

## THE SMALL CHINA-MARK *CATACLYSTA LEMNATA* (LINNAEUS, 1758) (LEPIDOPTERA: CRAMBIDAE: ACENTROPINAE) IN SERBIA

VANJA MARKOVIĆ<sup>1\*</sup>, BORIS NOVAKOVIĆ<sup>2</sup>, MILENKA BOŽANIĆ<sup>1</sup>,  
KATARINA STOJANOVIĆ<sup>1</sup>, ANĐELINA TATOVIĆ<sup>1</sup> and IVANA ŽIVIĆ<sup>1</sup>

<sup>1</sup> University of Belgrade - Faculty of Biology, Studentski trg 16, 11000 Belgrade, Serbia  
E-mail: mika.zunic@bio.bg.ac.rs; k.bjelanovic@bio.bg.ac.rs; andjelina.tatovic@bio.bg.ac.rs; ivanas@bio.bg.ac.rs;  
\*vanja.markovic@bio.bg.ac.rs (corresponding author)

<sup>2</sup> Serbian Environmental Protection Agency, Ministry of Environmental Protection, Žabljčka 10A, 11160 Belgrade, Serbia  
E-mail: bokinovak@gmail.com

### Abstract

The Western Palaearctic moth *Cataclysta lemnata* (Linnaeus, 1758) is considered one of Europe's most common water moths. However, there are limited data regarding the larval stages, particularly in eastern and southeastern Europe. During the 2017-2021 aquatic macroinvertebrate survey, *C. lemnata* was detected at seven sites in the Pannonian region of Serbia. All sightings were of the larval/aquatic phase and originated from both heavily polluted habitats and relatively unpolluted waterbodies. A consistent feature at all sites is duckweed (*Lemna* sp.), confirming the preference of *C. lemnata* for this plant. Our findings contribute to a better understanding of the presence of this species in the region and suggest that it may be more abundant in its various aquatic habitats. As the adult stages are simpler to identify, and with the advent of public online databases (Alciphron, biologer.rs), there have been multiple records of adult moths in recent years. Regarding the aquatic stages, there is a need for more comprehensive surveys with a primary emphasis on suitable habitats throughout the region and the use of molecular methods for the identification of early larval stages would be beneficial.

KEY WORDS: aquatic moth, larval phase, distribution, Pannonian Plain

### Introduction

Despite being a species-rich and diverse group of insects, Lepidoptera are not usually associated with aquatic habitats. Apart from some smaller groups/families from the Far East, all other representatives with an aquatic developmental stage (larvae) belong to the subfamily Acentropinae in the family Crambidae (Pabis, 2014).

Acentropinae is rather limited in number, with only eight species present in central Europe (Vallenduuk & Cuppen, 2004).

Acentropinae moths are herbivorous, feeding primarily on aquatic monocotyledons (Léger *et al.*, 2021). As stem borers, they are often considered pests (Velasco Pazos *et al.*, 2007). However, some species, including aquatic species, are considered beneficial and are used as biological control agents for certain invasive plant species. One such species that is beneficial in this respect is the small china-mark *C. lemnata*.

This Western Palearctic species is found throughout Europe and also in Morocco and Iran (Goater *et al.*, 2005; Agassiz, 2012; Farahpour-Haghani *et al.*, 2017) and is considered one of the most abundant aquatic moths in its range (Vallenduuk & Cuppen, 2004). The moths have aquatic caterpillars that are polyphagous, with a preference for duckweed (genus *Lemna*, subfamily Lemnoideae) (Van der Velde, 1988; Pabis, 2014; Farahpour-Haghani *et al.*, 2017). Larval development occurs in water and consists of a total of four stages, of which only the first is hydrophilic; the others are hydrophobic, and the larvae live in a shell filled with air. In most cases, the protective case is made of duckweed leaves, but there have been reports of other materials being used, including plastic from garden ponds. Pupation occurs in cocoons made of the same material as the cases. Adults fly from spring to autumn (March to November) in temperate regions. Two generations are produced per year in the northern and central parts of its range, whereas in the southern parts, several generations per year may occur. For more details on the life cycle and biology, see Van der Velde (1988), Vallenduuk & Cuppen (2004), and Goater *et al.* (2005).

