

## New records of *Larinia elegans* (Araneae: Araneidae) from Czechia and North Macedonia with remarks on its ecology

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**Abstract.** *Larinia elegans* Spassky, 1939 is an orb-weaver (Araneidae) inhabiting reeds growing from shallow water bodies from central Europe to China. In Europe, it was previously only found in Austria, Hungary, Czechia, Ukraine and southern part of European Russia. In this study, we present the first record of this species for North Macedonia as well as further records from Czechia. We also provide a synthesis of the ecological data, supported by our observations. Additionally, we highlight its cryptic way of life and prompt arachnologists in surrounding countries to search for this species, which may have been overlooked in the past.

**Keywords:** Dojran, eulittoral, Nové Mlýny, orb weavers, range expansion, reed, spiders, steppe lakes

**Zusammenfassung. Neue Nachweise von *Larinia elegans* (Araneae: Araneidae) aus Tschechien und Nordmazedonien mit Bemerkungen zur Ökologie.** *Larinia elegans* Spassky, 1939 ist eine Radnetzspinne (Araneidae), die Schilfbestände an flachen Gewässern von Mitteleuropa bis China bewohnt. In Europa wurde sie jedoch nur in Österreich, Ungarn, Tschechien, der Ukraine und im südlichen Teil des europäischen Russlands gefunden. In dieser Studie präsentieren wir den ersten Nachweis dieser Art für Nordmazedonien sowie weitere Funde für Tschechien und bieten eine Synthese der ökologischen Daten, die durch unsere Beobachtungen gestützt werden. Zudem möchten wir ihre verborgene Lebensweise aufzeigen und die Arachnologen in den umliegenden Ländern dazu veranlassen, nach diesen Spinnen zu suchen, weil sie möglicherweise übersehen wurden.

The araneid genus *Larinia* Simon, 1874 comprises 61 species distributed over all continents except Antarctica (WSC 2023). Four native members of this genus can be found in Europe, namely *L. bonneti* Spassky, 1939, *L. elegans* Spassky, 1939, *L. jeskovi* Marusik, 1986 and *L. lineata* (Lucas, 1946). Moreover, the non-native species *L. phthibisica* (L. Koch, 1871) was recorded in Crete (Bosmans et al. 2013).

In Central Europe, *Larinia elegans* was first described as a new species of the genus *Singa* from the area of Lake Fertő (Nemenz 1956). Jäger (1995) later noted, based on an examination of type specimens of *Singa phragmiteti* Nemenz, 1956 and drawings in Spassky's publication, that *S. phragmiteti* is in fact a junior synonym of *L. elegans*. This finding was later referred to by other publications from Central Europe (Szita et al. 2002, Szinetár & Eichardt 2004).

*Larinia elegans* differs from its congeners by the morphology of genitalia and by a distinctive dorsal pattern, which makes it identifiable even at immature stages (Marusik 1986). Although the species inhabits a large area spanning from Austria to China, its known distribution is rather patchy and faunistic records relatively scarce. Until recently, in Europe it was only found in Austria (Nemenz & Pühringer 1973, Thaler & Knoflach 2003), Czechia (Šich & Rückl 2020, Řezáč et al. 2021), Hungary (Szinetár & Eichardt 2004), Ukraine (Spassky 1939, Marusik 1986) and the southern part of Russia (Ponomarev et al. 2011). This goes hand in hand with the

affinity of *L. elegans* to larger shallow water bodies with a dense vegetation of reeds, a steppe-bound biotope found only locally across Europe (Nemenz & Pühringer 1973, Marusik 1986, Szinetár & Eichardt 2004, Šich & Rückl 2020).

*Larinia elegans* is a nocturnal species (Szinetár & Eichardt 2004), which makes a new orb web only when it is dark (Šich & Rückl 2020). During the day, the spiders hide in reed ears (Nemenz & Pühringer 1973, Šich & Rückl 2020), less often in reed stumps (Nemenz & Pühringer 1973). In Hungary, *L. elegans* was also found on *Schoenoplectus litoralis* (Schrad.) during daylight, because this plant does not provide such good hiding places as reeds (Szinetár & Eichardt 2004). *Larinia elegans* can also be effectively collected in traps made of broken reeds, which it widely uses as a suitable shelter for overwintering (Szinetár et al. 2012).

