BIHAREAN BIOLOGIST 12 (2): 79-83
Article No.: e171209

http://biozoojournals.ro/bihbiol/index.html

# Notes on life history, host plants and parasitoids of *Malacosoma castrensis* L. (Lepidoptera: Lasiocampidae) in Urmia region, Iran

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Received: 10. June 2017 / Accepted: 03. October 2017 / Available online: 05. November 2017 / Printed: December 2018

**Abstract.** Observations on the life history, host plants and parasitoids of *Malacosoma castrensis* (Linnaeus) (Lepidoptera: Lasiocampidae) were made in northwest of Iran at Urmia region during 2014 to 2016. This vulnerable species completes one generation in a year and overwinters as egg in ring-liked shape on small stems of herbaceous plants. Overwintering eggs hatch the following spring in early April. The duration of larval development was 21-28 and pupation also takes 10 to 14 days in natural conditions. Adults appeared in the mid to late June and females begin laying eggs 1-2 days after mating. In the natural conditions, as few as 346 and as many as 512 eggs occurred in clusters. In the Urmia region, food plants of lackey ground are belonging to Rosaceae, Fabaceae, Euphorbiaceae and Geraniaceae families. However, it does not appear to be a pest. Six larval and pupal parasitoids of the *M. castrensis* includes, *Pteromalus bifoveolatus* Forester (Hym., Pteromalidae), *Pimpla instigator* Fabricius, *Gregopimpla malacosomae* (Sierig) (Hym., Ichneumonidae), *Brachymeria* cf. *tibialis* (Hym., Chalcididae), *Masicera sphingivora* (Robineau-Desvoidy) and *Tachina praeceps* Meigen (Dip., Tachinidae) were found in the study areas. The combination of factors including parasitoids, destruction of natural habitats for dry land farming and deterioration of habitats quality are likely responsible for severe decline of *M. castrensis* in Urmia region.

**Key words:** Life history, food plants, Parasitoids, *Malacosoma castrensis*, Urmia, Iran.

## Introduction

*Malacosoma castrensis* (L.) (Lepidoptera: Lasiocampidae) is a polyphagous species which utilized from wide range of plant species belonging to different plant families. This species was recorded from NW Africa, Central and Eastern Europe, Caucasus, Transcaucasia, Asia Minor, Middle Asia mountains, Kazakhstan, South of W Siberia, Iran, China (Tibet, Guangxi-Zhuangzu), Southern Mongolia, Buryatia, and Southern Primorye (Tshistjakov 1998).

Martin & Serrano (1985) documented its taxonomy, cytotaxonomy and biology in the Iberian Peninsula. Simsek (2000) reported its occurrences in forest nursery in Turkey. Those of Özbek and Hayat (2003) noted *M. castrensis* as sainfoin (*Onobrychis viciifolia* Scop.) pest in the Eastern part of Turkey. Zwölfer (1970) reported that *M. castrensis* is found on leafy spurge in Eastern Europe, although in Austria its normal host is *Sanguisorba* (Rosaceae). Over the past twenty years I have observed sever decline in population sizes of *M. castrensis* in its natural habitats.

This study was carried out on life history, host plant and parasitoids of this species in natural conditions. Since of considerable decreasing in population as well as few studies documented.