Although it is relatively common in Europe, findings of *C. lemnata* are rare in eastern and southern Europe, including Serbia. So far, the species has been reported in the literature only five times (Plant & Jakšić, 2018), with the oldest record dating back to the beginning of the last century (Abafi-Aigner, 1910). The species was mentioned by Mihajlović (1978), with other records reported in the 21<sup>st</sup> century. The first was from Futog (near Novi Sad) by Kurz & Horvat (2010), the second from Đerdap National Park by Stojanović & Radaković (2016), and the third from Timočka Krajina (Zečević, 2002). All these findings were of adult moths. As the adult stages are simpler to identify, and with the advent of public online databases (Alciphron, biologer.rs), there have been multiple records of adult moths in recent years. To our knowledge, there has been no report of the aquatic/larval stage of *C. lemnata* from Serbia.

In this article, we report on new larval findings and provide additional data on the distribution and ecology of *C. lemnata* in Serbia. The rarity of aquatic findings is further discussed.

## Material and Methods

The study took place in the period 2017-2021. The sampling of benthic macroinvertebrates was conducted as part of the regular annual water-quality monitoring program of the Serbian Environmental Protection Agency (SEPA) and during research of wetlands in the area of Vojvodina in 2021 by the Faculty of Biology of the University of Belgrade.

The studied area covered the whole territory of Serbia. Samples were collected with a commercial benthological hand net (25x25 cm, 500-µm mesh) or manually with tweezers. All samples were preserved in 70% ethanol and processed in the laboratories of SEPA and the Faculty of Biology in Belgrade. Species identification was performed using the appropriate keys (Nilson, 1996; Vallenduuk & Cuppen, 2004) and a Zeiss SteREO Discovery.V8 stereomicroscope. Some of the identified specimens are deposited in the collection of aquatic macroinvertebrates at the Faculty of Biology, Institute of Zoology.

## Results

During regular annual water-quality monitoring in 2017 and 2018 by SEPA and surveys of smaller watercourses in Vojvodina by the Faculty of Biology (Belgrade) in 2021, the presence of *Cataclysta lemnata*, was confirmed at seven sites (Table I., Fig. 1).

Table I. New aquatic findings of *Cataclysta lemnata* in Serbia

	Site	Date	Coordinates	Elevation (m)	Number of individuals	Saprobic Index (Zelinka Marvan)
1	Novi Sad	18 Sep 2017	N 45.282389° E 19.816056°	76	1	2.30
2	Hetin	25 Sep 2018	N 45.652667° E 20.798667°	74	1	2.12
3	Doroslovo	02 Oct 2018	N 45.603944° E 19.175083°	79	2	2.24
4	Bač	02 Oct 2018	N 45.387833° E 19.232167°	76	2	2.18
5	Novo Miloševo	30 Oct 2018	N 45.768750° E 20.366417°	74	2	2.55
6	Sonta	28 May 2021	N 45.578493° E 19.054713°	77	1	2.36
7	Batar	04 Jun 2021	N 44.928147° E 19.474521°	76	1	2.38

All these sites are located in the Pannonian region of the country and are primarily artificial watercourses (canals) that are part of the extensive Danube-Tisza-Danube irrigation system (DTD). The findings of the species were from late spring (28 May) to autumn (30 Oct) (Table I), and the sites are characterized by dense aquatic and semi-aquatic vegetation (Figure 2). Most of these sites can be classified as polluted according to national legislation (Official Gazette RS, 74/2011). Particularly poor water conditions were found in the localities of Bač and Novi Sad.

