Notes on the larval ecology of *Hypena munitalis* Mann, 1861, *Eutelia adoratrix* (Staudinger, 1892) (Lepidoptera, Noctuoidea, Noctuidae) and *Acantholipes regularis* (Hübner, [1813]) (Noctuoidea, Erebidae) in Samos (Greece)

Wolfgang Wagner and Dieter Fritsch

Dr. Wolfgang Wagner, Baseler Strasse 6, D-70619 Stuttgart, Germany; wolfgang@pyrgus.de, www.pyrgus.de
Dieter Fritsch, Josef-Pfeffer-Weg 9, D-79540 Lörrach, Germany; dfritsch@vfritsch.de

Abstract: In the East Aegean island of Samos, larvae of *Hypena munitalis, Eutelia adoratrix* and *Acantholipes regularis* have been recorded in the field. They are figured apparently for the first time and observations on their ecology are given. *Hypena munitalis* larvae could be detected on *Vincetoxicum canescens* (Willd.) Decne (Apocynaceae) in rocky pastures on Mount Kerkis. They differ from other *Hypena* in their yellow-black warning colour. In Samos, *Eutelia adoratrix* lives probably exclusively on *Rhus coriaria* L. (Anacardiaceae) while *Acantholipes regularis* is linked with *Glycorrhiza glabra* L. (Fabaceae) in coastal marshes according to present knowledge.

Beobachtungen zur Larvalökologie von *Hypena munitalis* Mann, 1861, *Eutelia adoratrix* (Staudinger, 1892) (Lepidoptera, Noctuoidea, Noctuidae) und *Acantholipes regularis* (Hübner, [1813]) (Noctuoidea, Erebidae) auf der griechischen Insel Samos

Zusammenfassung: Auf der ostägaischen Insel Samos wurden Raupen von *Hypena munitalis, Eutelia adoratrix* und *Acantholipes regularis* im Freiland gefunden. Sie werden in vorliegender Arbeit offenkundig zum ersten Mal abgebildet. Zudem werden Beobachtungen zur Ökologie angeführt. *Hypena munitalis*-Raupen wurden an *Vincetoxicum canescens* (Willd.) Decne (Apocynaceae) in felsigen Ziegenweiden am Berg Kerkis gefunden. Sie unterscheiden sich von anderen *Hypena* durch ihre gelbschwarze Warnfarbe. *Eutelia adoratrix* lebt im Freiland auf Samos wahrscheinlich ausschließlich an *Rhus coriaria* L. (Anacardiaceae), während *Acantholipes regularis* nach bisheriger Kenntnis an *Glycorrhiza glabra* L. (Fabaceae) in eher feuchten Küstenbereichen gebunden ist.

Introduction

Hypena munitalis Mann, 1861, *Eutelia adoratrix* (Staudinger, 1892) and *Acantholipes regularis* (Hübner, [1813]) show a southeastern distribution in Europe. While the first two species are generally found very locally in the Balkan Peninsula, in some eastern Aegean Islands and from S-Ukraine eastward, *A. regularis* is obviously restricted to the latter regions in Europe (plus Crete). Outside of Europe all three species are distributed from Asia Minor to at least Western Asia (e.g. the Levant, Caucasus region, N-Iran), *A. regularis* also in parts of Africa. Both larval ecology and the larvae themselves are still very poorly known and are not included e.g. in Beck (1999, 2000).

Hypena munitalis is mainly a species (according to records of adult moths) of dry and often rocky pastures and very sparse, open, dry woodlands in mountainous areas. According to Hacker (1989), Pinker reared the larva ex ovo with *Stellaria* (Caryophyllaceae), but so far no photo has been published. Fibiger et al. (2010) mention *Vincetoxicum* without citing a source. According to Meyer (1919: 100) the larvae have been found gregariously on *Vincetoxicum tmoleum* in Lydia (nowadays Western Anatolia): "gesellig von Lederer in Lydien gefunden (*V. tmoleum*)".

