

زیست‌شناسی و بوم‌شناسی جنس *Zygaena* Fabricius, 1775 در ایران (Lepidoptera: Zygaenidae)

نگارش

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چکیده

تا دهه ۱۹۷۰ دانش موجود درباره زیست‌شناسی و بوم‌شناسی گونه‌های متعلق به جنس *Zygaena* Fabricius, 1775 در ایران بسیار اندک بود. از آن پس مطالعات صحرایی گسترده‌ای توسط Racheli, Naumann, Ebert و Tremewan به عمل آمد. برخی از مطالعات انجام شده به توسط این پژوهشگران در منابع مختلف به چاپ رسیده است. در این مقاله خلاصه‌ای از یافته‌های مربوط به زیست‌شناسی و بوم‌شناسی به همراه منابع و مآخذ مهم، به عنوان پایه‌ای برای پژوهش‌های بعدی، ارائه می‌شود.

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**The biology and ecology of *Zygaena* Fabricius, 1775
(Lepidoptera: Zygaenidae) in Iran**

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Introduction

Very little was known about the biology and ecology of the Iranian species of *Zygaena* Fabricius, 1775, until the 1970s, when extensive field work was carried out in the region, notably by G. Ebert, C. M. Naumann, T. Racheli and W. G. Tremewan. Although some of the observations made by these workers have been recorded elsewhere, it was thought that a summary of the biological and ecological information, and a list of relevant references, might serve as a useful basis for further research. A monograph dealing with the systematics and distribution of the Iranian species and subspecies of *Zygaena* is being published elsewhere (Naumann & Tremewan, in press).

***Zygaena (Mesembrynus) seitzi* Reiss, 1938**

Z. (M.) seitzi is endemic to the central and southern Zagros mountains where it is represented by two subspecies: *Z. s. nocturna* Ebert, 1974, and *Z. s. seitzi* Reiss, 1938.

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Biology

Larva. Wiltshire (1952: 176, pl., fig. 5) describes the fully grown larva as green, with a series of pale yellow medio-dorsal spots, the black dorsal spots large, diffuse.

Host-plant: *Cachrys ferulacea* (L.) Calestani (*Prangos ferulacea* (L.) Lindley) (Apiaceae). Racheli & Naumann (1979: 54) erroneously considered the larva to feed also on a species of *Astragalus*, because Racheli had observed females ovipositing on this plant; however, it is well known that many species of *Zygaena* regularly oviposit on plants other than the larval host-plant. A single fully grown larva was found on *Eryngium billardieri* Delar. near Sepidan [formerly known as Ardakan] (Prov. Fars) on May 28, 1994 (CN) and was described as follows: light green throughout, with insignificant yellowish markings dorsally and laterally; black dorsal, subdorsal and lateral spots absent, yellow spots absent, but with a whitish green subdorsal line; peritreme of spiracles black. This larva formed a cocoon after four weeks without feeding. A male moth emerged on July 12, 1994.

Cocoon. Bluntly fusiform, white-grey (Wiltshire, 1952: 177).

Ecology

Inhabits dry slopes and hillsides at 2200-2250m. The adults of subsp. *seitzi* are usually found singly and fly with a slow, steady flight (Wiltshire, 1952: 177; Tremewan, 1975: 234), but they will fly off swiftly if disturbed. In contrast, Racheli found them in numbers during the late afternoon when pairs in copula were observed resting inside *Astragalus* bushes (Racheli & Naumann, 1979: 54); in this situation females were ovipositing, while males were seen buzzing around the bushes and searching for them. The species is also nocturnal as the original series of males of subsp. *nocturna* was captured at light (Ebert, 1974: 166-167). The latter subspecies has also been observed flying by day in the type-locality where the adults were attracted to the flowers of a *Thymus* sp. (CMN & WGT). The habitat where a single larva was found near Sepidan (see above) is a steep dry slope with sparse vegetation, *Eryngium billardieri* being common, but *Prangos* being absent.

Zygaena (Mesembrynus) rubricollis Hampson, 1900

In Iran, *Z. (M.) rubricollis* is represented by subspp. *fredi* Reiss, 1938, *escaleraiana* Holik, 1958, *qashqai* Tremewan, 1975, *askarii* Tremewan, 1975, *kermanensis* Tremewan,

1975, and *taftanica* Reiss, 1960.

Biology

Ovum. Pale yellowish cream. Deposited in small batches, consisting of single layers, on the underside of a leaf of the larval host-plant, *Eryngium billardieri* Delar. (Apiaceae); in all cases the plants were in the rosette stage and would therefore continue to grow into the following year, thereby providing food for the larvae after they had broken diapause in the spring (Tremewan, 1975: 237).

Holik (1938a: 390, pl. 9, figs. 8,10; 1953: 189) appears to be the first to publish information on the biology of this species when he described a larva (preserved in alcohol) that Rjabov had collected at Ordubad, Nakhichevan. The early stages were subsequently described by Tremewan (1975: 237-239) who reared adults from ova and early instar larvae collected on the Gardaneh-ye Kowli Kosh, N. of Deh Bid, Fars, in June 1971. *Eryngium billardieri* grows on the Gardaneh-ye Khaneh Sorkh and is considered to be the host-plant of the larva (Tremewan, 1975: 241).