From these seven localities/samples, a relatively small number (10) of *C. lemnata* were collected. All identified specimens were larvae and were classified as last instars (Fig. 3). Considering juvenile/smaller crambid larvae were frequently found in the samples, it was possible that some also belonged to *C. lemnata*.

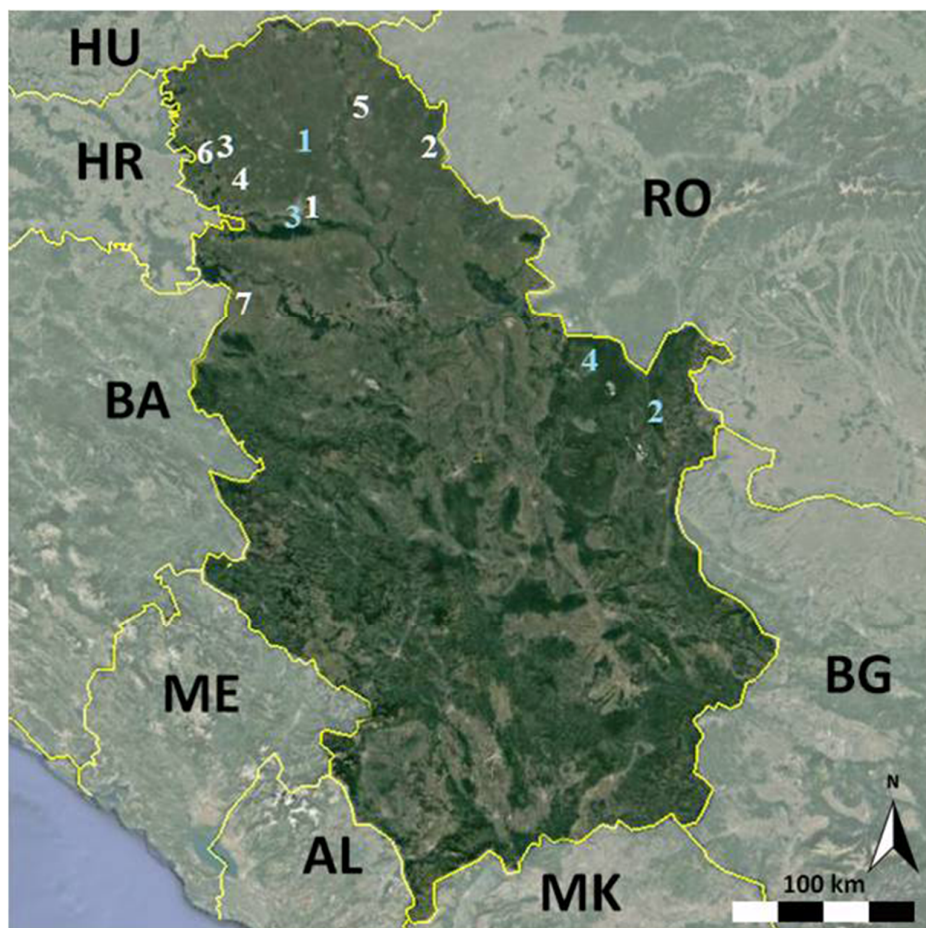


Figure 1. Distribution map of *Cataclysta lemnata* in Serbia; white numbers, our larval findings (numbered as in table 1); blue numbers – available literature data: 1 – Mihajlović (1978); 2 – Zečević (2002); 3 – Kurz & Horvat (2010); 4 – Stojanović & Radaković (2016).

Among the European aquatic crambids, *C. lemnata* can be confused with *Elophila nymphaeata* (Linnaeus, 1758) in the larval stage. In addition to a slightly different ecology, these two species can be distinguished in the later larval stages in that *C. lemnata* has narrower frames on the prolegs, and the anterior and posterior hook rows are not the same size (Fig. 3B) as in *E. nymphaeata*.





Figure 2. Typical habitat of *C. lemnata* (Savino Selo, Novi Sad, DTD canal; photo Author).