Mating, which takes place in summer, is known for a phenomenon of female genitalia mutilation. During copulation, the males of some *Larinia* orb-weavers (including *L. elegans*) tear off a part of the female's epigyne called the scapus (Nemenz & Pühringer 1973, Marusik 1986, Szinetár & Eichardt 2004). In this way, the male tries to monopolize the female because she can no longer mate with other males after the scapus is removed. In *L. jeskovi*, it was found that at the end of the mating season, all females had their genitalia mutilated (Mouginot et al. 2015). Although more detailed observations of the mating process are lacking for *L. elegans*, the same principles can be expected in this species.

According to Nentwig et al. (2023), adults of both sexes of *L. elegans* supposedly occur in May and June only. In Szinetár & Eichardt (2004), adults were recorded from May–September. However, the literature also mentions one case of an adult male found in October (Nemenz 1956). The young spiders hatch from the eggsacs at the end of summer (Szinetár & Eichardt 2004) and overwinter as subadults especially in reed stumps (Nemenz & Pühringer 1973).

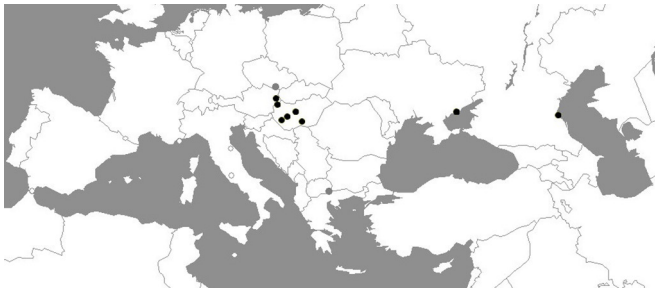
### Material and methods

In Czechia, we observed *Larinia elegans* on 12. Jun. 2020, 11. Sep. 2020, 30. Apr. 2021 and 17.–18. Jun. 2022. We arrived at the localities at around 9 pm, before sunset. Documenting

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**Fig. 1:** Map of the known distribution of *Larinia elegans* in Europe. Black circles – localities of older published records; grey circles – localities in Czechia and North Macedonia

of the behaviour of *L. elegans* began after sunset at around 9:30 pm. On the 19. Jun. 2022, our observations took place at 3:30 am in the morning. In North Macedonia, we visited the locality on 2. Nov. 2018, 2. Sep. 2021, 2. Oct. 2021, 7. Jul. 2022 and 5. Nov. 2022.

In both countries, we searched for spiders in their webs at night using an LED reflector and observed and photographed them in their natural habitat. We limited our research to the coast and close eulittoral zone. We excluded exploring of reeds in deeper water zones, because we did not have sufficient equipment to do so. Voucher individuals of *L. elegans* were hand-collected and fixed in ethanol. Here, we present a complete list of findings and observations of *L. elegans* in Czechia and North Macedonia. These represent the first published records of this species for North Macedonia.

Collected material is deposited in the National Museum of the Czech Republic in Prague and in the personal collections of the authors. The spiders were identified according to Nentwig et al. (2023). Digital photos of specimens from Czechia were taken by the fourth author using an Olympus DP70 camera mounted on an Olympus SZX12 stereomicroscope. Photos of the copulatory organs were stacked in Deep Focus 3.1 implemented in QuickPHOTO MICRO 2.3. Digital photos of field observations in Czechia were taken using a Canon EOS 77D digital camera with a Canon EF 100mm f/2.8L Macro IS USM lens and a Nikon D750 digital camera and Sigma 150mm F 2.8 EX APO DG HSM lens. Digital photos of field observations in North Macedonia were taken using an Olympus TG5 digital camera.