Eutelia adoratrix inhabits dry and hot bushy areas like maquis, edges of garrigues, bushy slopes or road side verges. It was supposed that its larva should feed on *Pistacia* species (Anacardiaceae) like its congener *Eutelia adulatrix* (Hübner, [1813]). This was confirmed by a publication (Wagner 1925) for Dalmatia. But it was so far not possible to find a single larva on *Pistacia* (own observations, Fritsch et al. 2014) in Samos Island. In late April 2015, during an excursion with the second author, the first author had the idea that *E. adoratrix* could develop on the deciduous *Rhus coriaria* which is locally common in Samos Island. But beating the plants, the buds of which just had burst, was not successful at that early time whereas the young larvae of *E. adulatrix* were common on *Pistacia* simultaneously.

Acantholipes regularis is possibly a species of coastal marshes or other not too dry areas in Samos Island most often close to the coast. It can still live in fairly cultivated areas like olive groves on former marsh land or even gardens provided that there are seldom mown margins. In Samos Island it is so far only known between Ireon and the airport (Fritsch et al. 2014). Apart from hints to *Glycorrhiza glabra* as hostplant (e.g. Meyer 1919, Goater et al. 2003) little is known about the larva. It has obviously never been illustrated so far, too.

The very rich moth fauna of Samos is relatively well known, especially thanks to the paper of Fritsch et al. (2014). Thus it is often possible to search for so far unknown larvae in the more or less well-known habitats of the adult moths.

Material and methods

The first author has spent a week of field research in Samos Island in late June and early July 2016 where he found larvae of all three species in the field. *Hypena munitalis* larvae could be detected (some 40 larvae) by visual investigation of *Vincetoxicum* plants on Mount Kerkis in western Samos. From earlier excursions the first author remembered large stands of *Vincetoxicum* on Mount Kerkis. *Eutelia adoratrix* larvae (some 20) have been beaten from *Rhus* in several parts of the island

(e.g. Moni Vronda, Stavrinides, Psili Ammos, Mitilini, Spatharei). *Acantholipes regularis* larvae (9 larvae) have been beaten from *Glycorrhiza glabra* near Ireon.

All larvae have been reared to imago. While *H. munitalis* already pupated during the stay in Samos or shortly after, *E. adoratrix* have been fed with *Rhus typica* in confinement. *A. regularis* refused any other plant (*Lotus, Onobrychis* etc., all Fabaceae) and could only been fed with *Glycorrhiza* from the refrigator. Thus only two moths emerged in this species.

The second author has beaten some 25 larvae of *E. adoratrix* already in late May 2016 from *Rhus coriaria* in several parts of Samos which was not known by the first author until July. He also found no *E. adulatrix* on *Rhus*.

Results

Hostplants and larval habitats in Samos

Hypena munitalis larvae could be observed on *Vincetoxicum canescens* between 900 and 1250 m above sea level on Mount Kerkis (below and above Profitis Elias chapel). The lowest larval habitats had been located in a mix of open, stony or rocky open patches and *Quercus coccifera* (Fagaceae) scrub. Below 900 m the first author has seen no *Vincetoxicum* plant there. Other larval habitats included open, rocky and sparse pastures and a kind of spiny *Astragalus* (Fabaceae) phrygana (Figs. 7–8). *Vincetoxicum* was very abundant there. But above approximately 1250 m *Vincetoxicum* stopped with abrupt transition. The larvae (1–8 per plant, most often 2–3, all instars from L_2 to mature) generally preferred the upper side of leaves for resting, but a few also the lower side or the stem near the ground, perhaps according to sun heat. When disturbed, they bounce up suddenly, fall in the litter on the ground of the plants and fidget around typically for *Hypena*-larvae if further molested.

Eutelia adoratrix has been recorded on *Rhus coriaria* only. This bush has the ability to spread via root suckers and thus can easily cover large areas, especially in disturbed places, after fire, on "rolling slopes" or on abandoned fields. Smaller stands occur in maquis, open woodland, road side verges (Fig. 15) or between fields. It is general quite local in Samos, but can regionally be abundant. It seems to be pushed back more and more by agriculture in some places. Larger stands (which were rare) almost always hosted some larvae. The first author usually recorded only one larva per bush, whereas the second author reports groups of larvae (from small larvae to adult ones). At the same time many bushes of *Pistacia terebinthus* and *Pistacia lentiscus* L. (hostplants of *E. adulatrix* in Samos) were beaten, but not a single larva could be found.