The full-grown Larva (Tremewan, 1975: 238, pl. 6, fig. 3) varies from light grey to grey, a narrow, whitish medio-dorsal line, anterior black dorsal spots large, posterior dorsal spots small, a series of pale yellow spots below, dorsal and subdorsal verrucae dark grey, setae longer than those of the larva of *Z. (M.) manlia*.

Pupa and cocoon. Pupa shiny, brown or blackish brown, abdomen lighter. Cocoon (Tremewan, 1975: 239, pl. 6, fig. 4) bluntly fusiform, surface parchment-like, irregularly wrinkled, with a weak sheen, varying in colour from white to cream or light brown. The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Inhabits *Artemisia/Stipa* steppe and dry mountain slopes at elevations of 2100-2260 m. where the larval host-plant, *Eryngium billardieri*, occurs. The adult has a strong, fast flight and nectars at the flowers of *Astragalus cephalanthus* DC. (Fabaceae); occasionally it can be found at rest on the underside of a leaf of *Eryngium*. In contrast to the adult, the larva is very lethargic. Adults were observed nectaring at a pink-flowered scabious, *Pterocephalus plumosus* (L.) Coulter (Dipsacaceae), the common *Marrubium*

parviflorum Fisch. & Mey. (*crassidens* Boiss.) (Lamiaceae) an unidentified purple-flowered species of Lamiaceae and the pink flowers of an *Acantholimon* sp. (Plumbaginaceae) Tremewan, 1975: 241).

Zygaena (Mesembrynus) manlia Lederer, 1870

In Iran, *Z. (M.) manlia* is represented by subspp. *Isfahanica* Tremewan, 1975, *aisha* Naumann & Naumann, 1980, *belutschistani* Koch, 1941, *manlia* Lederer, 1870, and *turkmenica* Reiss, 1933.

Biology

Ovum. Greenish white, with one pole transparent, becoming dull grey just prior to hatching. Deposited in a batch consisting of several layers on the underside of a leaf of the larval host-plant, *Eryngium billardieri* Delar. (Apiaceae); the plant was not in flower but in the rosette stage and would therefore have continued to grow into the following year, thereby providing food for the larvae after diapause in the spring (Tremewan, 1975: 243, pl. 6, fig. 6).

Larva. The fully grown larva is dark bluish grey or bluish black, intersegmental areas bluish grey, medio-dorsal line narrow, whitish grey; anterior and posterior black dorsal spots large, inconspicuous, a series of conspicuous yellow spots below. Larvae were reared in captivity on *Eryngium campestre* L. and *E. maritimum* L. over a period of two or more years, diapause therefore occurring more than once (Tremewan, 1975: 243-244, pl. figs 7,8).

Pupa and cocoon. Pupa shiny, dark blackish brown, abdomen lighter. Cocoon (Tremewan, 1975: 245, pl. 6, fig. 9) broadly fusiform, surface parchment-like, irregularly wrinkled, with a weak sheen, varying from white to cream. After emergence of the adult the pupal exuviae are not retained by the cocoon.

For a detailed description of the early stages and rearing the species ab ovo see Tremewan (1975: 234-345).

Ecology

Inhabits *Artemisia/Stipa* steppe and hillsides at 2000-2500 m. where there is an abundance of the larval host-plant, *Eryngium billardieri*. The adults nectar at the white flowers of *Centaurea candolleana* Boiss. (Asteraceae) and *Stachys inflata* Bentham

(Lamiaceae), or can be found at rest on the larval host-plant, *Eryngium billardieri*; their flight is rather slow and heavy. In contrast the larvae are very active and if exposed to bright sunshine will immediately crawl to the underside of a leaf.

Zygaena (Mesembrynus) cacuminum Christoph, 1877

Z. (M.) cacuminum is endemic to Iran and is known only from Shahkuh in the eastern Alborz mountains where it was first discovered by Christoph in 1983: as yet no further specimens have been taken.

Biology

The biology of this species is unknown.

Ecology

Christoph (1877: 244) captured the adults in July on a stoney plateau and the highest slopes of the rocky mountain ridges near Shahkuh, where they were observed searching for plants of a *Thymus* sp. (Lamiaceae) growing between the rocks at 3400 m. An intensive five-day search in 1995 failed to find the species which could well be extinct owing to overgrazing of the habitat. The presumed foodplant, a *Thymus* sp., was extremely rare which may be the reason why we did not find *Z. (M.) cacuminum*.

Zygaena (Mesembrynus) speciosa Reiss, 1937

Z. (M.) speciosa is endemic to the central Alborz mountains where it was first discovered by E. Pfeiffer in 1936; further material was taken by W. Forster and E. Pfeiffer in 1937.

Biology

The biology of this species is unknown. According to Holik (1938a: 391)), however, the field observations of Forster (see below) suggest that the host-plant of the larva is a species of *Thymus*, and not *Eryngium*, as one might expect from the systematic position of *Z. (M.) speciosa*. A single, dead larva was observed in July 1980 at the type-locality in the immediate vicinity of an unidentified species of *Thymus* (CMN).

