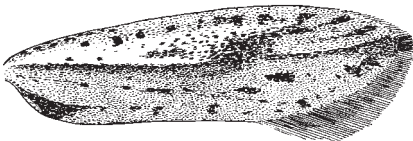


Fig. 100. Forewing - *Ypsolopha parenthesella* (L.).

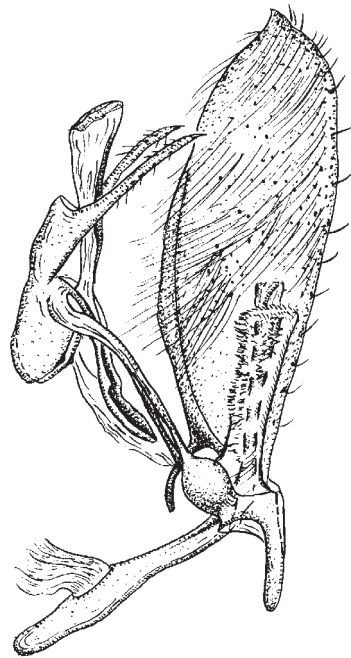


Fig. 101. Male genitalia - *Ypsolopha parenthesella* (L.).

General distribution. Western Europe (except Trans-Polar region), Caucasus, mountains of Central Asia (Zagulajev 1990, 1994), Japan (Moriuti 1977), Israel.

Distribution in Israel: Mt. Hermon, lower Cable Station at 1,400 m asl. (Fig. 102).

Ypsolopha albiramella (Mann, 1861)

Cerostoma albiramella, Mann 1861: 188, Pl. 3, Fig. 5.

Ypsolopha albiramella (Mann, 1861), Friese 1966: 452.

- *albiramella* (Mann, 1861), Zagulajev 1990: 491, 502, Figs. 346 (4), 355 (2).
- *albiramella* (Mann, 1861), Zagulajev 1994: 262.
- *albiramella* (Mann, 1861), Agassiz & Friese 1996: 59.
- *albiramella* (Mann, 1861), Gershenson & Pavlíček 2002: 128.

Description. Imago (♂ and ♀). Wingspan: 15-18 mm. Each forewing with diffuse dark triangular spot (Fig. 103).

Male Genitalia (Fig. 104). Valva oval, more than two times longer than saccus. Aedeagus stout, almost twice as wide as saccus.

Remarks. This species can be easily recognized by the abovementioned forewing pattern and male genitalia structures. Larval food plants: *Ephedra equisetina* Bunge, *E. intermedia* Schrenk ex C.A. Meyer, and *E. distachya* L. (Zagulajev 1992, 1994).

General distribution. Southern Europe, Armenia, Asia Minor, Iran (Zagulajev 1990, 1994), Israel.

Distribution in Israel: Lower Nahal Oren (= EC I) (Fig. 105).

Plutella porrectella (Linnaeus, 1758)

Phalaena Tinea porrectella, Linnaeus 1758: 540.

Plutella porrectella (Linnaeus, 1758), Schütze 1931: 96.

- *porrectella* (Linnaeus, 1758), Grandi 1951: 96.
- *porrectella* (Linnaeus, 1758), Benander 1965: 1-2.
- *porrectella* (Linnaeus, 1758), Friese 1966: 449-450.
- *porrectella* (Linnaeus, 1758), Keilbach 1966: 546.
- *porrectella* (Linnaeus, 1758), Zagulajev 1990: 506, 507, Figs. 364 (2A), 366 (7,8).
- *porrectella* (Linnaeus, 1758), Zagulajev 1994: 262.
- *porrectella* (Linnaeus, 1758), Agassiz 1996: 41.
- *porrectella* (Linnaeus, 1758), Agassiz & Friese 1996: 60.