Acantholipes regularis has been recorded in a large coastal marsh between Ireon and the airport (southern coast of Samos) that is more and more interspersed with agricultural fields (olives, cereals, fruits etc.). But there are still large reed stands, meadows and ditches with more or less natural vegetation. In winter and spring these areas are usually very wet or even partially inundated, but can be very desiccated in summer. In this area *Glycorrhiza glabra* especially grows along ditches, in sparse reed, on only seldom mown grasslands and even in extensively used olive groves and fields. Larvae could be recorded singly in all these types of habitat (Fig. 22). Outside this last large wetland of the island the hostplant also occurs in quite dry places (e.g. near Votsalakia at the SW coast, Marathokampos, Kokkari, Drosia). These places are not yet examined during larval time. So it is possible that the species also occurs in small populations in other places of the island, too.

Life cycles

The hibernation stage of *Hypena munitalis* is not yet determined satisfactorily. In early April 2011 a pupa has been found in the field during a collecting trip of the second author and Günter Stangelmaier in the Ampelos mountains at approximately 1000 m. The moth hatched on 20. iv. 2011. Thus hibernation likely occurs in pupal stage.

The first author recorded larvae in late June and early July. In Fritsch et. al. (2014) moth records are restricted in the field to the months of June and July. According to the pupal record the species should start flying already in (mid-)May. Most of the July records should refer to the new generation resulting from larvae in late May and June. Taking into account that many pupae released the moths within two weaks in rearing, that *Vincetoxicum* is driving out relatively late in spring (fully developed leaves at 1000 m not before May, own observations) and that leaves get very hard in late summer, it is probable that the species has two overlapping generations (the second probably only partial) per year with larvae presumably between late May/June and early or mid-August (peak probably between mid-June and mid-July). Further field research is needed to verify these assumptions. Pupal (Fig. 5) stage is short in early summer (rearing: 10–15 days at room temperature) provided that no dormancy is involved.

Eutelia adoratrix hibernates like its congener *E. adulatrix* in pupal stage (Fig. 13). The adults (Fig. 14) start flying much later in the spring (usually not before mid-May, see Fritsch et al. (2014, *E. adulatrix*: from March or early April onward). The larval records from late May to early July 2016 correspond well with this phenology. In rearing the majority of moths hatched without hibernation (only 5 pupae of the first author's 15 pupae went into diapause, 4 out of 9 of the second author's pupae). Thus a partial second generation of moths should appear especially in July. The resulting larvae should occur in late July and August but have not yet been recorded in the field.

Acantholipes regularis larvae have been found in late June and early July (most small, some half-grown). This species apparently hibernates as pupa, too (Fig. 20). The two moths (Fig. 21) developed without diapause.

There is a large lack in field records in this species, but we guess that it should have two or three generations per year with moths in May and June, July and August and possibly again in September/October. But this will depend on summer drought and the availability of fresh shoots (only one generation in dry environments?).

Description of larvae

Fully-grown larvae (Figs. 2–3) of *Hypena munitalis* show a bright yellow primary colour. They bear large black pinacula (much larger than in the other European *Hypena*) which are usually coronated a bit lighter (whitish-yellow) than the primary colour. These black pinacula also appear on head (Fig 4) and prothoracic shield. Apart from the pinacula the head shows the primary colour, only sometimes slightly darker. The dorsal line is irregular confined, grayish-green. Another, broader and even more irregular grayish-green shade runs through the region of the subdorsal lines and below. Younger larvae (Fig. 1) are very similar to older ones.

