Data for the tick faunal studies of Kis-Balaton

Adatok a Kis-Balaton kullancsfaunisztikai vizsgálataihoz

Szilvia Kovács

MATE Georgikon Campus

kovacs.szilvia.georg@uni-mate.hu

Abstract: Recently, significant changes have been observed in the distribution patterns of ticks in Europe. Climate change affects the distribution and activity of ticks and also contributes to the emergence of new species, posing a serious health risk to people. The author conducted his studies between June 2023 and April 2024 in the inner areas of Kis-Balaton, starting from the Research House. Ticks were collected using the dragging method in 8 areas. During the 11-month of the survey, the author found 240 specimens of 5 species. *Dermacentor reticulatus* occurred with the highest frequency (78% of the collected individuals), and was found in the areas in every month except January. In addition, *Dermacentor marginatus* (14.5%), *Ixodes ricinus* (5.4%), *Haemaphysalis concinna* (1.6%), and *Haemaphysalis inermis* (0.4%) were found. *Dermacentor* species occurred in all months of the study period, while *I. ricinus* was present in the area in March, April and June. The thermophilous species *H. concinna* was found in the collected sample in June, while the cold-tolerant *H. inermis* was found in the collection in February. The survey results clearly show that ticks, which are responsible for the spread of tick-borne encephalitis, TIBOLA, Lyme disease, tularemia, and other significant diseases, are present in the area, with peak activity in spring and autumn.

***Keywords**: Kis-Balaton; tick; dragging; Dermacentor; climate change*

Összefoglalás: Az utóbbi időben jelentős változások figyelhetők meg a kullancsok elterjedési mintázatában Európában. A klímaváltozás hatással van a kullancsok elterjedésére, aktivitására és hozzájárul új fajok megjelenéséhez is, amelyek komoly egészségügyi kockázatot jelenthetnek a lakosságra nézve. A szerző vizsgálatait 2023 júniusa és 2024 áprilisa között végezte a Kis-Balaton belső területein a Kutatóháztól kiindulva. A kullancsok gyűjtése dragging módszerrel történt 8 területen. A felmérés 11 hónapja alatt 5 faj 240 példányát találta meg a szerző. Legnagyobb gyakorisággal a *Dermacentor reticulatus* fordult elő (a gyűjtött egyedek 78%-a), amely január kivételével minden hónapban megtalálható volt a területeken. Ezen kívül *Dermacentor marginatus (14,5%)*, *Ixodes ricinus (5,4%)*, *Haemaphysalis concinna (1,6%)* és *Haemaphysalis inermis (0,4%)* fajok kerültek elő. A *Dermacentor* fajok a vizsgálati időszak valamennyi hónapjában előfordultak, míg az *I. ricinus* március, április és június hónapban volt jelen a területen. A *H. concinna* melegkedvelő faj, ennek megfelelően júniusban fordult elő a gyűjtött mintában, míg a *H. inermis* hidegkedvelő, a februári gyűjtés során került elő. A felmérés eredményei jól mutatják, hogy a kullancsok, amelyek felelősek többek között a kullancsencephalitis, a TIBOLA, Lyme-kór, tularémia és egyéb jelentős betegségek terjesztéséért, jelen vannak a területen, tavaszi és őszi aktivitási csúccsal.

***Kulcsszavak**: Kis-Balaton; kullancs; dragging; Dermacentor; klímaváltozás*

1. Introduction

The study of the distribution and species composition of ticks (Ixodidae) is essential not only from an ecological perspective but also because of their public health importance. Tick distribution is influenced not only by the movement of host organisms (e.g., wildlife, migratory birds, dogs, cats, humans) but also by climate change, which increasingly facilitates the appearance of tick species not previously established in Hungary. With the growing likelihood of the introduction and emergence of novel pathogens, the risk of human infections also increases. Therefore, regular field surveillance and tick collection aimed at monitoring the occurrence and prevalence of native species responsible for transmitting human and (other) mammal pathogens, as well as the early detection of newly expanding species, is of outstanding preventive importance.

Due to changing climatic conditions, the distribution range of ticks in Europe is beginning to shift compared to previous patterns, and they are now detected even at higher altitudes (Cunze et al., 2022). In addition, global warming may have a significant impact on the occurrence and frequency of vector-borne diseases (Gray et al., 2009). Given the changing environmental conditions, the regular monitoring of tick species across different habitats is indispensable.