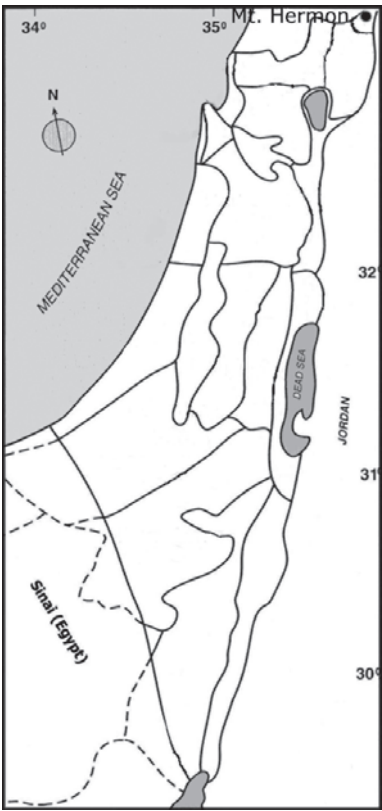


Fig. 102. Collection sites of *Ypsolopha parenthesesella* (Linnaeus, 1761) in Israel.

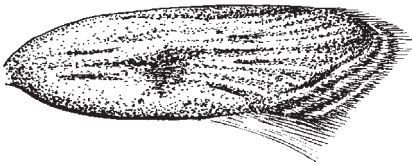


Fig. 103. Forewing - *Ypsolopha albiramella* (Mann).

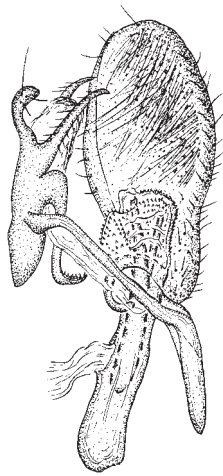


Fig. 104. Male genitalia - *Ypsolopha albiramella* (Mann).

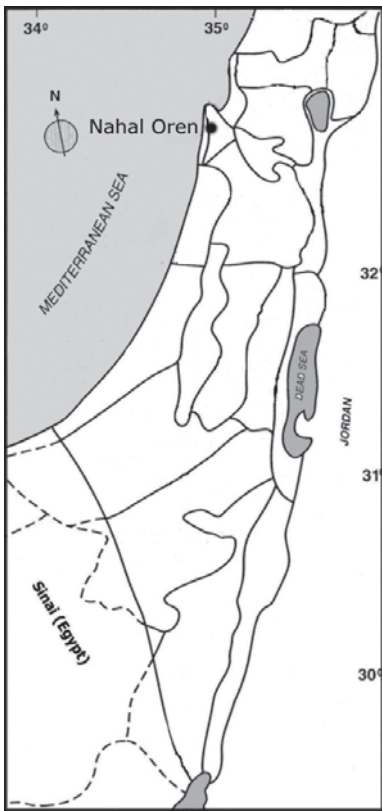


Fig. 105. Collection sites of *Ypsolopha albiramella* (Mann) in Israel.

- *porrectella* (Linnaeus, 1758), Gershenson *et al.* 2002: 79.

Synonyms

Tinea hesperidella, Hübner 1796: 169.

Description. Imago (♂ and ♀). Wingspan: 14-16 mm. Head ochreous-whitish. Forewings pale ochreous with whitish, brownish, and blackish scales and dark fuscous apex spotted black (Fig. 106a). Hindwings gray.

Male genitalia (Fig. 106b,c) Valva broad with apex forming a distinct narrow process. Saccus curved, less than two times shorter than aedeagus.

Remarks. Externally similar with *P. xylostella* (L.) from which it differs by the absence of longitudinal sinuous stripe on forewings and by the presence of apical process on valvae. Larvae are trophically connected with *Erysimum canescens* Roth., *E. cheiranthoides* L., *Cochlearia arctica* Schltld. ex DC., *Capsella bursa-pastoris* (L.), *Syrenia siliculosa* (Bieb.) Andr., *Alliaria officinalis* L., and *Hesperis matronella* L. (Zagulajev 1994).

General distribution. Europe (except Trans-Polar region), Caucasus, southern Siberia, Russian Far East (Zagulajev 1990, 1994), Israel.

Distribution in Israel. Lower Nahal Oren, N. Keziv (Fig. 107).