Larvae of *Eutelia adoratrix* (Figs. 9–11) are very similar to their congener *E. adulatrix*. They are usually light green with two white subdorsal lines. The body is speckled with small, irregular shaped spots. The spiracles are orange to reddish, the head whitish green. *E. adoratrix* is often less yellowish green than its congener, but more bluish green. But this is not the case in all larvae. Presumably the only major difference can be found on the prothoracic shield. The white subdorsal lines vanish or at least become blurred in the second half of the shield in all *E. adoratrix*, but run distinctly (and then most often change to yellow) to the front of the shield in *E. adulatrix* (Fig. 12) where they seem to be connected by a yellow, strengthened belt. In *E. adulatrix* rarely also a pinkish form is reported (only in rearing?) that was not observed in *E. adoratrix* so far.

Acantholipes regularis larvae (Figs. 17–18) bear a yellowish brown to creamy primary colour with many undulating longitudinal stripes of more or less pinkish colour. These stripes are concentrated in the dorsal zone in two quasi-subdorsal lines each consisting of two thinner outer lines and a broader belt, all bordered by lighter creamy colour. Another, similar concentration is found in the spiracular zone. Pinacula are small and dark. Spiracles yellowish to creamy, bordered black, coronated with white. The head (Fig. 19) is yellowish-creamy and also bears pinkish brown stripes one of which runs through frons and clypeus. Younger larvae (Fig. 16) are striped more simple and evenly.