### Materials and methods

The field research was conducted to determine the life history, host plants and parasitoids of lackey ground caterpillar. The experiments were carried out in 2014-2016 in the Urmia region given in *The Times Comprehensive Atlas of the World* (10th Ed. 1999) which favors the spelling, Orümïyeh (N 37°31´-E 45°01´), West Azarbaidjan (Azarbaijan-e-Gharbi) Province-Iran. The field trials were located in the natural habitat of *M. castrensis* on meadows in Qasemlü valley (1340m S.L.) and Sir mountain (Fig. 1) vicinity of Sir church areas (1710m S.L.) situated at 35km SE and 6km SW of Urmia, respectively. The plots of study were selected approximately 10 hectares in Shohada valley and 15 hectares in Sir mountain. Study plots were covered by wide range of herbaceous plant species. Seasonal temperatures in the studying areas range 38°C during July and August to extremes of -22.8°C and lower in December and January. Annuals precipitation averages less than 350mm. Plant species within these study areas include *Astragalus* spp., *Vicia* spp. and *Cornilla varia* (Fabaceae), *Centaurea* spp., *Cousinia* spp., *Echinops* spp., *Tragopagon* spp., *Cirsium* spp., *Picris strigosa*, *serratula cerintifolia* and *Achillea millefolium* (Asteraceae), *Euphorbia macroclada* and *Euphorbia* spp. (Euphorbiaceae), *Salvia* spp. (Laminaceae), *Poterium sangoisorba* (Rosaceae), *Geranium tuberosum* and *Erodium cicutarium* (Geraniceae), *Poa* spp., *Bromus* spp., *Hordeum* spp. and *Dactylis glomerata* (Poaceae). During early April of 2014 to 2015, when the newly hatched larval masses of *M. castrensis* were first observed in studying areas, they were kept (n=40, total=80) in cage (75×75×100cm) and periodically examined for larval, pupal development and adults emergence. Each year I used 2 cages which containing 20 larvae. The larvae were transferred to fresh, caged, host plant when the host plants were nearly completely consumed. Observations concerning moth life stage and their duration, overwintering, adults' emergence, egg hatching, feeding, host plants and egg laying were assessed and recorded in natural conditions. During 2 years all plants which larval masses observed on them and voraciously consumed by larvae of *M. castrensis* were recorded as food plants. In order to obtain parasitoids of *M. castrensis*, a group of 40 fully developed larva and 50 pupa were collected among or out of the host plants 11-20.VI. 2014 (n=45, 20 larva, 25 pupa) and 13-20.VI.2015 (n=45, 20 larva, 25 pupa), as well as a group

Figure 1. Natural habitat of *M. castrensis* (Sir Mountain, Urmia).

Table 1. Results of field observations related to date of egg hatching in *M. castrensis* egg masses.

| Year | Number of hatched egg masses during experiment periods | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9-14. April | 15-20. April | 21-26. April | 27 April - 2 May | 3-8. May | 9-14. May | 15-20. May |
| 2015 | 1 | 1 | 8 | 6 | 2 | 0 | 1 |
| 2016 | 0 | 1 | 5 | 4 | 1 | 0 | 0 |
| Total | 1 | 2 | 13 | 10 | 3 | 0 | 1 |