Ecology

According to Forster (Holik, 1938a: 391), the biotope is situated at 2800-4200 m. on a steep, north-west-facing stoney slope or scree which is surrounded on all sides by large snow fields. The sparse vegetation consists only of a species of grass (Gramineae), a white-flowered *Astragalus* and a low-growing violet-blue-flowered species of *Thymus* (Lamiaceae), while *Eryngium* is absent. The adults were attracted to the flowers of *Thymus* (on which pairs in copula were also found at rest) and were never observed to visit the *Astragalus*.

Zygaena (Mesembrynus) tamara Christoph, 1889

In Iran, *Z. (M.) tamara* is represented by subspp. *tamara* Christoph, 1889, *mahabadica* Reiss, 1978, *kerendica* Reiss, 1978, *fahima* Naumann & Naumann, 1980, and *kendevarica* Tremewan, 1977. Adults of this species were first reared by Naumann & Tremewan (1980) from eggs obtained from females collected on the south side of the Gardaneh-ye Kandavan, Tehran; the descriptions of the early stages provided below are based on that paper. Further observations on the biology (and ecology) of this species have been recorded by Holik (1938a: 389, pl. 8, fig. 4, pl. 9, fig. 9), Wiltshire (1957: 154, pl. 12, figs. 8,9) and Tremewan (1977b: 225-226, pl. 9, fig. 4).

Biology

Ovum. Bright yellow, with one pole transparent; becoming dark grey prior to hatching; deposited in irregularly shaped batches consisting of several layers (Naumann & Tremewan, 1980: 118, pl. 5, fig. 1).

Larva. The fully grown larva varies from pale yellow to bright or canary-yellow, whitish green or whitish grey intersegmentally, anterior black dorsal spots small but distinct, each spot suffused posteriorly (common form-Naumann & Tremewan, 1980: 119, pl. 4, figs 1,2, pl. 5, figs 2,3), or dorsal spots varying in size and intensity and represented by a greyish suffusion below cuticle (Naumann & Tremewan, 1980: 119, pl. 5, figs. 4,5), yellow spots hardly discernible. The larval host-plants are *Eryngium billardieri* Delar., *E. giganteum* Bieb. and a *Prangos* sp. (Apiaceae).

Pupa and cocoon. Pupa shiny, head, thorax, wings and appendages brownish green, abdomen green. Cocoon fusiform, rather stout, parchment-like surface wrinkled, with a weak sheen, varying from off-white to cream-brown, pale brown or beige

(Naumann & Tremewan, 1980: 119-120, pl. 4, figs. 5,6 pl. 5 figs. 6,7). The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Inhabits steep mountain slopes with a south-easterly aspect at 1300-2650 m. where the vegetation is characterized by *Eryngium*, *Thymus* and *Onobrychis*. The adults have a strong, swift flight and nectar at the flowers of thistles (Asteraceae), a white flowered scabious (Dipsacaceae) and the blue-flowered *Eryngium billardieri*. On the south side of the Gardaneh-ye Kandavan they are syntopic with *Z. (M.) cambysea* Lederer, 1870, but can be readily distinguished whilst in flight by their orange-red appearance.

Zygaena (Mesembrynus) cuvieri Boisduval, [1828]

In Iran, *Z. (M.) cuvieri* is represented by the nominotypical subspecies. No biological/ecological data of this species are known from Iran. Adults of this species were first reared by Tremewan (1977a) from eggs collected by T. B. Larsen in Lebanon; the descriptions of the early stages provided below are based on that paper. Further observations on the biology of this species have been recorded by Wiltshire (1935) and Larsen (1980).

Biology

Ovum. Pale yellow, with one pole transparent, becoming bright yellow and finally greyish yellow prior to hatching (Tremewan, 1977a: 18); deposited in an irregularly shaped batch, consisting of several layers, on the underside of a leaf of the host-plant.

Larva. The fully grown larva is pale yellow, tinged with greyish intersegmentally and along spiracular line; anterior black dorsal spots elongate, posterior dorsal spots small, yellow spots inconspicuous (Tremewan, 1977a: 19, pl. 1, figs. 1,2).

Pupa and cocoon. Pupa blackish brown, abdomen paler. Cocoon broadly fusiform, surface parchment-like, irregularly ribbed, with a weak sheen, off-white in colour (Tremewan, 1977a: 19, pl. 1, figs. 3,4). The pupal exuviae remain protruding from the cocoon after emergence of the adult.

According to Larsen (1980: 106) and Wiltshire (1935: (1)), the larval host-plants in Lebanon are *Eryngium glomeratum* Lam., *Ferula elaeochytris* Korovin and *Ferulago*

trachycarpa Boiss. (Apiaceae). Holik (1938a: 390) states that Rjabov observed the larva feeding on a *Prangos* sp. (Apiaceae) in Armenia, while Tremewan (pers. obs.) found larvae feeding on *Eryngium campestre* L. in southern Turkey.

Ecology

Inhabits dry mountain slopes and hillsides at elevations of 1700-2000 m, occurring locally in discrete colonies, sometimes in large numbers. The adults nectar at the flowers of various plants, especially those of *Vicia tenuifolia* Roth. (Fabaceae) and species of *Scabiosa* (Dipsacaceae); their flight is slow and heavy. They are also nocturnal as Wiltshire (1935: (1)) observed examples that were attracted freely to light. In Iran, the same appears to be true for the province of Kordestan, from where specimens taken at light are preserved in the collection of the Plant Pests and Diseases Research Institute, Tehran.