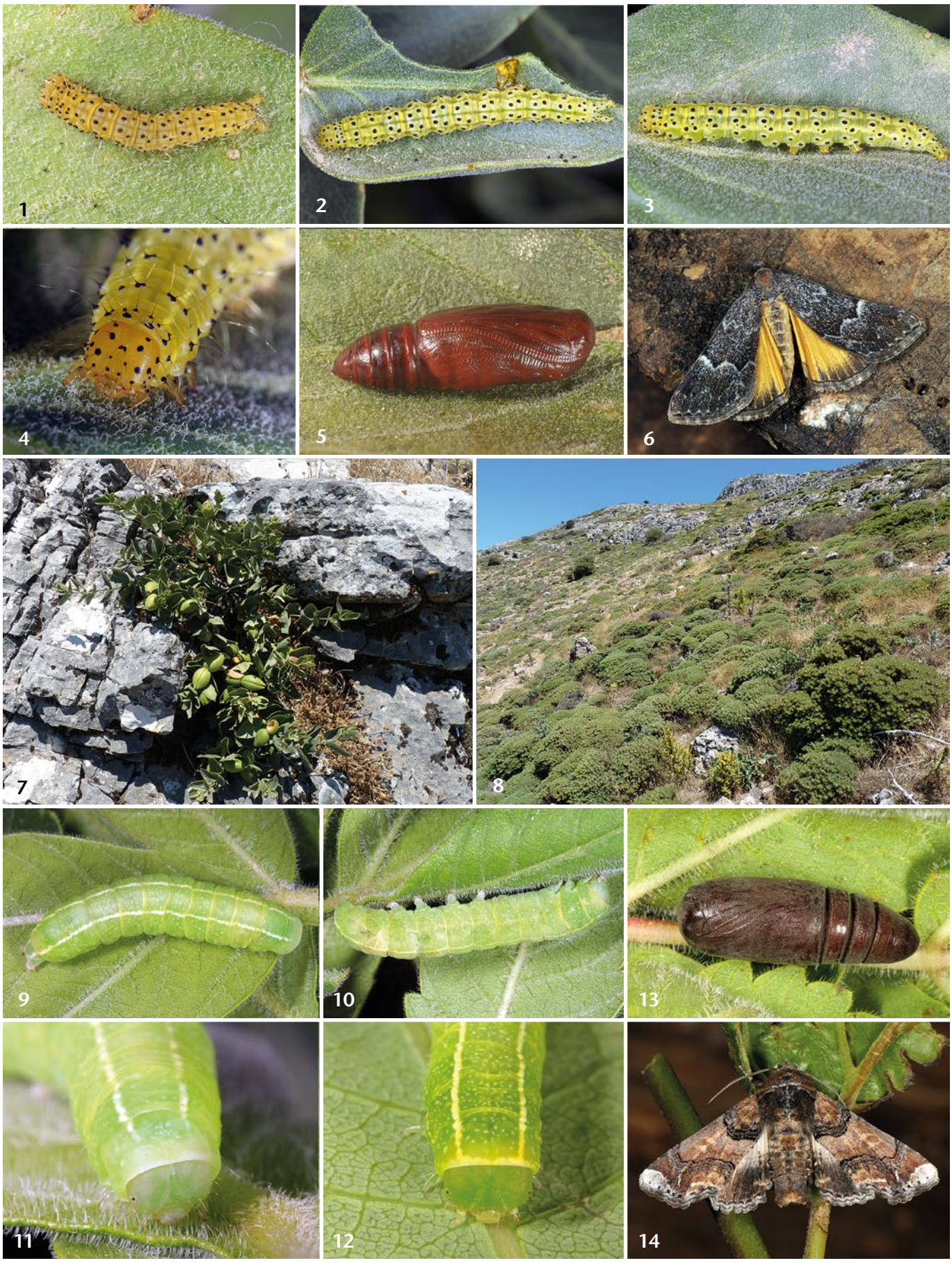
Discussion

Larval habitats of *Hypena munitalis* are obviously restricted to the two higher mountain ranges in Samos (Kerkis and Karvouni/Ampelos). Single moth records in other regions and altitudes can be explained with dispersing individuals. At least is there no hint so far that the species could use other hostplants (e.g. other *Vincetoxicum* or related taxa) in this island. But this cannot be ruled out and needs further research. *Vincetoxicum canescens* is a mountain species that occurs on both Kerkis and Karvouni (Duell & Kalheber 2011) between 900 and 1250 resp. 1100 m (occasionally even lower, e.g. Ampelos above Moni Vronda). It is possible that *Vincetoxicum canescens* locally descends further, e.g. in gorges. On Karvouni the population is supposedly smaller than on Kerkis where larvae were quite abundant. If the first author had searched more thoroughly, he surely would have found hundreds of larvae there. *Hypena munitalis* also settles especially in dry and hot (in summer) mountain regions elsewhere within its total distribution, e.g. in Bulgaria (S-Pirin) or mainland Greece (e.g. Mount Olympus, Tymfristos) where possibly other *Vincetoxicum* species are used as hostplants. *Vincetoxicum canescens* occurs from the eastern Aegean islands across Anatolia, the Near and Middle East far into Asia (e.g. the Himalayas) and should be an important hostplant wherever the ranges coincide. Other species of *Vincetoxicum* (e.g. *V. tmoleum*) are surely relevant as well (Meyer 1919). *Stellaria* which belongs to a different family is most probably nothing more than a foodplant in rearing.