Plutella xylostella (Linnaeus, 1758)

Phalaena Tinea xylostella, Linnaeus 1758: 538. No. 265.

Plutella xylostella (Linnaeus, 1758), Wocke 1871: 281, No. 1626.

- *xylostella* (Linnaeus, 1758), Bradley 1966: 219.
- *xylostella* (Linnaeus, 1758), Avidov & Harpaz 1969: 403-405.
- *xylostella* (Linnaeus, 1758), Bradley & Tams 1971: 11, Pl. 1, Fig. 1.
- *xylostella* (Linnaeus, 1758), Moriuti 1977: 53-59, Figs. 1, 121, 122, 128, 173, 178, 219, 371, 504, 544.
- *xylostella* (Linnaeus, 1758), Agassiz 1996: 41.
- *xylostella* (Linnaeus, 1758), Agassiz & Fries 1996: 59.
- *xylostella* (Linnaeus, 1758), Fries 1966: 449.
- *xylostella* (Linnaeus, 1758), Zagulajev 1990: 505, 506, 507, Figs. 343 (3, 4), 363 (1), 366 (1, 2).
- *xylostella* (Linnaeus, 1758), Zagulajev 1994: 259-260.

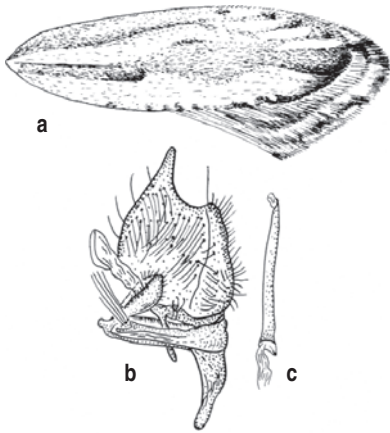


Fig. 106. Forewing and male genitalia - *Plutella porrectella* (L.): a) forewing, b) male genitalia, c) aedeagus.

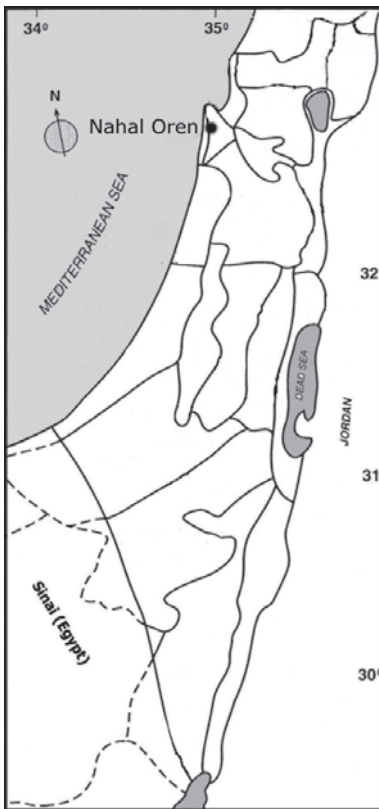


Fig. 107. Collection sites of *Plutella porrectella* (L.) in Israel.

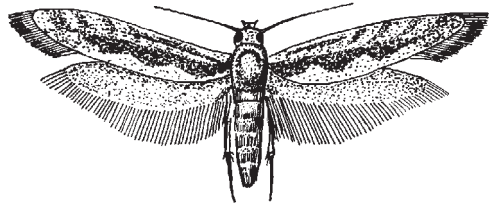


Fig. 108. Adult moth - *Plutella xylostella* (L.).
Drawing: V. Kozhevnikova.

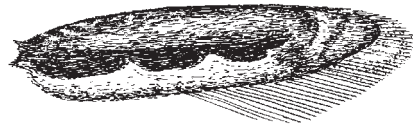


Fig. 109. Forewing - *Plutella xylostella* (L.). Drawing:
V. Kozhevnikova.