Also, the hook row of the claspers on the last abdominal segment (X) is curved at both ends (Fig. 3C), whereas it is straight or only slightly curved in *E. nymphaeata*. Finally, the prothoracic shield is uniformly dark brown in *C. lemnata* (Fig. 3A), whereas in *E. nymphaeata* it has a dark central area (on both sides of the median line), while the other parts are lighter (light brown).

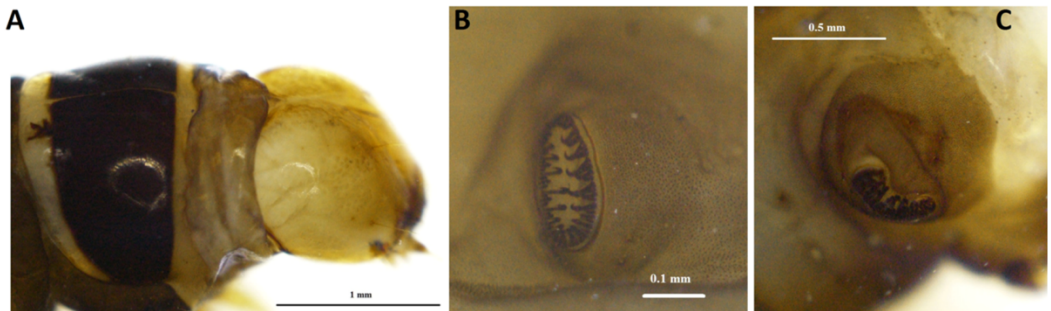


Figure 3. *C. lemnata* (final (IV) larval instar) from the Batar locality: A) head and the first thoracic segment, B) frame on a proleg (segment VII), C) hook row on the claspers (segment X) (photo Author).

## Discussion

Although considered one of the most common water moths in its range (Vallenduuk & Cuppen, 2004), aquatic records of *C. lemnata* are scarce in certain parts, especially in eastern and southern Europe (de Jong *et al.*, 2014; Gumhalter, 2019). Due to the lack of records, Serbia is a “grey area” as regards the occurrence of this water moth (Plant & Jakšić, 2018). Our records thus contribute significantly to the knowledge about the presence of this species in aquatic habitats in the region. It should be mentioned that our records are from the northern Pannonian region of the country (Fig. 1). Based on the available data from online databases (Alciphron, biologer.rs) as well as the relatively broad ecological preferences (Van der Velde, 1988; Vallenduuk & Cuppen, 2004; Goater *et al.*, 2005) and general distribution (Goater *et al.*, 2005; Agassiz, 2012; Farahpour-Haghani *et al.*, 2017) of the species, more reports from suitable aquatic habitats in central and southern Serbia could be expected. In addition, *E. nymphaeta* was recorded in Tara National Park (Stojanović *et al.*, 2014). Further surveys should be carried out in the near future.

Our records of the last larval stages in spring/summer and autumn suggest a bivoltine life cycle. Two generations have been reported for the northern and central parts of the species' range (Goater *et al.*, 2005). The relatively low number of specimens discovered (one or two per sample/site) might indicate a low abundance of this species in its habitats, which could partly explain its rare occurrence in the region thus far. Another reason for its rarity could be uncertain identification in the case of early larval stages (smaller, undeveloped larvae). It is conceivable that the species is more widespread and abundant, as smaller crambid larvae are not uncommon in macroinvertebrate samples routinely collected from the Pannonian watercourses and canals. To test this hypothesis, sequencing/barcoding of these smaller specimens should be carried out. *C. lemnata* is known to tolerate organic pollution and prefers calm or slow-moving waters with dense vegetation and duckweed (Vallenduuk & Cuppen, 2004). Our study confirms this, as most of the records were from alpha-mesosaprobic waters with dense aquatic vegetation where duckweed was abundant. Several records from less polluted habitats (Batar River, Zasavica Special Nature Reserve) indicate its broader ecological preferences.