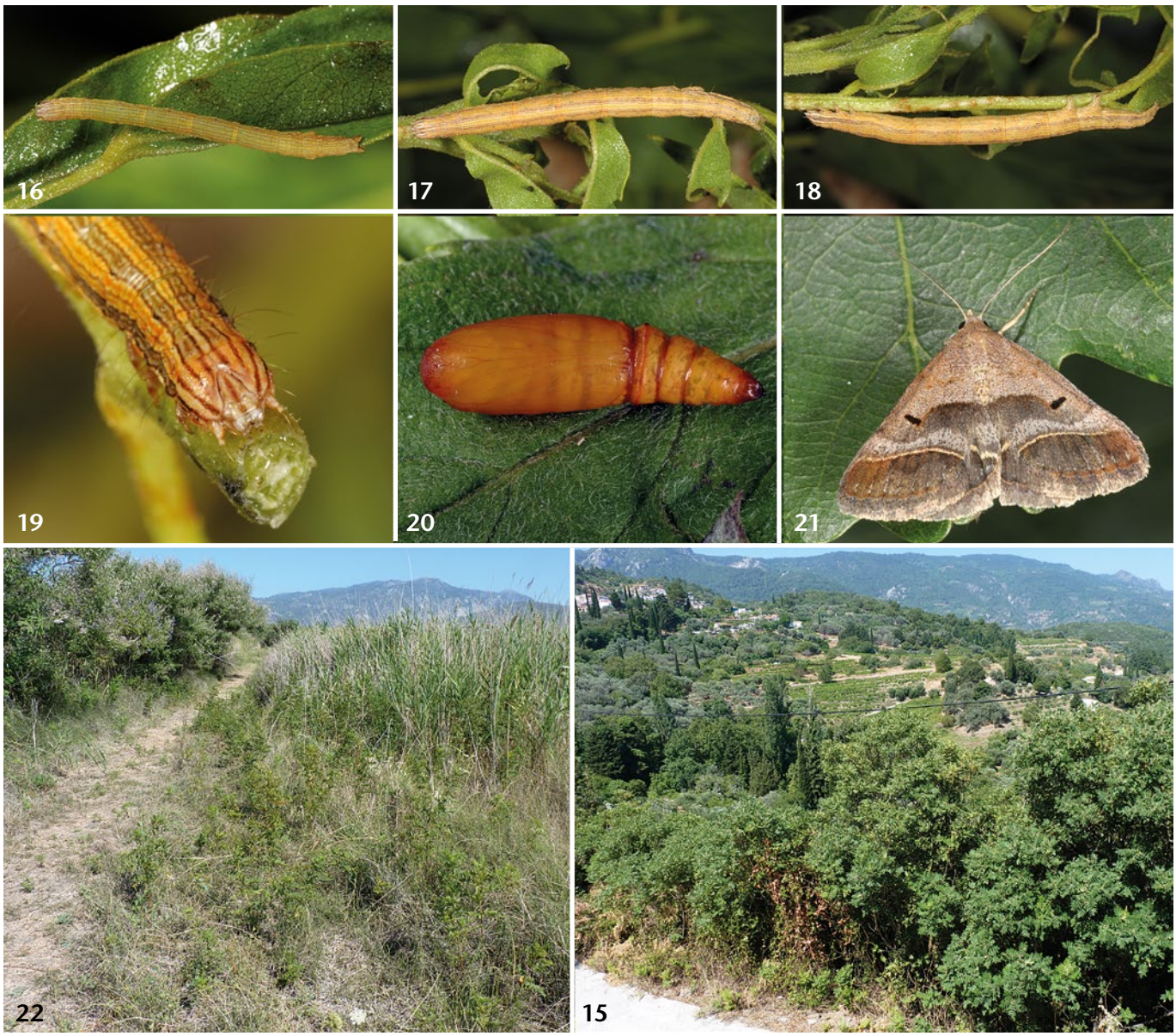
The strongly deviating (compared with other European *Hypena*) yellow-black warning colour can be explained with the poison of the hostplant *Vincetoxicum*. The same applies for the genus *Abrostola* Ochsenheimer, 1816 (Noctuidae, Plusiinae), where the larvae of most species show protective mimicry. But the "*Vincetoxicum*-species" *Abrostola asclepiadis* (Denis & Schiffermüller, 1775), however, shows a yellow-white-black warning colour. Probably even the in the genus *Hypena* Schrank, 1802 quite unusual yellowish hind wing colour (Fig. 6) can also be interpreted as warning colour. *Hypena opulenta* (Christoph, 1877) (e.g. Asia Minor, S-Ukraine) shows the same yellowish hind wing colour. It is thus probable (but to be proved in the field) that this species also lives on *Vincetoxicum* (or another poisonous species).

In Samos *Eutelia adoratrix* seems to be restricted to *Rhus coriaria* in the field. Though *Pistacia* (especially *Pistacia terebinthus*) has been beaten very often at several times of the year only larvae of *E. adulatrix* could be recorded on these plants. But it is still not sure, however not probable, that *E. adulatrix* also uses *Rhus*. So far no larva could be recorded anyway. With *Rhus, E. adoratrix* shows a scattered distribution in Samos with strongholds near the northern coast between Kokkari across Moni Vronda, Vourliotes and Ydroussa to Karlovassi. In other parts of the island often only small and more local albeit not really rare habitats are known, so for example near Pagondas or Mitilini. *Rhus* and also *E. adoratrix* generally ascend higher to the mountains (up to approx. 1000 m) than *E. adulatrix* (up to 540 m according to second author) and *Pistacia*.