In Central and Western Europe, *Ixodes ricinus* (Linnaeus, 1758) is one of the most important and most frequently occurring tick species (Gray et al., 2024; Tóth et al., 2023). It is the principal vector of Lyme borreliosis (Lakos, 2012; Burn et al., 2023) and a transmitter of viruses, bacteria, and protozoa (Burn et al., 2023). The causative agent of Lyme disease is the *Borrelia burgdorferi* sensu lato species complex (Földvári and Rigó, 2009). In addition, *I. ricinus* is also primarily responsible for the transmission of tick-borne encephalitis (Zubriková et al., 2020).

In Central Europe, and in Hungary as well, the second most widespread tick species is *Dermacentor reticulatus* (Fabricius, 1794) (Rubel et al., 2014). It frequently occurs in cooler regions. While it is considered a characteristic species of floodplain and marshy habitats (Földvári and Farkas, 2005), in Hungary it has also established populations in drier grasslands (Hornok and Farkas, 2009). One of the most important human diseases transmitted by *D. reticulatus* is TIBOLA (tick-borne lymphadenopathy), which is most often caused by *Rickettsia slovaca* and *Rickettsia raoultii* (Barthel et al., 2025). The species also plays a role as a secondary vector in the transmission of the tick-borne encephalitis virus (Sidorenko et al., 2021). Furthermore, *D. reticulatus* is the primary vector of *Babesia canis*, the causative agent of canine babesiosis (Koczwarska et al., 2023).

Dermacentor marginatus (Sulzer, 1776) is typically associated with steppe habitats and drier meadows. In Hungary, it occurs primarily in the Transdanubian region, with the highest prevalence in Somogy, Zala, and Vas counties (Földvári and Farkas, 2005). The transmission of Q fever is most commonly linked to this species; however, the pathogen may also enter the human body via sheep as intermediate hosts or through the consumption of unpasteurized raw cow's milk (Kimmig et al., 2004).

Haemaphysalis concinna (Koch, 1844) plays an important role in the transmission of tick-borne encephalitis and tularemia (caused by *Francisella tularensis*), and it also serves as a vector for numerous pathogens of both human and veterinary relevance (Rubel et al., 2018). It is an endemic species in Europe. In Hungary, it is the third most widespread tick species after *I. ricinus* and *D. reticulatus* (Rubel et al., 2014).

2. Materials and Methods

During my research, I investigated the occurrence and frequency of various tick species in the Kis-Balaton area between June 2023 and April 2024. Sampling sites were selected within the

inner areas, some of which are frequently visited by tourists during guided tours, while the remaining areas are primarily accessed by professional staff. Tick occurrence was examined at eight locations: 1. Research House, 2. Bank of the Gyöngyös Creek, 3. Meadow, 4. Diás Island, 5. Almás Island Lookout, 6. Ingói Marshes, 7. "Mulch area", and 8. Airport corner (Figure 1). Collections were conducted during the morning or early afternoon depending on weather conditions.

Field surveys were performed using the dragging method. A 1 m² light-colored textile towel attached to a pole was dragged over the vegetation at each sampling site for a standardized duration of 8 minutes. The towel was checked every 3–4 meters within the sampling area. Ticks easily clung to the loops of the towel fabric and were collected using tweezers. Specimens were stored in 1.5 ml Eppendorf tubes containing 70% ethanol. Species identification was carried out using a stereomicroscope, referencing Babos Sándor's faunistic guide (1965) and Hillyard's (1996) identification keys.