Our results contribute to a better understanding of the presence of this species in the region and suggest that *C. lemnata* may be more abundant across its various aquatic habitats. We suspect that the limited records so far are due, in part, to the species being overlooked or unidentified during routine aquatic macroinvertebrate surveys. As adult forms are simpler to identify and likely easier to collect, and given that most lepidopteran specialists focus solely on adult forms (prior to our report, all reports on the species were based on the adult forms), recent data should provide more insight into this species' presence in the region. Regarding the aquatic stages, more thorough surveys are needed with a primary focus on suitable habitats across the region. Additionally, the use of molecular methods (barcoding) is essential for the identification of early larval stages.

## Acknowledgments

This research was financially supported by the Serbian Ministry of Science, Technological Development and Innovation (No. 451-03-47/2023-01/ 200178). The authors would like to thank the two anonymous reviewers who helped us to improve the manuscript.

## References

- Abafi-Aigner, L. (1910). Adaléka Magyar Tengermellék, Horvátország és Dalmácia lepkefaunájához. *Rovartani lapok*, 17(3-4), 55-57.
- Agassiz, D. (2012). The Acentropinae (Lepidoptera: Pyraloidea: Crambidae) of Africa. *Zootaxa*, 3494(1), 1-73.
- de Jong, Y., Verbeek, M., & Michelsen, V. (2014). Fauna Europaea - all European animal species on the web. *Biodiversity Data Journal*, 2: e4034.
- Farahpour-Haghani, A., Hassanpour, M., Alinia, F., Nouri-Ganbalani, G., Razmjou, J., & Agassiz, D. (2017). Water ferns *Azolla* spp. (Azollaceae) as new host plants for the small China-mark moth, *Cataclysta lemnata* (Linnaeus, 1758) (Lepidoptera, Crambidae, Acentropinae). *Nota Lepidopterologica*, 40(1), 1-13.
- Goater B., Nuss M., & Speidel, W. (2005). *Microlepidoptera of Europe*. In: Goater, B., Nuss, M., & Speidel, W. (Ed.): Pyraloidea I (Crambidae: Acentropinae, Evergestinae, Heliethelinae, Schoenobiinae, Scopariinae). Stenstrup, Denmark: Apollo Books, 304 pp.
- Gumhalter, D. (2019). First checklist of pyraloid moths (Lepidoptera: Pyraloidea) in Croatia. *Zootaxa*, 4604(1), 59-102.
- HabiProt (2021). Alciphron - baza podataka o insektima Srbije, <https://alciphron.habiprot.org.rs/listing-443044-cataclysta-lemnata>
- Kurz, M., & Horvat, L. (2010). New and interesting Lepidoptera from the Balkans (Serbia, Croatia, Bosnia and Montenegro). *Mitteilungen aus dem Haus der Natur*, 18, 5-55.
- Léger, T., Mally, R., Neinhuis, C., & Nuss, M. (2021). Refining the phylogeny of Crambidae with complete sampling of subfamilies (Lepidoptera, Pyraloidea). *Zoologica Scripta*, 50(1), 84-99.
- Mihajlovic, L. (1978). First contribution to the knowledge of the superfamily Pyraloidea. *Fauna of Serbia*, 2, 177-201.
- Nilson, A. (1996). Aquatic Insects of North Europe; A Taxonomic Handbook, vol 1: Ephemeroptera-Plecoptera-Heteroptera-Neuroptera-Megaloptera-Coleoptera-Trichoptera-Lepidoptera. *Stenstrup: Apollo Books*, 274 pp.
- Pabis, K. (2014). Life cycle, host plants and abundance of caterpillars of the aquatic moth *Cataclysta lemnata* (Lepidoptera: Crambidae) in the post-glacial lake in central Poland. *North-Western Journal of Zoology*, 10(2), 441-444.
- Plant, C. W., & Jakšić, P. (2018). A provisional checklist and bibliography of the Pyraloidea of the Balkan Peninsula. *Atalanta*, 49(1-4), 219-263.
- Popović M, Vasić N, Koren T, Burić I, Živanović N, Kulijer D, Golubović A. Biologer: An open platform for collecting biodiversity data. *Biodivers Data J*. 2020;8:e53014. <https://biologer.rs/sr/groups/29/species/14972>
- Službeni glasnik Republike Srbije 74/2011. Parametri ekološkog i hemijskog statusa površinskih voda i parametri hemijskog i kvantitativnog statusa podzemnih voda.
- Stojanović, D. V., & Radaković, N. Z. (2016). *Fauna Lepidoptera Nacionalnog Parka "Đerdap": Microlepidoptera (superfamilia Pyraloidea)*. Deo drugi. Nacionalni park "Đerdap", 145-146.
- Stojanović, D. V., Ćurčić, S. B. & Tomić, M. M. (2014). *Fauna Lepidoptera Nacionalnog parka „Tara“. Deo prvi - Microlepidoptera*. Institut za nizijsko šumarstvo i životnu sredinu, Univerzitet u Novom Sadu, JP Nacionalni park „Tara“ & JP Nacionalni park „Fruška gora“. Novi Sad-Bajina Bašta-Sremska Kamenica, 303 pp.
- Vallenduuk, H. J., & Cuppen, H. M. (2004). The aquatic living caterpillars (Lepidoptera: Pyraloidea: Crambidae) of Central Europe. A key to the larvae and autecology. *Lauterbornia*, 49, 1-17.
- Van Der Velde, G. (1988). *Cataclysta lemnata* L. (Lepidoptera, Pyralidae) can survive for several years consuming macrophytes other than Lemnaceae. *Aquatic botany*, 31(1-2), 183-189.
- Velasco Pazos, P., Revilla Temiño, P., Monetti, L., Butrón Gómez, A. M., Ordás Pérez, A., & Malvar Pintos, R. A. (2007). Corn borers (Lepidoptera: Noctuidae: Crambidae) in northwestern Spain: population dynamics and distribution. *Maydica* 52, 195-203.
- Zečević, M. (2002). *Fauna leptira Timočke krajine:(Istočna Srbija)*. Bakar Bor i Narodni muzej Zaječar, 307 pp.