Rhus coriaria is generally native from parts of S-, SE-Europe across W-Asia (e.g. Asia Minor, Levante)



Figs. 1–8: ***Hypena munitalis*****,** Samos, Mount Kerkis, 900–1250 m, larvae 29. VI. 2016. — **Fig. 1:** Half-grown larva. **Fig. 2:** Fully-grown larva, dorsal view. **Fig. 3:** Fully-grown larva, lateral view. **Fig. 4:** Fully-grown larva, head. **Fig. 5:** Pupa, e.l. rearing, cocoon removed. **Fig. 6:** Imago, e.l. rearing. **Fig. 7:** Larval habitat: rocky pasture with *Vincetoxicum canescens*. **Fig. 8:** Larval habitat: *Astragalus*-rich mountain slopes with much *Vincetoxicum*. — **Figs. 9–11, 13–15:** ***Eutelia adoratrix*****,** Samos, Vourliotes, 360 m, larva 30. VI. 2016. — **Fig. 9:** Fully-grown larva, dorsal view. **Fig. 10:** Fully-grown larva, lateral view. **Fig. 11:** Fully-grown larva, had and prothoracic shield. — **Fig. 12:** *Eutelia* ***adulatrix:*** head and prothoracic shield for comparison (larva Greece, Mount Olympus, late VII. 2012). — **Fig. 13:** *Eutelia* ***adoratrix*****,** pupa, e.l. rearing, cocoon removed. **Fig. 14:** Imago, e.l. rearing.



Figs. 16–21: ***Acantholipes regularis*****,** Samos, E of Ireon, young larvae in early VII.2016. — **Fig. 16:** Half-grown larva, e.l. rearing. **Fig. 17:** Fully-grown larva, dorsal view, e.l. rearing. **Fig. 18:** Fully-grown larva, lateral view, e.l. rearing. **Fig. 19:** Fully-grown larva, head, e.l. rearing. **Fig. 20:** Pupa, e.l. rearing, cocoon removed. **Fig. 21:** Imago, e.l. rearing. **Fig. 22:** ***Acantholipes regularis*****,** larval habitat with *Glycorrhiza glabra*. — **Fig. 15:** ***Eutelia adoratrix*****,** larval habitat with *Rhus coriaria*. — All photos by first author, material from Samos, all photos (if not indicated as e.l. = ex larva rearing) taken in the field.

to Central Asia. It has been introduced to many other regions. The first author knows some other habitats of *E. adoratrix*, e.g. in SW-Bulgaria near Melnik. In these hot slopes *Rhus coriaria* locally forms large stands. In late July 2015 the first author recorded *Eutelia* larvae on *Rhus* and *Pistacia* (thus perhaps both *Eutelia* species) there, but a too hot car unfortunately prevented further rearing. *Rhus coriaria* also occurs in lower parts of Mount Olympus (e.g. Leptokarya) near the coast where *Eutelia adoratrix* also occurs. Thus it is quite possible that *R. coriaria* is at least the most important hostplant in Europe. But further field research is necessary. According to a publication from the 1920s (Wagner 1925), larvae of *E. adoratrix* have been recorded on *Pistacia terebinthus* (and singly also *P. lentiscus*) in Dalmatia (Croatia) and could be reared to moths. *Rhus coriaria* also occurs in parts of Dalmatia. Thus it is not clear yet if there are local specializations. The very short description of the larva in Wagner (1925) is not useful for distinguishing the species. Judging from this paper the univoltinism is much stricter in Dalmatia than in Samos.

Acantholipes regularis seems to be restricted to coastal habitats in Samos, but has to be checked in other places where the hostplant occurs. This species is known only from the coastal wetland of Ireon so far. But it is also found in other islands of the East Aegean, e.g. Kalymnos. Because there are no noteworthy wetlands on this island (own observations) the moths probably reproduce also in other types of habitat provided the hostplant is available, e.g. olive groves. As the habitat in Samos is endangered by agriculture (many former parts are now destroyed by drainage and cultivation), airport construction and partly also tourism, the species must also be regarded as endangered. The very important wetland of Ireon should be preserved at all costs at least in its present-day dimension.

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