The following abbreviations are used: coll. – collection, det. – identified, juv. – juvenile, NMPC – National Museum

of the Czech Republic, Prague, leg. – collected, obs. – observed, rev. – revised.

## Results

*Larinia elegans* Spassky, 1939

CZECHIA (Figs 1, 2a, 3-4, 5a, 6): 1 ♂, 1 ♀, Nové Mlýny dam, Pasohlávky, 48.8988°N, 16.5337°E, 172 m a.s.l., ear of *Phragmites australis* on the coast of dam, 8. May 2020, leg. & det. R. Šich, rev. P. Dolejš, hand collecting, coll. NMP (P6A 7351), first record for Czechia; 3 ♂♂, 7 ♀♀, same locality, 10. May 2020, obs. R. Šich; 2 ♂♂, 2 ♀♀, same locality, 12. Jun. 2020, leg. & det. R. Šich & K. Rückl, hand collecting, coll. R. Šich (Šich & Rückl 2020); 2 juv., same locality, 11. Sep. 2020, obs. R. Šich & K. Rückl; 15 juv., same locality, 30. Apr. 2021, obs. R. Šich & K. Rückl.

1 ♂, Nové Mlýny dam, Pasohlávky, 48.8931°N, 16.5897°E, 188 m a.s.l., ear of *P. australis* on the coast of dam, 17. Jun. 2022, leg. & det. K. Rückl & V. Střeščík, hand collecting (Rückl & Střeščík 2022).

1 ♂, 2 ♀♀, Nové Mlýny dam, Horní Věstonice, 48.8849°N, 16.6090°E, 180 m a.s.l., *P. australis* on the coast of dam, 17. Jun. 2022, leg. & det. K. Rückl & V. Střeščík, hand collecting (Rückl & Střeščík 2022); dozens ♀♀, same locality, 17.–19. Jun. 2022, obs. K. Rückl & V. Střeščík;

1 ♀, Nové Mlýny dam, Dolní Věstonice, 48.8887°N, 16.6523°E, 177 m a.s.l., ear of *P. australis* on the coast of dam, 18. Jun. 2022, leg. & det. K. Rückl & V. Střeščík, hand collecting (Rückl & Střeščík 2022).

In Czechia (Southern Moravia, Nové Mlýny dam) the first adult specimens of *Larinia elegans* were discovered in May 2020 by individual collection from ears of reeds *Phragmites australis* (Cav.) Trin. Ex Steud (Fig. 3) (Šich & Rückl 2020). During nightly observations since June 2020, a large population was recorded. When it was not yet completely dark, we did not find any webs or specimens of *L. elegans*, but we observed abundant *Larinioides suspicax* (O. Pickard-Cambridge, 1876) specimens repairing their webs. In complete darkness (around 9:30 pm) many *L. elegans* individuals left their nests and built new orb-webs (Fig. 4a). According to early morning observations (3:30 am), specimens of this species had by then completely wrapped their webs and consumed the silk with small insects which were caught in the cobweb (Fig. 4b). At dawn (around 4 am), the spiders disappeared. Some hid in old reed leaves (Fig. 5a). During the day the spiders were



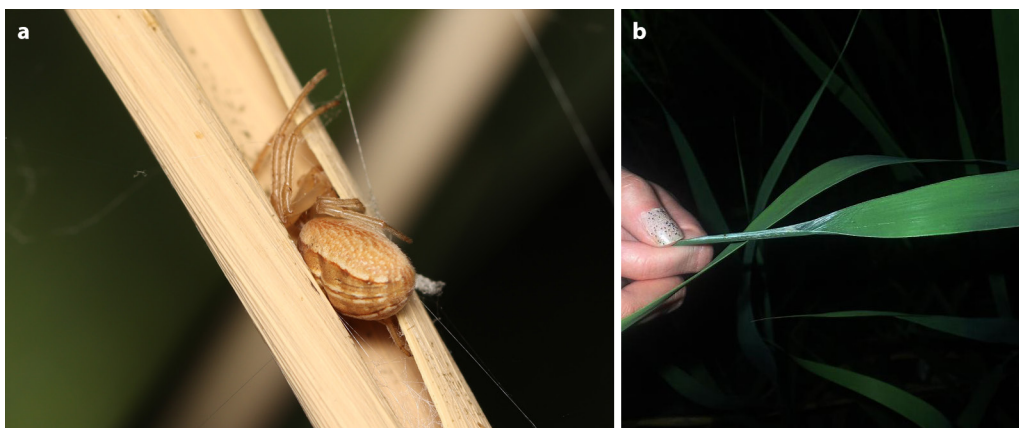
**Fig. 2:** Biotops of *Larinia elegans* in **a.** Czechia (photo V. Střeščík) and **b.** Macedonia (photo M. Komnenov)