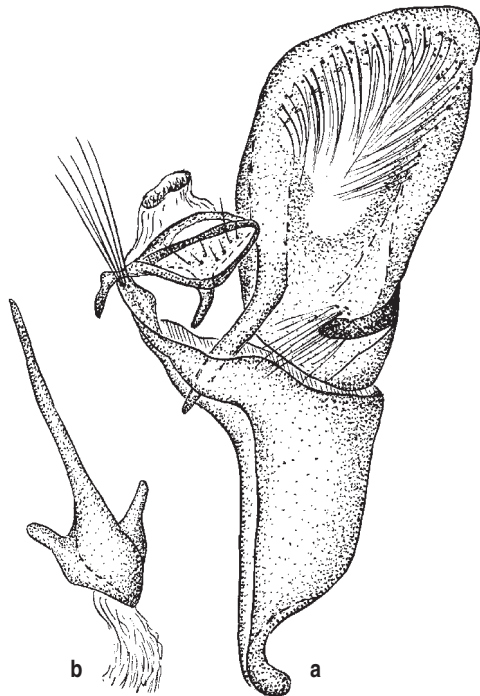


Fig. 110. Male genitalia - *Plutella xylostella* (L.): a)
lateral view without aedeagus, b) aedeagus.

Synonyms

Cerostoma maculipennis, Curtis 1832: 2, Pl. 420.

Description. Imago (♂ and ♀) (Fig. 108). Wingspan: 11-16 mm. Forewings ground-colour light fuscous, light ochreous or light gray-ochreous, sometimes sprinkled with whitish scales and small blackish dots. Forewing pattern consists of a whitish-ochreous dorsal longitudinal stripe extending from base to tornus, above edged with fuscous, beneath shading into a pale-ochreous dorsal area (Fig. 109). Anterior margin of stripe sinuate and when wings folded three distinct indentations visible. Hindwings gray with whitish gray cilia.

Male genitalia (Fig. 110). Valva in apical part covered with dense long hairs; apical narrow process is absent. Aedeagus almost as long as saccus or sometimes slightly longer.

Remarks. Can be easily determined by specific forewing pattern and abovementioned structures of male genitalia. Larvae trophically connected with cruciferous plants, particularly with cultivated cabbage mustard, cauliflower, turnip, radish sprouts as well as wild Brassicaceae such as *Capsella bursa-pastoris* (L.), *Barbarea vulgaris* R. Br., *Erysimum cheiranthoides* L., and others.

General distribution. Cosmopolitan.

Distribution in Israel: Representatives of this species occur in all landscapes including mountains, deserts, and valleys.

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11. Index to taxonomic names

(Presently valid species and genera names of Yponomeutoid moths are marked in bold, as well as the page number of species description if included in the book)

A

- Acer* sp. 70
 Acrolepiidae Heinemann, 1870 25
Alliaria officinalis L. 76
Alnus sp. 36
Alucita costella Fabricius, 1775 72
Alucita dentella Fabricius, 1775 71
Alucita dorsella Fabricius, 1794 67
Alucita vittella (Linnaeus, 1758) 67
Argyresthia brockeella (Hübner, 1810-1813) 15, 18, 30, 31, 36, 38, **39**
Argyresthia conjugella Zeller, 1839 2, 13, 15, 30, 31, **36**, 37
Argyresthia curvella (Linnaeus, 1761) 15, 27, 30, 31, **32**, 33
Argyresthia goedartella (Linnaeus, 1758) 15, 18, 29, 30, 31, **34**, 35, 39
Argyresthia Hübner, 1826 5, 29, 30
Argyresthia mendica (Haworth, 1828) 34
Argyresthia pruniella (Clerck, 1759) 5, 15, 17, 18, 27, 29, 30, 31, **32**, 33, 35
 Argyresthiidae Bruand, 1850 1, 6, 8, 13, 15, 16, 17, 18, 24, 25, 26, 29, 30
 Argyresthiinae Bruand, 1851 24
 Asteraceae 14
 Attevidae Mosher, 1916 25

B

- Barbaraea vulgaris* R. Br. 78
Betula sp. 19, 21, 36
 Betulaceae 19, 30, 39, 55
Blastotere arceuthina (Zeller, 1839) 29
Blastotere Ratzius, 1840 28, 29, 30
 Boraginaceae 14
Brassica napus L. 13
Brassica oleracea L. 13, 22