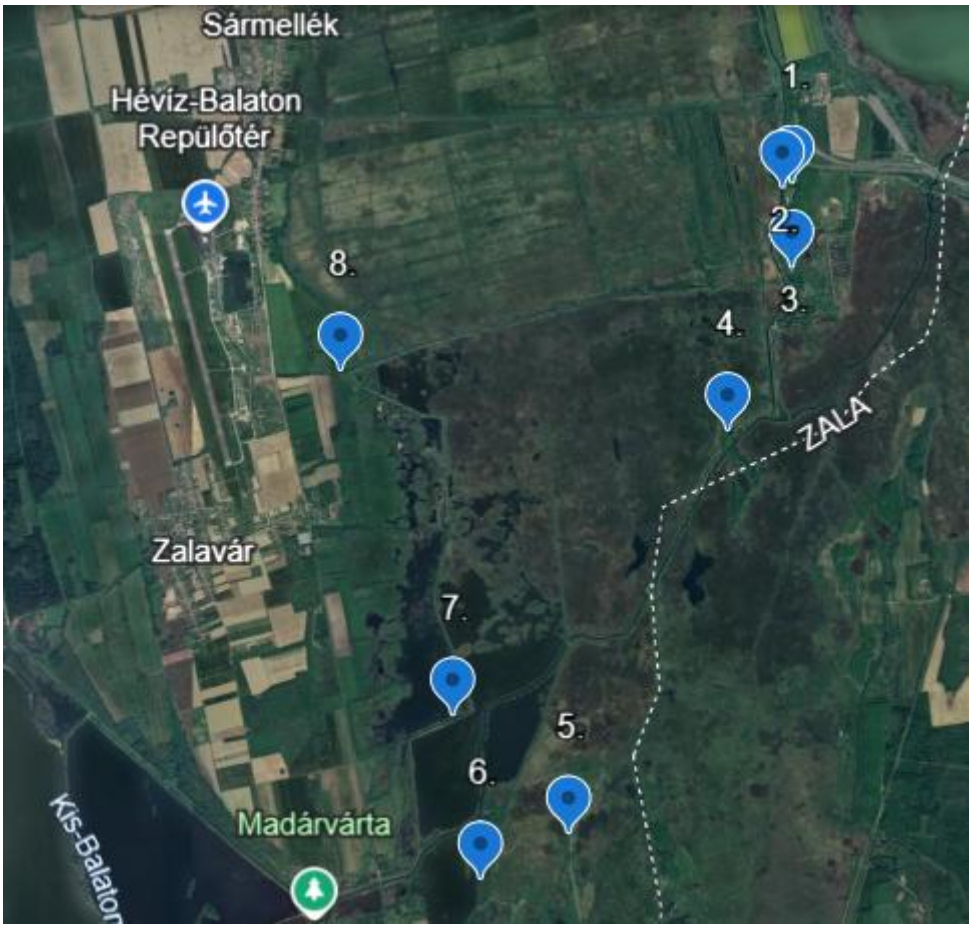

Figure 1 *Simpling locations: 1. Research house, 2.Bank of the Gyöngyös creek, 3.Meadow, 4.Diás Island, 5.Almás Island Lookout, 6. Ingói Marshes, 7. "Mulch area", 8. Airport corner (Source of locations: Google Earth web)*

3. Results

During the study period, a total of 240 ticks were collected, belonging to the genera *Dermacentor*, *Ixodes*, and *Haemaphysalis*.

Research House: This site represents a grassland–forest ecotone. A total of 61 ticks were collected here, of which 74% were *D. reticulatus* (28 males, 17 females). No specimens were collected from January to March or during the hot summer months. The majority of individuals were collected in September (6 females, 2 males) and October (7 males, 5 females). Nine *D. marginatus* specimens (4 females, 5 males) were collected between March and April. For *I. ricinus*, two specimens were collected in June and two in March, while three *H. concinna* were collected in June (1 larva, 1 adult male, 1 adult female).

Bank of the Gyöngyös Creek: Dense grass cover provided suitable microhabitats for ticks. Only *Dermacentor* species were collected here: 38 *D. reticulatus* and 17 *D. marginatus*. All ticks were adults. Of the *D. reticulatus*, 27 were males and 11 females; for *D. marginatus*, 11 were females and 6 males. Peak abundance occurred in October, November, and February. No ticks were collected in July, December, or January.

Meadow: Characterized by grasslands with floodplain forest vegetation. A total of 31 ticks were collected, 87% of which were *D. reticulatus* (19 females, 9 males). Peak abundance for this species was observed in October and April, with the lowest, a single individual, in June. The species was absent during summer and winter months. Two *D. marginatus* males were collected in July, one female *I. ricinus* in June, and one male *H. concinna* in June.

Diás Island: A frequently visited area with surrounding floodplain forest providing shaded habitats. Periodic water coverage occurs during rainy weather, creating unfavorable conditions for ticks. A total of 29 ticks were collected, 72% of which were *D. reticulatus* (15 females, 6 males). Three female *D. marginatus*, three female *I. ricinus* and one male, and one female *H. concinna* were also collected.