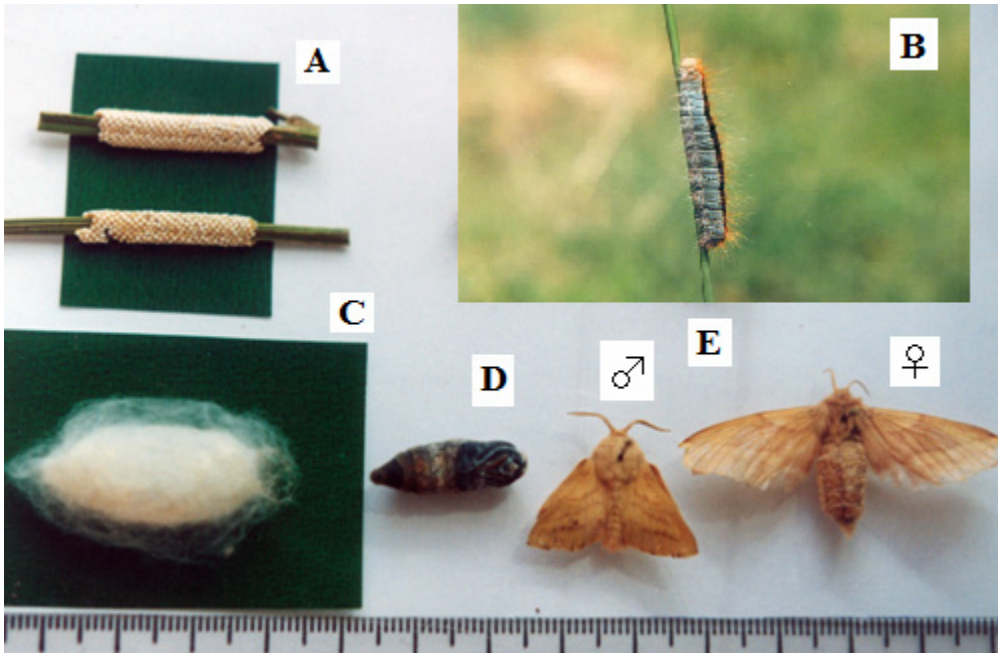


Figure 2. A composite photo of developmental stages of the Lackey ground tent caterpillar *Malacosoma castrensis*. A) Cluster of eggs; B) The forth instar; C) Cocoon; D) The pupa; E) Adult moths (male and female).

of 20 fully development larvae of *M. castrensis* were collected on host plants 2.VI.2013. Collected larvae were brought to the laboratory for rearing on potted *Poterium sanguisorba* L. (Rosaceae) as a main host plant. They were placed into fine mesh cage (50×50 cm and 100 cm in height) and checked daily for emergence of *M. castrensis* adults and parasitoids.

Table 2. Field observations related to date of start, peak and end of adult's emergence of *M. castrensis* under cages.

| Year | Number of emerged adults during experiment periods | | | |
|---|---|---|---|---|
| | 1-7. June | 8-15. June | 16-23. June | 24-30. June |
| 2015 | 1 | 9 | 9 | 2 |
| 2016 | 1 | 11 | 6 | 2 |
| Total | 2 | 20 | 15 | 4 |

## Results

Life history and biology

Field studies revealed that the lackey ground tent caterpillar has only one generation per year. Overwintering egg masses begin emerging in early spring coincide with the emergence and expanding of buds on host plants. In Urmia, mass hatching of eggs commonly peaks during late April, but has been observed as early as April and as late as mid-May (Table 1). The young larvae are gregarious. After hatching, young larvae initially feed together on the expanding buds and foliage. However, once larvae are mature, they consume the leaves entirely. Fully developed and late instars larvae tend to wander, individually travelling within among or out of food plants, either in search of additional food or a place to pupate. The duration of larval development was 21-28 days in natural conditions. Lackey ground tent caterpillar larvae have five instars. Head capsule widths for larvae measure 0.71-0.91, 1.5-1.8, 2.0-2.3, 2.8-3.0 and 3.2-3.5mm for instars one through five, respectively. The first instar is black in appearance, with long hyaline seta over the body. In the all larval stages, head capsule, anal prolegs, antennae, legs and their tarsal segments were black. The prolegs are light brown with crochets black in color. Second to fifth instars were similar in appearance. Their appearance is bluish in color. In the second instar one dorsal strip were appeared extending posteriorly which is dark brown in color and bearing the light brown long seta. The width of strip in fully developed larvae is up to 2mm (Fig 2B).

Duration of larval developments in 1-5 instars were 7.8±0.4, 5.8±0.7, 5.6±0.3, 5.5±0.6 and 4.9±0.3 days respectively. The fully developed larva averages 1.45± 0.18gr (n=20) in weight and 55±3mm (n=20) in length.