Zygaena (Mesembrynus) haematina Kollar, 1849

In Iran, *Z. (M.) haematina* is represented by subsp. *haematina* Kollar, 1849, and *fruzica* Reiss, 1981; both occur in the southern Zagros mountains.

Biology

Ovum. Dirty cream or pale yellowish brown; deposited in a single layer (Tremewan, 1975: 236).

Larva. The first and second instar larvae are pale, in the second instar comparatively large anterior black dorsal spots are present. First and second instar larvae reluctantly accepted *Falcaria vulgaris* Bernh. as a food-plant, but the rate of mortality was high. *Ferula communis* L. and a number of other related Apiaceae were not accepted.

Pupa and cocoon. Pupa brown, abdomen lighter. Cocoon bluntly fusiform, light fawn or beige, wrinkled, with a weak sheen; spun on a small stone and concealed about 10 cm. below the surface of scree.

Ecology

Inhabits dry hillsides and mountain slopes at elevations of 2600-3750 m. The adults have a strong, steady flight low over the ground but occasionally their flight can be wild

and erratic. They can be easily approached when nectaring at the flowers of *Astragalus* sp. (Fabaceae), *Acantholimon* sp. (Plumbaginaceae) and *Phlomis* sp. (Lamiaceae); they are also attracted to the purple flowers of *Marrubium astracanicum* Jacq. (Lamiaceae). On the Kuh-e Barm Firuz, north-west of Shiraz Fars, Tremewan (1975: 235-236) observed that many examples (mostly females) found at rest were always amongst the foliage of a tall (ca 2m.) yellow-flowered umbellifer which has been provisionally determined as *Echinophora cinerea* (Boiss.) Hedge & Lamond (Apiaceae), and which is strongly suspected to be the larval host-plant. The same plant occurred in great numbers in the locality in the Kuh-e-Dena range (near Sisakht).

Zygaena (Mesembrynus) cambysea Lederer, 1870

In Iran, *Z. (M.) cambysea* is represented by subspp. *cambysea* Lederer, 1870, and *hafis* Reiss, 1938. Adults of this species were first reared by Tremewan (1978) from eggs obtained from females collected at Nessa on the south side of the Alborz mountains; the descriptions of the early stages provided below are based on that paper. Christoph (1872: 213) considered the host-plant to be "an *Eryngium* with light red flowers", a statement that is obviously erroneous (Tremewan, 1978: 47).

Biology

Ovum. Pale cream or pearly white, with one pole transparent, darkening in colour two days prior to hatching (Tremewan, 1978: 48); deposited in a single or double layer, or in several layers to form an irregularly shaped hatch.

Larva. The fully grown larva (Tremewan, 1978: 49, pl. 3, figs 2,3) varies from grey to dark grey, a geryish white or white medio-dorsal line broadening posteriorly, sometimes with a series of diffuse, pale yellow or cream spots, each spot situated in posterior part of segment, anterior black dorsal spots present, a series of prominent bright yellow spots below, each spot situated in posterior part of segment. the larval host-plant is *Eryngium billardieri* Delar. (Apiaceae).

Pupa and Cocoon. Pupa with head, thorax, wings and appendages shiny, dark brown, abdomen matt, light brown, yellowish brown on each segment anteriorly. Cocoon broadly fusiform, characteristically flattened dorsally and ribbed on each side, shiny, varying from light beige to yellowish white (Tremewan, 1978: 50, pl. 3, figs. 4-6); spun

concealed amongst plant-litter on the ground (Tremewan, 1975: 245, pl. 6, fig. 11). The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Inhabits dry mountain slopes and plateaux where the larval host-plant, *Eryngium billardieri*, is abundant, from 2000-2750m. The adults fly strongly but are relatively lethargic when nectaring at the flowers of *Marrubium astracanicum* Jacq. to which they are strongly attracted; during the evening and at night they rest fully exposed on *Eryngium*, *Artemisia* or the stems of *Stipa* (Tremewan, 1975: 245). The species is widespread and often common in the Alborz mountains, but very local and rare in the Zagros chain and in Fars.

Zygaena (Mesembrynus) minos ([Denis & Schiffermüller], 1775)

In Iran, *Z. (M.) minos* is represented by subspp. *persica* Burgeff, 1926, and *smirnovi* Christoph, 1884, which occur in the Alborz mountains and Kopet-Dag respectively.

Biology

Nothing is known of the biology of this species in Iran; recorded larval host-plants elsewhere are *Eryngium campestre* L., *Falcaria vulgaris* Bernh. and *Pimpinella saxifraga* L. (Apiaceae). Quite probably the larva feeds on a species of *Eryngium*, possibly *E. billardieri* Delar., in Iran. The coloration of the larva varies between subspecies; the descriptions of the early stages provided below are based on the populations occurring in Anatolia, Turkey.

Ovum. Pale yellow; deposited in an irregularly shaped hatch consisting of several layers.

Larva. The fully grown larva is blackish grey, a broad medio-dorsal line, dorsal and subdorsal verrucae and area below spiracles light grey, anterior black dorsal spots present, suffused and inconspicuous, a series of conspicuous, bright yellow spots below.