Almás Island Lookout: Frequently visited by tourists, with notable wildlife activity contributing to tick distribution. Only *Dermacentor* species were collected: 23 *D. reticulatus* (17 females, 6 males) and one *D. marginatus*. Most *D. reticulatus* were collected in April (7 specimens), with additional activity in September (5) and October (4), as well as February (5).

Ingói Marshes: Sampling occurred on the grassy area between the embankment and the roadside forest strip. Low numbers of three species were collected: *D. reticulatus* (4 females, 3 males), *D. marginatus* (1 male), and *Haemaphysalis inermis* (1 male). Peak abundance of *D. reticulatus* was recorded in September and April (3 individuals each), with one individual in February. The *D. marginatus* male was collected in January, and the *H. inermis* male in February.

"Mulch Area": Also located between embankment and forest strip. Mostly *D. reticulatus* were collected (11 individuals: 7 females, 4 males). Peak activity was observed in April (6 specimens), with 2 collected in September and 3 in a mild February period. One *D. marginatus* was collected in October, and one *I. ricinus* in June.

Airport corner: Characterized by mixed grass and woody vegetation, with high wildlife activity. Only *Dermacentor* species were found: 17 *D. reticulatus* (10 females, 7 males) and one *D. marginatus*. Specimens were only collected in September and April.

Considering overall species occurrence, four species were recorded at the Research House and Kis-Diás Island (*D. reticulatus*, *D. marginatus*, *I. ricinus*, *H. concinna*). Only *Dermacentor* species were found at the Gyöngyös Creek, Almás Island, and Airport Corner, whereas *I. ricinus* also occurred at the Meadow, Mulch Area, and Ingói Marshes. *H. inermis* was only detected at Ingói Marshes.

Monthly occurrence data (Tables 1 and 2) show two main activity peaks. In 2023, *D.* reticulatus dominated in September and October, with high abundance continuing in November. *D. marginatus* showed higher occurrence in October and April. The year 2023 was among the warmest in recent Hungarian history, contributing to high tick numbers during the autumn period. *I. ricinus* was observed in low numbers in June, March, and April. *H. concinna* was only recorded in June at the Research House and Kis-Diás Island.

Table 1 Occurrence of tick species between June and November 2023 (number of individuals) in the Kis-Balaton region

Species/Collection date	June	July	Aug.	Sept.	Oct.	Nov.
Dermacentor reticulatus	2		7	28	36	17
Dermacentor marginatus	2	2	1	1	10	3
Ixodes ricinus	5					
Haemaphysalis concinna	4					
Haemaphysalis inermis						

Table 2 Occurrence of tick species between December and April 2024 (number of individuals) in the Kis-Balaton region

Species/Collection date	Dec.	Jan.	Feb.	Mar.	Apr.
Dermacentor reticulatus	2		21	10	64
Dermacentor marginatus		1	5	2	8
Ixodes ricinus				7	1
Haemaphysalis concinna					
Haemaphysalis inermis			1		

During the surveys, 97.5% of the collected ticks were in the adult stage. Only seven nymphs (3 *I. ricinus*, 4 *D. reticulatus*) and one larva (*H. concinna*) were found alongside the adults. The species composition was 78% *D. reticulatus*, 14.5% *D. marginatus*, 5.4% *I. ricinus*, 1.6% *H. concinna*, and 0.4% *H. inermis*.

The high tick abundance in the autumn months was due to the unusually warm weather. September 2023 temperatures were 3.5°C higher than in previous years, and October was also milder than usual. Daily mean temperatures in 2023 deviated significantly from the multi-year average, resulting in the warmest autumn months since 1901 (Internet1). The winter months of 2023/2024, following the mild autumn, were the warmest recorded since 1901. February was particularly mild, showing spring-like temperatures (Internet2). These conditions also affected tick activity: in February, *D. reticulatus* was present in high numbers at the study sites. *D. marginatus* was recorded in January and February. During the March and April collections, a significant number of *D. reticulatus* (n=64) indicated their active period.

4. Discussion

The collections from June 2023 to April 2024 demonstrate that environmental conditions in the Kis-Balaton region are suitable for the permanent presence of ticks. Their occurrence varies

among sites, as it is influenced by specific habitat preferences, the presence of hosts, and fluctuating temperatures. Milder winters and a long, warm autumn extend the active period of ticks, increasing the potential for pathogen transmission.