Brassica sp. 22

Brassicaceae 14, 17, 55, 78

C

- Caprifoliaceae 55
Capsella bursa-pastoris (L.) 22, 76, 78
Carpinus sp. 72
 Cedestinae Kloet et Hincks, 1945 24, 28
Cedestis farinatella (Duponchel, 1840) 6
Cedestis gysselelliella (Zeller, 1839) 6, 19, 27
Cedestis Zeller, 1839 40
 Celastraceae 55
Cerostoma albiramella Mann, 1861 74
Cerostoma dorsimaculella Kearfoot, 1907 67
Cerostoma instabilella Mann, 1866 58
Cerostoma maculipennis Curtis, 1832 78
Cerostoma trichonella Mann, 1861 63
Cochlearia arctica Schlttdl. ex DC. 76
Crataegus sp. 17, 21, 48, 64, 67, 72
 Cupressaceae 30

E

- Ephedra distachya* L. 60, 64, 74
Ephedra equisetina Bunge 60, 64, 74
Ephedra foemina Forssk. 17
Ephedra intermedia Schrenk ex C.A. Meyer 60, 64, 74
 Ericaceae 30, 55
Erysimum canescens Roth. 76
Erysimum cheiranthoides L. 76, 78
Eubyonomeutoides ribesiella (Joann.) 6
Evonymus europaeus L. 47
Evonymus sp. 21, 46, 61
Evonymus verrucosus Scop. 47

F

- Fagaceae 30, 55
Fagus sp. 68, 72

G

Glyphipterigidae Stainton, 1854 25
Grossulariaceae 30

H

Heliodinidae Heinemann & Wocke, 1876 25
Hesperis matronella L. 76
Hofmannia saxifragae (Stainton, 1868) 52

J

Juglandaceae 55

K

Kessleria fasciapennella (Stainton, 1849) 52
Kessleria Nowicki, 1864 14, 42
Kessleria saxifragae (Stainton, 1868) 15, 16,
17, 18, 40, 52, 53

L

Lantana camara L. 14
Lepidium densiflorum Schrad. 22
Lonicera sp. 17, 58, 68, 72
Lyoniidae Stainton, 1854 25

M

Malus domestica Borkh. 21, 37
Malus sp. 17, 18, 19, 32, 64, 67

N

Nygmia cognatella Hübner, 1825 46

O

Ochsenheimeriidae Heinemann, 1870 25
Ocnerostoma friesei Svensson, 1966 6, 14, 15,
18, 40, 50, 53
Ocnerostoma piniariellum Zeller, 1847 6, 52
Ocnerostoma Zeller, 1847 40, 42
Oleaceae 55

P

Parargyresthia Moriuti, 1969 29, 30
Paraswammerdamia conspersella (Tengström,
1848) 6
Paraswammerdamia Friese, 1960 5
Paraswammerdamia iranella Friese, 1960 5

Paraswammerdamia ornicbella Friese, 1960
7, 9, 14, 20

Phalaena sequella Clerck, 1759 69
Phalaena Tinea asperella Linnaeus 1761 66
Phalaena Tinea caudella Linnaeus, 1767 61
Phalaena Tinea curvella Linnaeus, 1761 32
Phalaena Tinea evonymella Linnaeus, 1758 46
Phalaena Tinea mucronella (Scopoli, 1763) 61
Phalaena Tinea parentbesella Linnaeus, 1761 72
Phalaena Tinea porrectella Linnaeus, 1758 74
Phalaena Tinea scabrella Linnaeus, 1761 64
Phalaena Tinea sylbella Linnaeus, 1767 70
Phalaena Tinea vittella Linnaeus, 1758 67
Phalaena Tinea xylostella Linnaeus, 1758 76
Phalaena viginti punctata Retzius, 1783 49
Pinaceae 30

Pinus sp. 19, 21

Pinus sylvestris L. 52

Plutella porrectella (Linnaeus, 1758) 15, 16,
17, 18, 55, 56, 59, 74, 76, 77

Plutella Schrank, 1802 55, 56

Plutella xylostella (Linnaeus, 1758) 3, 6, 8, 10,
12, 13, 14, 15, 16, 17, 18, 19, 22, 27, 54, 55,
56, 76, 77