Pupa and Cocoon. Pupa brown or yellowish brown, abdomen lighter. Cocoon bluntly fusiform, surface shiny, irregularly ribbed and wrinkled, off-white to light beige; spun concealed amongst plant-debris on the ground.

Ecology

In Turkey it inhabits dry mountain slopes and calcareous regions where *Eryngium* is common. The adults fly strongly in sunshine but can also be found resting on grass-heads and other vegetation; they visit flowers, especially those of *Scabiosa* (Dipsacaceae).

Zygaena (Agrumenia) rosinae Korb, 1903

In Iran, *Z. (A.) rosinae* is represented by subspp. *brandti* Reiss, 1937, *cyrus* Tremewan, 1975, *xerxes* Tremewan, 1975, *Kermana* Naumann & Naumann, 1980, and *sengana* Holik & Sheljuzhki, 1956. There is little information available on the biology of this species; Korb (1903) described the larva and cocoon from eastern Turkey, while Holik (1938) illustrated a cocoon that had been collected by Rjabov in Nakhichevan, Azerbaydzhan.

Biology

Larva. Pale green, with small, anterior, black dorsal spots (Korb, 1903: 327). According to Korb, the larval host-plant in eastern Turkey is a yellow-flowered species of *Coronilla* (Fabaceae), a record that needs confirmation. In Iran it is assumed to feed on *Astragalus* spp.

Cocoon. Fusiform, surface shiny, porcelain-like, whitish to green (Korb, 1903: 327; Holik, 1938a: 394, pl. 8. fig. 2).

Ecology

Inhabits dry mountain slopes and hillsides at elevations of 1800-2700m. The adults have a fast, steady flight and even at rest they are very wary and dash wildly away if disturbed. They sometimes fly strongly low over the ground in strong winds. They visit the flowers of *Stachys inflata* Benth. (Lamiaceae), *Centaurea candolleana* Boiss. (Asteraceae), *Astragalus compylorrhynchus* Fisch. & Mey. and *A. cephalanthus* DC. (Fabaceae) (Tremewan, 1975: 230); the two species of *Astragalus* are probably the larval host-plants in Iran (Tremewan, 1975: 230-231). In the province of Kerman (Kotal-e-Khan-e-soikh) the species flies together with *Z. rubricollis*, which is much more common; here, *Z. rosinae* is extremely shy and strongly resembles *Z. olivieri* when

dashing away.

***Zygaena (Agrumenia) escalerae* Poujade, 1900**

Z. (A.) escalerae is endemic to Iran where it is represented by subspp. *thomasorum* Naumann & Racheli, 1978, *saadii* Reiss, 1938, and *escalerae* Poujade, 1900. The species is polytypic, with yellow individuals predominant in the Kuh-e-Dena and Barm Firuz regions.

Biology

Nothing is known about the early stages and life history. The larval host-plant is probably a woody species of *Astragalus*; at Dasht-e Arzhan, Fars, Tremewan (1975: 231) observed a female flying around and showing interest in a bushy *Astragalus* sp., and a pair in copula were also found at rest on this species of plant.

Ecology

Inhabits dry hillsides and mountain slopes where there is an abundance of an *Astragalus* species, at elevations of 2200-2700 m. The adults are very active and have a wild, erratic flight; they nectar at the flowers of *Pterocephalus persicus* Boiss. (Dipsacaceae), *Marrubium parviflorum* Fisch. & Mey. (*crassidens* Boiss.) (Lamiaceae) and an *Acantholimon* sp. (Plumbaginaceae) (Tremewan, 1975: 231-232). In the Sisackht area the moths were attracted to a *Thymus* sp.

***Zygaena (Agrumenia) truchmena* Eversmann, 1854**

In Iran, *Z. (A.) truchmena* is represented by subsp. *esseni* Blom, 1973.

Biology

Ovum. Yellow, with one pole transparent.

Larva. The fully grown larva is pale whitish green, tinged with yellowish latero-ventrally, dorsal and subdorsal verrucae darker, a very faint, whitish medio-dorsal line, anterior black dorsal spots present, a series of small, pale yellow spots below (Tremewan, 1976: 216, pl. 10, figs. 2,3; Wilde, 1976: 159, figs. 1a, 1b). Feeding on *Alhagi mannifera* Desv. (*A. graecorum* Boiss.) (Fabaceae) in Khorasan and on other species of *Alhagi* in Turkmenistan and Central Asia.

Pupa and cocoon. Pupa with head, thorax, wings and appendages light yellowish brown, abdomen light yellow. Cocoon broadly fusiform, surface with a weak sheen, white tinged with yellow, or dirty white; spun up on *Acroptilon* and other vegetation (Tremewan, 1976: 216, pl. 10, fig. 4, pl. 11, fig. 1). The pupal exuviae remain protruding from the cocoon after emergence of the adult. Great numbers of cocoon were observed on the tops of walls at a height of about two metres.

Ecology

The species occurs locally but in large numbers in areas where there is an abundance of *Alhagi*, frequently in habitats disturbed by man and even within villages, at elevations of 1000 m. The adults have a steady flight and are active during the morning, when they nectar at the flowers of *Alhagi* and *Acroptilon repens* (L.) DC. (Asteraceae). In the intense heat of the early afternoon, however, they rest amongst the larval host-plant, or amongst the purple-flowered *Acroptilon repens* (L.) DC, quite often those growing in the shade of *Populus* and other trees. When at rest on *Alhagi*, the adults are rather inconspicuous and resemble the pinkish or reddish flowers. Later in the afternoon the moths fly around very actively. They have also been observed visiting the flowers of *Tamarix* and resting in the blades of reeds. This appears to be one of the very few opportunist species of *Zygaena* in Iran as it takes advantage of habitats that have been disturbed by man.