During my surveys, *Dermacentor* species were present in all months in the inner areas of Kis-Balaton, demonstrating both the high adaptability of these species and increasingly favorable temperature conditions. Milder winters and the absence of snow facilitate the proliferation of tick populations. Their primary hosts in the region, red deer and wild boar are abundant, contribute to the wider distribution of these species within Kis-Balaton. *Ixodes ricinus*, *Haemaphysalis concinna* and *H. inermis*, in contrast to *Dermacentor* species, prefer cooler, shaded habitats. *I. ricinus* specimens were observed in March, April, and June at half of the sampling sites. Their activity peaks in May–June, followed by a second autumn peak. The four *H. concinna* specimens collected in June indicate that this species favors warmer conditions, whereas the *H. inermis* collected in February is cold-adapted.

Among the tick species recorded in Kis-Balaton, *D. reticulatus* and *I. ricinus* are of particular public health significance. *I. ricinus* is the main vector of the tick-borne encephalitis virus, while *D. reticulatus* primarily transmits TIBOLA and, to a lesser extent, also contributes to the transmission of tick-borne encephalitis virus to humans. Additionally, *D. reticulatus* is a significant vector of *Babesia canis* in dogs. All species studied play an important role in transmitting pathogens to humans, making their monitoring and knowledge of occurrence essential for disease prevention and control.

The highly diverse fauna of Kis-Balaton ensures the presence of suitable hosts for ticks, allowing all developmental stages to feed and develop. Kis-Balaton is part of the Natura 2000 network, designating it as a protected area, especially for birds. The avifauna is particularly rich, especially during migration periods, highlighting the importance of monitoring the local tick population. Global warming may facilitate the introduction of tick species by migratory birds, which pose potential threats to humans. In recent years, *Hyalomma* species have appeared in Hungary, likely transported by migratory birds. *Hyalomma marginatum* (Koch, 1844) and *Hyalomma rufipes* (Koch, 1844) are among the most important vectors of Crimean-Congo hemorrhagic fever. Ticks are active from spring to autumn and can survive the winter in Hungary following molting. There is no treatment for the viruses carried by these ticks, and human infection can be fatal (Internet3). Observing the spread of these non-native ticks is crucial, especially given their distinct hunting behaviour, as they actively pursue hosts, unlike local species which wait on vegetation.

The unique bird fauna of Kis-Balaton warrants attention not only for conservation purposes but also for public health, due to the potential presence of dangerous tick species. Mapping the distribution of potentially lethal ticks is crucial for preventive measures. Faunistic surveys are indispensable for this purpose.

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References

Babos, S. 1965. Kullancsok – Ixodidea. Magyarország állatvilága. Fauna Hungariae. XVIII. kötet. 7. füzet. Akadémiai kiadó, Budapest. 38 pp.

Barthel, C., Stynen, J., Grau, M., Poulle, M-L., Bauda, P., and Boulanger, N. 2025. *Dermacentor* ticks and their human pathogens in various ecosystems of eastern France, *Ticks and Tick-borne Diseases*, **16 (**4), 102520, https://doi.org/10.1016/j.ttbdis.2025.102520.

Burn, L., Tran, T. M. P., Pilz, A., Vyse, A., Fletcher, M. A., Angulo, F. J., Gessner, B. D., Moïsi, J. C., Jodar, L. and Stark, J. H. 2023. Incidence of Lyme Borreliosis in Europe from National Surveillance Systems (2005-2020). *Vector Borne Zoonotic Disease* 2023 Apr., **23** (4) 156–171. https://doi.org/10.1089/vbz.2022.0071

Cunze, S., Glock, G., Kochmann, J. and Klimpel, S. 2022. Ticks on the move – climate change-induced range shifts of three tick species in Europe: current and future habitat suitability for *Ixodes ricinus* in comparison with *Dermacentor reticulatus* and *Dermacentor marginatus*. *Parasitology Research* **121.** 2241–2252. https://doi.org/10.1007/s00436-022-07556-x

Földvári, G., Farkas, R. 2005. A *Dermacentor reticulatus* (Acari: Ixodidae) kullancsfajjal kapcsolatos irodalmi áttekintés és újabb ismeretek a hazai előfordulásáról. *Magyar Állatorvosok Lapja*, **127.** 289–298.