Plutellidae Guenée, 1845 1, 8, 13, 15, 16, 18, 24,
25, 26, 28, 54, 55

Plutellinae Guenée, 1845 24, 28, 54, 55

Populus sp. 72

Praydinae Moriuti, 1977 24, 28, 54, 55

Prays citri (Millière, 1873) 3, 55

Prays fraxinella (Bjerkander, 1784) 54

Prays Hübner, 1825 55

Prays oleae (Bernard, 1788) 3, 22, 55

Prunus armeniaca L. 61

Prunus avium L. 34

Prunus cerasus L. 34, 67

Prunus domestica L. 34, 64

Prunus dulcis (Mill.) Webb. 61

Prunus padus L. 13, 21

Prunus persica (L.) Batsch. 34, 61

Prunus sp. 17, 18, 21, 32

Prunus spinosa L. 21, 34

Prunus stepposa Klok. 19

Pyrus communis L. 21, 64

Pyrus sp. 19, 67

Q

- Quercus calliprinos* Webb. 18
Quercus robur L. 47
Quercus sp. 17, 18, 36, 68, 70, 72

R

- Raphanus sativus* L. 22
Rhagoletis pomonella 12
Rhopalosiphum padi L. 13
Rosaceae 19, 30, 55, 61

S

- Salicaceae 30, 55
Salix sp. 17, 19, 21, 49, 70
Saridoscelinae Moriuti, 1977 24, 26
Saxifraga aizoides L. 52
Saxifraga grisebachii L. 52
Saxifraga hederacea (L.) 17, 52
Saxifraga oppositifolia L. 52
Saxifraga paniculata P. Mill. 52
Saxifraga spatularis Brot. 52
Scythropiinae Friese, 1966 24, 28, 54, 55
Sedum telephium L. 8, 50
Sorbus aucuparia L. 37, 64
Sorbus sp. 18
Swammerdamia pyrella (De Villers, 1789) 19, 20
Syrenia siliculosa (Bieb.) Andr. 76

T

- Taxodiaceae 55
Tberistis mucronella (Scopoli, 1763) 61
Tilia sp. 70
Tinea brockeella, Hübner 1813 39
Tinea cagnagella, Hübner 1813 44
Tinea goedartella, Linnaeus 1758 34
Tinea hesperidella Hübner, 1796 76
Tinea maurella Denis & Schiffermüller, 1775 67
Tinea ochrella Hübner, 1793 72
Tinea parenthesella (Linnaeus, 1761) 72
Tinea persicella Fabricius, 1787 60
Tinea plumbellus, Denis & Schiffermüller 1775 46
Tinea pruniella Clerck, 1759 32
Tinea pterodactylella Hübner, 1793 64
Tinea sisymbrella Denis & Schiffermüller, 1775 67
Tinea sulphurella Hübner, 1793 60