Zygaena (Agrumenia) chirazica Reiss, 1938

Z. (A.) chirazica is endemic to Iran where it is represented by subspp. *chirazica* Reiss, 1938, and *eckweileri* Naumann & Naumann, 1980.

Biology

Nothing is known about the early stages and life history. At Dasht-e Arzhan, Fars, the species is syntopic with *Z. (A.) escalerae*, and the larval host-plant, therefore, is probably a woody species of *Astragalus* (Fabaceae), on which copulating pairs were found in Fars and in the Kuh-e-Dena (Dena mountains) area.

Ecology

Inhabits dry hillsides at elevations of 2200-3000 m, where there is an abundance of a woody species of *Astragalus*. As mentioned above, at Dasht-e Arzhan, Fars, it is syntopic with *Z. (A.) escaleraei*, but it occurs more rarely. The adults are attracted to the yellow-flowered scabious *Pterocephalus persicus* Boiss. (Dipsacaceae) (Tremewan, 1975: 223) and to *Marrubium parviflorum* Fisch. & Mey. (*crassidens* Boiss.) (Lamiaceae) (Racheli & Naumann, 1979: 54). In the Kuh-e-Dena it was found at 2800-3000m. and was associated with the montane species *Z. (M.) haematina*.

***Zygaena (Agrumenia) haberhaueri* Lederer, 1870**

In Iran, *Z. (A.) haberhaueri* is represented by subsp. *elbursica* Tremewan, 1975.

Biology

Regarding the early stages of this species in the central Alborz mountains, only the cocoon is known. In Georgia the larval host-plant is *Astragalus microcephalus* Willd. (Fabaceae) (Slaby, 1967: 178).

Pupa and Cocoon. Pupa blackish brown. Cocoon fusiform, surface irregular, shiny, pale brownish green; attached to a grass stem low down near the ground and, although not concealed in the sparse vegetation, inconspicuous because of its green coloration (Tremewan, 1976: 217, pl. 11, fig. 6). The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Inhabits dry mountain slopes and hillsides at 2500-3000m. where there is an abundance of *Astragalus*, the probable host-plant of the larva. The adults have a strong steady flight and can be found resting on the vegetation or visiting flowers, especially those of a thistle (*Carduus* or *Cirsium* sp. (Asteraceae)).

***Zygaena (Agrumenia) carniolica* (Scopoli, 1763)**

In Iran, *Z. (A.) carniolica* is represented by subspp. *demavendi* Holik, 1936, and *transiens* Staudinger, 1887, which occur in the central and eastern Alborz mountains respectively. In north-western Iran the more vividly coloured subsp. *suavis* Burgeff, 1926, is found, a subspecies that is widely distributed in south-eastern Turkey, Armenia and

Biology

Ovum. Pale yellow; deposited in irregularly shaped batches on the underside of the leaves of the food-plant.

Larva. In Iran the fully grown larva is dark grey, a whitish grey medio-dorsal line, anterior black dorsal spots, small, hardly discernible, a series of conspicuous yellow spots below. Host-plant: *Onobrychis cornuta* (L.) Desv. (Fabaceae) (Tremewan, 1976: 218, pl. 11, fig. 8; 1977b: 224, pl. 9, fig. 1). The grey form of the larva also occurs in eastern Turkey, but in Europe (except in Spain) it is green to greenish grey.

Pupa and cocoon. Pupa brown to blackish brown. Cocoon ovoid, varying from white to pale yellow (Tremewan, 1976: 218, pl. 11, fig. 7; 1977b: 224, pl. 9, fig. 2); spun on the host-plant or other vegetation and concealed, partially concealed or exposed. The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Inhabits mountain slopes and plateaux where there is an abundance of *Onobrychis cornuta*, the larval host-plant, often occurring in great numbers; in July 1976, the larvae were so common on the north-east side of the Gardaneh-ye Kandavan that many of the plants of *Onobrychis* had been completely defoliated (Tremewan, 1977b: 224). In contrast, only a single cocoon was discovered in the same locality in July 1995. Thus, considerable changes in population density must be accounted for in this species. The adults (Tremewan, 1977b: pl. 9, fig. 3) have a strong, active flight by day; during the evening they can be found roosting in large numbers on a grass-head or other vegetation. The larvae are easily disturbed and drop immediately into the centre of the host-plant cushion which has strong spines and is very difficult to penetrate.

Zygaena (Zygaena) christa Reiss & Schulte, 1967

Z. (Z.) christa is endemic to Iran where it occurs in the Qareh Dagh (Jala Dagh), Azerbaijan.

Biology

Ovum. Milky white, large; deposited in lines consisting of 5-6 eggs on the underside of a leaf of the host-plant, *Onobrychis cornuta* (L.) Desv. (Fabaceae) (Naumann, 1985: 47-48).