The yellowish white pupal cocoons (Fig. 2C) which weakly covered by yellowish powder are commonly located amongst webbed leaves on or out of host plants. The cocoon and pupa averages 29.3±2.8mm (n=20), 22.4±2.1mm (n=20) in length and 14.2±1.4mm (n=20), 7.1±0.6mm (n=20) in diameter, respectively. Pupa is brownish in color, becoming dark brown (Fig. 2D) prior to emergence of adult. Pupation takes 10-13 days. It is appeared that adults (Fig. 2E) of this univoltine insect emerged from the pupae hidden in their protective cocoons in the early to late June. Adult moths

Table 3. Species composition, structure and impact of the parasitoids of *M. castrensis* in Urmia during the year 2014.

| Family / species | Number of parasitoids ♂ | ♀ | Total | Emergence date | Number of parasitized host by… | Percentage in the parasitoids complex | Host Mortality % |
|---|---|---|---|---|---|---|---|
| Ichneumonidae | 12 | 7 | 19 | | 10 | 30.7 | 41.7 |
| *P. rufipes* | 5 | 2 | 7 | 21-29.VI.2014 | 6 | 10.9 | 25.0 |
| *G. malacosomae* | 7 | 5 | 12 | 2-11.V.2015 | 4 | 18.9 | 16.7 |
| Tachinidae | 3 | 2 | 5 | | 5 | 7.8 | 20.8 |
| *M. sphingivora* | 1 | 1 | 2 | 21-29.VI. 2014 | 2 | 4.7 | 8.3 |
| *T. praeceps* | 2 | 1 | 3 | 21-29.VI. 2014 | 3 | 7.8 | 12.5 |
| Pteromalidae | 12 | 17 | 29 | | 5 | 45.3 | 20.8 |
| *P. bifoveolatus* | 12 | 17 | 29 | 20-29.VI. 2014 | 5 | 45.3 | 20.8 |
| Chalcididae | 4 | 7 | 11 | | 4 | 17.2 | 16.7 |
| *B.* cf. *tibialis* | 4 | 7 | 11 | 20-29.VI. 2014 | 4 | 17.2 | 16.7 |
| Total | 29 | 35 | 64 | | 24 | 100 | 100 |
| | | 64 | | | | | |

Table 4. Species composition, structure and impact of the parasitoids of *M. castrensis* in Urmia during the year 2015.

| Family / species | Number of parasitoids ♂ | ♀ | Total | Emergence date | No. of parasitized host by... | Percentage in the parasitoids complex | Host mortality % |
|---|---|---|---|---|---|---|---|
| Ichneumonidae | 8 | 19 | 27 | | 17 | 35.1 | 50.0 |
| *P. rufipes* | 3 | 13 | 16 | 21-29.VI.2015 | 13 | 20.8 | 38.2 |
| *G. malacosomae* | 5 | 6 | 11 | 2-11.V.2016 | 4 | 14.3 | 11.8 |
| Tachinidae | 3 | 5 | 8 | | 8 | 10.4 | 23.5 |
| *M. sphingivora* | 2 | 2 | 3 | 21-29.VI. 2015 | 3 | 3.9 | 8.8 |
| *T. praeceps* | 1 | 3 | 5 | 21-29.VI.2015 | 5 | 6.5 | 14.7 |
| Pteromalidae | 14 | 19 | 33 | | 6 | 42.8 | 17.6 |
| *P. bifoveolatus* | 14 | 19 | 33 | 18-29.VI.2015 | 6 | 42.8 | 17.6 |
| Chalcididae | 3 | 6 | 9 | | 3 | 11.7 | 8.8 |
| *B.* cf. *tibialis* | 3 | 6 | 9 | 20-29.VI.2015 | 3 | 11.7 | 8.8 |
| Total | 28 | 49 | 77 | | 34 | 100 | 100 |
| | | 77 | | | | | |

mate and females oviposite egg masses 2 days after mating in a ring-like cluster around stems of herbaceous plants (Fig.2A). In the natural conditions, as few as 346 and as many as 512 eggs occurred in clusters. A single female lay an average 468±25 eggs (n=20). Dissection of 5 females yielded abdominal egg counts of 458±39 with a range of 372-563 eggs. Comparing these fecundity values with the number of eggs on stems suggests that females normally deposit all their eggs in one cluster. Small egg clusters are likely a result of disturbance during oviposition. Average adults longevity in field cages were 4.3±0.4 days (range 4-5). Eggs are apparently white, but 1/5 apex of them is white and 4/5 base of them is yellowish. They are vase-shaped, tetragonal, about 1.0±0.1mm in length, 0.46±0.06mm in base and 0.62±0.03mm in apex. The length of egg masses on the stems averaged 1.8± 0.4cm with a range of 1.3- 2.6cm (n= 26).