U

- Ulmaceae 30, 55
Ulmus sp. 36, 68, 72

V

- Verbenaceae 14

Y

- Yponomeuta albonigratus* Gershenson, 1972
14, 15, 16, 17, 18, 40, 42, 44, 45, **48**, 49, 51
Yponomeuta bipunctellus Matsumura, 1931
47
Yponomeuta cagnagellus (Hübner, 1813) 9,
11, 12, 13, 14, 15, 16, 18, 20, 40, 41, 42, 43, **44**
Yponomeuta cognatella Treitschke, 1832 46
Yponomeuta evonymellus (Linnaeus, 1758) 9,
12, 13, 20, 21
Yponomeuta irrorellus (Hübner, 1796) 6, 12
Yponomeuta Latreille, 1796 5, 7, 11, 12, 21, 23,
40, 41, 42, 44
Yponomeuta mabalebells Guenée, 1845 11,
20, 46
Yponomeuta malinellus Zeller, 1838 5, 6, 7, 9,
19, 20, 21, 27, 29, 41, 46
Yponomeuta meguronis Matsumura, 1931 11
Yponomeuta meridionalis Gershenson, 1972
10, 15, 16, 18, 40, 42, 44, 45, **47**
Yponomeuta orientalis Zagulajev, 1969 5, 11
Yponomeuta padellus (Linnaeus, 1758) 7, 8, 9,
12, 14, 19, 20, 21, 46, 48
Yponomeuta plumbellus (Denis &
Schiffermüller, 1775) 2, 5, 6, 12, 15, 16, 18,
40, 42, 43, 44, **46**
Yponomeuta polystigmellus C. et Felder, 1862
9, 11
Yponomeuta rhamnells Gershenson, 1974
14, 19, 20, 46
Yponomeuta rorrellus (Hübner, 1796) 5, 7, 9,
14, 19, 20, 40, 49
Yponomeuta sedellus Treitschke, 1832 2, 8, 9,
12, 20, 40, 42, 44, **49**, 51
Yponomeuta vigintipunctatus (Retzius, 1783) 49
Yponomeutidae Stephens, 1829 1, 3, 8, 13, 15,
16, 18, 23, 24, 25, 26, 40, 42
Yponomeutinae Stephens, 1829 24, 28, 29

Ypsolopha albiramella (Mann, 1861) 15, 16,
17, 18, 55, 56, 58, **74**, 75
Ypsolopha asperella (Linnaeus, 1761) 15, 16,
17, 18, 54, 55, 56, 58, **66**
Ypsolopha dentella (Fabricius, 1775) 15, 55,
56, 58, **71**, 73
Ypsolopha dorsata Fabricius, 1789 67
Ypsolopha eremella Amsel, 1933 3, 55
Ypsolopha falcella (Hübner, 1796) 58
Ypsolopha instabilella (Mann, 1866) 15, 16,
17, 18, 55, 56, **58**, 60, 62
Ypsolopha Latreille, 1796 55, 56, 57
Ypsolopha lucella (Fabricius, 1775) 72
Ypsolopha mucronella (Scopoli, 1763) 14, 15,
16, 18, 55, 56, 57, **61**, 63, 64
Ypsolopha nemorella (Linnaeus, 1758) 60
Ypsolopha nevoi Gershenson & Pavlíček, 2002
15, 16, 18, 55, 56, 57, **58**, 59
Ypsolopha parenthesella (Linnaeus, 1761) 15,
54, 55, 57, 64, **72**, 73, 75
Ypsolopha persicella (Fabricius, 1787) 15, 18,
55, 57, 58, **60**, 62

Ypsolopha scabrella (Linnaeus, 1761) 14, 15,
54, 57, 58, **64**, 65
Ypsolopha sculpturella (Herrich-Schäffer, 1854)
3, 55
Ypsolopha sequella (Clerck, 1759) 14, 15, 55,
56, 57, 67, 69, 70
Ypsolopha sylvella (Linnaeus, 1767) 15, 27, 55,
57, **70**, 71
Ypsolopha takamukui Matsumura, 1931 72
Ypsolopha trichonella (Mann, 1861) 15, 16,
17, 18, 55, 56, 57, **63**, 65
Ypsolopha unguiculata Fabricius, 1798 67
Ypsolopha ustella (Clerck, 1759) 59
Ypsolopha vittella (Linnaeus, 1758) 15, 16, 18,
55, 57, **67**, 68
Ypsolophidae 1
Ypsolophinae Guenée, 1845 24, 28, 54, 55
Ypsolophus Fabricius, 1798 56

Z

Zelleria saxifragae Stainton, 1868 52

Plates

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Plate 1



a) *Yponomeuta meridionalis* Gershenson, 1972



b) *Ypsolopha asperella* (Linnaeus, 1761)



c) *Yponomeuta plumbellus* Denis & Schiffermüller 1775



d) *Ypsolopha vittella* (Linnaeus, 1758)



e) *Yponomeuta albonigratus* Gershenson, 1972



f) *Ypsolopha sequella* (Clerck, 1759). Photo: T. Pavlíček