Larva. The first to fifth instars of the larva are described and the third to fifth illustrated by Naumann (1985: 48-49, fig 4-6). The fifth instar is grey-black with a light violet sheen, anterior and posterior black dorsal spots present, the posterior smaller than the anterior, a series of pale yellow spots below.

Pupa and cocoon. Unknown.

Ecology

The biotope (Naumann, 1985: 43, fig. 1) is situated on the flat summit of a mountain at 2800-2900 m. where the cushion vegetation consists mainly of *Onobrychis cornuta* and a yellow-flowered *Astragalus* species. The buzzing flight of the adults is usually not very rapid and, characteristic of high-mountain species which have to contend with storms and sudden gusts of winds, terminates on the ground; they fly only in full sunshine, descending to the ground if it clouds over and crawling into the low vegetation during longer periods of dull weather. Freshly emerged females and pairs in copula can be found in the cushion plants of *Onobrychis cornuta* or on single grass stems that grow through the cushions and are protected by this plant.

Zygaena (Zygaena) loti [(Denis & Schiffermüller), 1775]

In Iran, *Z. (Z.) loti* is represented by subsp. *suleimanic* Reiss, 1937. Little seems to be known of its biology in Iran, although the larval host-plant is *Coronilla varia* L. (Fabaceae) in the central Alborz mountains (Naumann & Tremewan, pers. obs). The descriptions of the early stages provided below are based on populations from elsewhere in its range.

Biology

Ovum. Pale yellow, with one pole transparent; deposited in a batch consisting of a single layer.

Larva. The fully grown larva is dark grey (or green in some populations), anterior and posterior black spots present, small, with a series of conspicuous yellow spots below.

Pupa and Cocoon. Pupa yellowish or greenish brown. Cocoon ovoid, surface shiny, porcelain-like, dirty white; spun on the ground and concealed amongst vegetation or plant-litter. The pupal exuviae remain protruding loosely from the cocoon or become detached after emergence of the adult.

Ecology

Inhabits dry mountain slopes and hillsides. On the north side of the Gardaneh-ye Kandavan it occurs in flowery clearings amongst scrub on slopes at 1600-2000m; here it is syntopic with *Z. (Z.) doryenii* from which it can be readily distinguished when on the wing by its dull appearance (Trmewan, 1976: 218). A single male was found at 2750m in a locality 20 km. NNE. of Gardaneh-ye Kandavan, where it was syntopic with *Z. (A.) habərkhaueri elbursica*, *Z. (A.) carniolica demavendi* and *Z. (M.) cambysea cambysea*. The adults have a strong, rapid flight and nectar at various flowers, including those of *Scabiosa* (Dipsacaceae) and *Coronilla* (Fabaceae).

Zygaena (Zygaena) ecki Christoph, 1992

Z. (Z.) ecki is endemic to Iran where it is represented by subspp. *schwingenshussi* Reiss, 1937, and *ecki* Christoph, 1882, in the central and eastern Alborz, mountains respectively.

Biology

Ovum. Pearly to greyish white; deposited in a single layer. The eggs are comparatively large, given the small size of the moth.

Larval. Host-plant *Onobrychis cornuta* (L.) Desv. (Fabaceae); in captivity the larva will accept *O. viciifolia* Scop.

Pupa and Cocoon. Pupa dark brown, abdomen lighter. Cocoon ovoid and typical of species of the *Z. loti*-group in shape, shiny, light brown or beige, the specimen which we found was spun just beneath the surface of the ground at the base of a small plant of *Onobrychis cornuta*.

Ecology

Inhabits very steep, north-east facing slopes at 2750-3700m; in the central Alborz

mountains it is syntopic with *Z. (M.) cambysea cambysea*, *Z. (A.) rosinae brandti*, *Z. (A.) haberhaueri elbursica* and *Z. (A.) carniolica demavendi*. In this locality the peak flight period is from mid afternoon until 19.00 hrs. A male was seen to alight on a large *Ferula* plant, then crawl into the dense foliage where it settled down to rest. A pair in copula was also found on this plant and others were found in such locations and in thick tussocks of grass, indicating that these are the main resting places during cold weather and at night. In the eastern Alborz mountains it occurs on dry northfacing slopes above the village of Shahkuh-e Pain at 2900-3200m. Here the adults fly between 9.45 and 13.30 hrs with a few stragglers until 15.00 hrs. Their flight is wild and rapid and they are seldom found at rest except when nectaring at the flowers of *Onobrychis*, *Marrubium*, *Centaurea*, *Acantholimon* and *Acanthophyllum*. Occasionally an example of either sex will drop onto a cushion of *Onobrychis cornuta* and disappear into the foliage of this spiny plant. Such behaviour usually occurs when there is a sudden gust of wind and undoubtedly they rest deep down inside the cushions during inclement weather and at night. Dead moths have been found trapped in the webs of the araneid spider *Aculepeira* sp. (Araneidae).

Zygaena (Zygaena) viciae ([Denis & Schiffermüller], 1775)

In Iran, *Z. (Z.) viciae* occurs in Mazandaran where it is represented by subsp. *burgeffiana* Reiss, 1930, originally described from north-eastern Iran. Nothing is known of its biology and ecology in Iran; the biological and ecological notes provided below are based on populations from elsewhere.

Biology

Ovum. Pale yellow, with one pole transparent; deposited in a batch consisting of a single layer.