Figure 3. *M. castrensis* foodplant: *Euphorbia macroclada*, (The third instars larvae on the leaves of *E. macroclada*).

Host plants

In the study areas, the host plants of *M. castrensis* include various species of *Astragalus* spp., *Poa* spp., *Hordeum* sp., *Coronilla varia*, *Poterium sanguisorba*, *Geranium tuberosum*, *Erodium cicutarium*, *Dactylis glomerata*, *Centaurea cyanus*, *C. behen*, *Euphorbia macroclada* (Fig. 3) and *E. heteradena*. The most common hosts were *P. sanguisorba*, *E. macroclada* and *C. behen*. Özbek & Hayat (2003) mentioned *Onobrychis viciifolia* as cultivated host plant of *M. castrensis* in Turkey.

Parasitoids

Studies on the species composition of the larval and pupal parasitoid complex of *M. castrensis* in Shohada valley and Sir Mountain yielded six species (Table 3, 4). All species were emerged from pupa. They belong to the two orders and four families as follows:

- *Pimpla rufipes* Miller, (Hymenoptera: Ichneumonidae)
  Syn., *P. hypocondriaca* (Retzius)
  *P. instigator* Fabricius
- *Gregopimpla malacosomae* (Seyrig) (Hymoptera: Ichneumonidae)
- *Pteromalus bifoveolatus* Förster, (Hymenoptera: Pteromalidae)*

- *Brachymeria* cf. *tibialis* (Hymenoptera: Chalcididae)*
- *Masicera sphingivora*, (Robineau-Desvoidy) (Diptera: Tachinidae)
- *Tachina praeceps* Meigen, (Diptera: Tachinidae)

* New species for parasitoid complex of *M. castrensis*.

*P. rufipes*, *P. bifoveolatus*, *G. malacosoma* and *B.* cf. *tibialis* were recovered as primary and gregarious parasitoids of *M. castrensis*. These species gregariously parasitize pupa of the *M. castrensis* and 1-3, 7-12, 3-5 and 2-3 individuals of the wasps may be emerged from host pupa, respectively. *M. sphingivora* and *T. praeceps* are solitary parasitoid of *M. castrensis*.

*P. rufipes* was the most important parasitoid in both of the studied years, reducing the *M. castrensis* number by 25.0% in 2014 and 38.2% in 2015. The second effective parasitoid was *P. bifoveolatus,* which appeared in both studied years. The emergence took place from 21-29 June in 2014 and 18-29 June in 2015. A parasitism level of this species was 20.8% in 2014 and 17.6% in 2015.

However, it was observed that other parasitoids had the low levels of parasitism rather than above mentioned parasitoids and was not important as them.

## Discussion

Here, the life history and foodplants, as well as associated parasitoids are described for *M. castrensis* for the first time in Iran. In general, the life cycle of *M. castrensis* was very similar to those of the some other *Malacosoma* species. The larvae of this family are hairy and many species spin conspicuous tent of silk that are used for shelter during inclement weather and molting site. Many species overwinter in the egg stage. The eggs are usually being deposited in a large mass which encircles the twig (Allen & Coufal, 1984). Çoruh & Özbek (2002) studied the biology of *Malacosoma neustria* (L.) in Turkey. The life cycle of *M. castrensis* is very similar to that of *M. neustria*. The larval foodplants of *M. castrensis* is sorely restricted to wide range of herbaceous plants but it didn't appear to be a pest. Although, Özbek and Hayat (2003) noted *M. castrensis* as sainfoin (*Onobrychis viciifolia* Scop.) pest in the Eastern part of Turkey.