Földvári, G., Rigó, K. 2009. A Lyme borreliosis járványtana és a gyíkfajok szerepe a betegség fenntartásában. *Magyar Állatorvosok Lapja*. **131.** 494–502.

Gray, J. S., Dautel, H., Estrada-Peña, A., Kahl, O. and Lindgren, E. 2009. Effects of climate change on ticks and tick-borne diseases in Europe. *Interdisciplinary Perspectives on Infectious Diseases* 2009:593232. https://doi.org/10.1155/2009/593232

Gray, J., Kahl, O. and Zintl, A. 2024. Pathogens transmitted by *Ixodes ricinus*, *Ticks and Tick-borne Diseases*, **15** (6) 102402. https://doi.org/10.1016/j.ttbdis.2024.102402.

Hillyard, P. D. 1996. Ticks of North-West Europe. Field Studies Council, Shrewsbury. p. 178.

Hornok, S., Farkas, R. 2009. Influence of biotope on the distribution and peak activity of questing ixodid ticks in Hungary. *Med. Vet. Entomol*., 23, pp. 41–46 https://doi.org/10.1111/j.1365-2915.2008.00768.x

Kimmig, P., Hassler, D. and Braun, R. 2004. Kullancsok. Egy kis szúrás súlyos következményekkel. M-érték Kiadó, Budapest. 54–55.

Koczwarska, J., Pawełczyk, A., Dunaj-Małyszko, J., Polaczyk, J. and Welc-Falęciak, R. 2023. *Rickettsia* species in *Dermacentor reticulatus* ticks feeding on human skin and clinical manifestations of tick-borne infections after tick bite. *Scientific Reports* **13**, 9930 https://doi.org/10.1038/s41598-023-37059-3

Lakos, A. 2012. Kullancs által terjesztett fertőzések: Lyme Borreliosis, kullancsencephalitis, TIBOLA. MTA Doktora Pályázat Doktori Értekezés, Budapest. p. 162.

Rubel, F., Brugger, K., Monazahian, M., Habedank, B., Dautel, H., Leverenz, S. and Kahl, O. 2014. The first German map of georeferenced ixodid tick locations. Parasit Vectors,7, p.477. https://doi.org/10.1186/PREACCEPT-1023109208140332

Rubel, F., Brugger, K., Walter, M., Vogelgesang, J. R., Didyk, Y. M., Fu, S. and Kahl, O. 2018. Geographical distribution, climate adaptation and vector competence of the Eurasian hard tick Haemaphysalis concinna, *Ticks and Tick-borne Diseases*, **9** (5), Pages 1080–1089, ISSN 1877-959X, https://doi.org/10.1016/j.ttbdis.2018.04.002

Sidorenko, M., Radzijevskaja, J., Mickevičius, S., Bratčikovienė, N., Paulauskas, A. 2021. Prevalence of tick-borne encephalitis virus in questing Dermacentor reticulatus and Ixodes ricinus ticks in Lithuania, *Ticks and Tick-borne Diseases*, Volume 12, Issue 1, 101594, ISSN 1877-959X, https://doi.org/10.1016/j.ttbdis.2020.101594

Tóth, A. G, Farkas, R., Papp, M., Kilim, O., Yun, H., Makrai, L., Maróti, G., Gyurkovszky, M., Krikó, E., Solymosi, N. 2023. *Ixodes ricinus* tick bacteriome alterations based on a climatically representative survey in Hungary. Microbiol Spectr. 2023 Dec 12;11(6):e0124323. https://doi.org/10.1128/spectrum.01243-23

Zubriková, D., Wittmann, M., Hönig, V., Švec, P., Víchová, B., Essbauer, S., Dobler, G., Grubhoffer, L., Pfister, K. 2020.Prevalence of tick-borne encephalitis virus and *Borrelia burgdorferi sensu lato* in *Ixodes ricinus* ticks in lower Bavaria and upper Palatinate. Germany Ticks Tick Borne Dis.;11(3):101375. https://doi.org/10.1016/j.ttbdis.2020.101375

Internet sources:

http1: https://www.met.hu/eghajlat/magyarorszag_eghajlata/eghajlati_visszatekinto/elmult_evszakok_idojarasa/main.php?no=6&ful=3

http2: https://masfelfok.hu/2025/08/19/hyalomma-kullancs-klimavaltozas/