Larva. The fully grown larva is dark emerald green, minutely speckled with black, tinged with grey anteriorly and posteriorly, a whitish medio-dorsal line, anterior black dorsal spots present, small, a series of yellow spots below. In southern Turkey the larval host-plant is *Vicia cracca* L. (Fabaceae), therefore one would expect to find the larva feeding on a *Vicia* sp. in Iran.

Pupa and Cocoon. Pupa shiny, head, wings and appendages black, thorax and

abdomen bright emerald green, abdomen lighter. Cocoon fusiform, surface shiny, longitudinally ribbed, pale yellow; attached to grass stems or the underside of leaves and concealed amongst the vegetation. The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

In Turkey the species inhabits hillsides and mountain slopes where there is an abundance of *Vicia cracca* at the flowers of which the adults can frequently be found nectaring. They also feed at other flowers, especially those of *Scabiosa* (Dipsacaceae); their flight is strong and rapid. In Mazandaran, it occurs at elevations of around 1000m. but has been recorded only rarely.

***Zygaena (Zygaena) dorycnii* Ochsenheimer, 1808**

In Iran, *Z. (Z.) dorycnii* is represented by subsp. *Keredjensis* Reiss, 1937. The descriptions of the early stages provided below are based on populations from Turkey.

Biology

Ovum. Pale yellow, with one pole transparent; deposited in a batch consisting of several irregular layers.

Larva. The fully grown larva is dirty yellow, a narrow, fragmented, black medio-dorsal line, anterior and posterior black dorsal spots present, former large, rounded, latter small, subdorsal and lateral spots small. Host-plant: *Coronilla vaira* L. (Fabaceae).

Pupa and Cocoon. Pupa shiny, dark brown to blackish brown. Cocoon fusiform, surface shiny, irregularly ribbed, varying from white to beige; attached to the dead stems of grasses and other vegetation and usually concealed. The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

Widely distributed and common in the central Albroz mountains where it inhabits dry slopes and flowery clearings amongst scrub at elevations of 1000-2000m. The adults have a strong, steady flight and frequently undulate over and around bushes; they can be

easily approached when feeding at the purple flowers of a species of Lamiaceae or those of a *Scabiosa* sp. (Dipsacaceae), but will fly off quickly if disturbed. In some localities it is syntopic with *Z. (Z.) loti* from which it can be readily distinguished when on the wing by its brighter red coloration and appearance (Tremewan, 1976: 219). A second generation has been found flying in October near Gorgan.

Zygaena (Zygaena) filipendulae (Linnaeus, 1758)

There are records of *Z. (Z.) filipendulae kulpiensis* Reiss, 1935, from the extreme north-west of Iran (Naumann, Feist, Richter & Weber, 1984: map 61). Nothing is known of its biology and ecology in Iran; the notes provided below are based on populations from elsewhere in its range.

Biology

Ovum. Yellow, with one pole transparent; deposited in an irregularly shaped batch consisting of several layers.

Larva. The fully grown larva is greenish yellow or yellow, anterior and posterior black dorsal spots prominent subdorsal and lateral black spots also present, yellow spots inconspicuous. Throughout its range, the larval host-plants are chiefly species of *Lotus* (Fabaceae); in Iran one would expect the larvae to be found feeding on *L. corniculatus* L.

Pupa and Cocoon. Pupa shiny, black, occasionally dark brown. Cocoon fusiform, irregularly ribbed, bright yellow to dirty white; attached to grass stems, rushes and other vegetation, and usually concealed in the Asiatic biotopes. The pupal exuviae remain protruding from the cocoon after emergence of the adult.

Ecology

In north-eastern Turkey *Z. (Z.) filipendulae* inhabits meadows and clearings in open pine forest, but in the drier regions of Anatolia it occurs in damp areas, often where *Juncus* (Cyperaceae) is found, at elevations of 800-2500m. The adults have a strong flight and nectar at various flowers, especially those of *Scabiosa* (Dipsacaceae) and *Cirsium* (Asteraceae), but during the evening can be found resting openly on grasses and other vegetation.

Zygaena (Zygaena) lonicerae (Scheven, 1777)

There are records of *Z. (Z.) lonicerae abbasumana* Reiss, 1937, from north-western Iran, but nothing is known of its biology and ecology in Iran; the notes provided below are based on populations from elsewhere in its range.

Biology

Ovum. Pale to dark yellow, with one pole transparent; deposited in a batch consisting of a single layer.

Larva. The fully grown larva is whitish green, anterior and posterior black dorsal spots prominent, subdorsal and lateral black spots also present, yellow spots below black dorsal spots conspicuous; readily distinguished by the long setae which give the larva a comparatively hairy appearance. In Europe the main host-plants are *Lathyrus pratensis* L., *Trifolium pratense* L. and *Onobrychis viciifolia* Scop. (Fabaceae); in central Turkey the species is usually associated with *L. pratensis*.

Pupa and Cocoon. Pupa shiny, black. Cocoon fusiform, relatively broader than that of *Z. (Z.) filipendulae* and comparatively translucent, irregularly ribbed, pale whitish yellow or greenish yellow to white; attached to stems of grasses and other vegetation but in Asia usually situated low down and often concealed.

Ecology

In south-eastern Turkey occurs in grassy clearings and pine woods.

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