*Malacosoma neustria* L. and *M. franconica* (Denis & Schiffermüller, 1775) have been reported as host for *P. rufipes* in Turkey (Çoruh & Özbek 2008). In Iran, *P. rufipes* is widespread and reported from faunistic studies (Kolarov & Ghahhari 2005; Kolarov & Ghahari 2005; Mohammadi et al. 2013; Kolarov & Ghahari 2006; Masnadi & Jussila 2008; Ghahari & Jussila 2011). The species distributed in eastern and western Palaearctic region (Yu et al. 2005) and Holarctic and Oriental (Zwakhals & Turrisi 2014). *M. castrensis* was the first host record for *P. rufipes* in Iran.

Fully developed larvae of *G. malacosomae* leave the host pupa and spin a pitcher like cocoon inside the host cocoon. Then they overwinter in pupal stage and adults were appeared in following spring. The ichneumon *G. malacosomae* is reported as a parasitoid of *M. neustria* in Turkey (Çoruh & Özbek 2008) and Yugoslavia (Glavendekić & Kolarov 1994). Also Delrio et al. (1983) reported *G. malacosomae* as parasitoid of this host in Italy which is responsible for 30% mortality of the pest. *G. malacosomae* has not been reported from other regions of Iran. Therefore, its distribution is restricted to Urmia region. The species is distributed in western Palaearctic (Yu et al. 2005). LGTC represents first host record for *G. malacosomae* in Iran.

*P. bifoveolatus* is the primary parasitoid of Lasiocampidae, Saturniidae, Lymantriidae and Notodontidae (Graham 1969; Noyes 2008). This species has been recorded from Plaearctic region (Noyes 2008). This is the first host record in Iran.

*M. sphingivora* is reported in Iran as a parasitoid of *Hyles euphorbiae* Hübner (Lepidoptera: Sphingidae) (Karimpour et al. 2006). It was shown *M. castrensis* is also a new host record for this species in Iran. Özbek & Çoruh (2012) noted *M. sphingivora* as the primary host of *M. neustria* in Turkey. The species most often reared from the hosts including Sphingidae (especially *Celerio* spp.), however utilize from different species of Noctuidae, Lymanttriidae, Lasiocampidae and Nymphalidae in Palaearctic region (Tschorsnig & Herting 1994).

*T. praeceps* is a predominantly southern European species, which develops in various host families (Lymantriidae, Lasiocampidae, Arctiidae, Sphingidae, Noctuidae) (Mückstein et al. 2007) as well as reported from Southern and southeastern European part of Russia, Transcaucasia, Middle Asia, Mongolia and North Africa (Richter 2008). Both species has been reported as parasitoid of *M. castrensis* from Turkey (Kara & Tschrsnig 2003). Moreover, Özbek & Çoruh (2012) mentioned *T. praeceps* as the primary host of *M. neustria* in Turkey. This is the first host record in Iran.

In conclusion, Natural habitats of lackey ground tent caterpillar in Urmia region are restricted to open area and sun exposed semi-dried hillsides. A combination of unfavorable conditions including natural enemies, decreasing of suitable habitats and deterioration of habitat quality due to over grazing are likely responsible for sever decline in population size of *M. castrensis*. Similar situation is present in Turkey (Personal communication with Hikmet Özbek). Hence the suitable form of management in conservation of natural habitats and indigenous plant biodiversity should be implemented to increase in population size of the species.

**Acknowledgment.** The author is thankful to the following scientists for the identifications as indicated: Late professor K. Horstmann (Ichneumonidae), Dr. S. Hyedon (Pteromalidae), Dr. H. P. Tschorsnig (Tachinidae) and Dr. H. Bauer (Chalcididae). This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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