## CATACLYSTA LEMNATA (LINNAEUS, 1758) (LEPIDOPTERA: CRAMBIDAE: ACENTROPINAE) У СРБИЈИ

ВАЊА МАРКОВИЋ, БОРИС НОВАКОВИЋ, МИЛЕНКА БОЖАНИЋ,  
КАТАРИНА СТОЈАНОВИЋ, АНЂЕЛИНА ТАТОВИЋ И ИВАНА ЖИВИЋ

### Извод

*Cataclysta lemnata* (Linnaeus, 1758) сматра се једним од најчешћих водених мољаца у Европи. Међутим, само неколико података је доступно за источну и југоисточну Европу, посебно на стадијумима ларве. Током истраживања водених макробескичмењака 2017-2021, *Cataclysta lemnata* је откривена на седам локалитета у панонском делу Србије. Сви налази се односе на ларвалну/водену фазу и потичу како из јако загађених, тако и из релативно незагађених водених станишта. Заједничка карактеристика свих локалитета је присуство биљке сочивице, што потврђује афинитет *Cataclysta lemnata* за ову биљку. Пријављени резултати доприносе бољем разумевању појаве ове врсте у региону и сугеришу да би могла бити распрострањенија у различитим воденим стаништима. Пошто је адулте лакше идентификовати, и уз појаву и развој наменских онлајн база (Alciphron, biologer.rs), последњих година пријављено је више налаза адулата ове врсте. Што се тиче ларвалних фаза, потребна су детаљнија истраживања, фокусирана првенствено на погодна станишта широм региона и допуњена употребом молекуларних метода.

Received: December 11th, 2023

Accepted: April 3rd, 2024