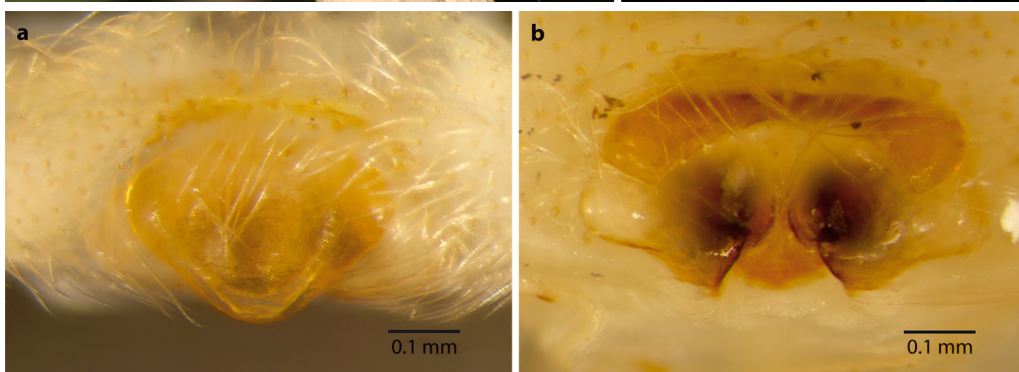
**Fig. 3:** *Larinia elegans* in reed ear (Czechia). **a.** adult male; **b.** adult female in nest (photo R. Šich)



**Fig. 4:** *Larinia elegans*, adult females (Czechia). **a.** female in the web; **b.** another female eating insect after wrapping her web (photo K. Rückl)



**Fig. 5:** *Larinia elegans*, adult female hiding in **a.** reed leaf (Czechia, photo K. Rückl); **b.** freshly folded green reed leaf (Macedonia, photo M. Komnenov)



**Fig. 6:** Epigyne of *Larinia elegans* (Czechia). **a.** with preserved scapus; **b.** with torn scapus after mating (photo P. Just)

hidden in their nests and we did not find any of their webs. The spiders preferred reeds growing in the water right by the shore. On the reeds above the ground, individuals built their webs only rarely. Some of the captured females had the scapus of the epigyne torn off (Fig. 6).

**NORTH MACEDONIA** (Figs 1, 2b, 5b): 3 juv., Dojran Lake, Nov Dojran, 41.2108°N, 22.7091°E, 155 m a.s.l., on *P. australis* near the lake, sweep netting during the daytime, 2.

Nov. 2018, leg. P. Just, M. Komnenov & N. Petrářová, det. P. Just & M. Komnenov, coll. M. Komnenov; 18 juv., same locality, hand collecting, 2. Oct. 2021, leg. & det. M. Komnenov & M. Trajkovska, coll. M. Komnenov; 2 ♂♂, 2 ♀♀, same locality, hand collecting, 2. Jul. 2022, leg. & det. M. Komnenov & M. Trajkovska, coll. M. Komnenov; 3 juv., same locality, hand collecting, 5. Nov. 2022, leg. & det. M. Komnenov, coll. M. Komnenov.

In North Macedonia, the first specimens of *L. elegans* were collected on 2. Nov. 2018 in the area of Nov Dojran, during daytime by sweep netting on the reeds *P. australis* by the Dojran lake. After detailed searches at the same locality on 2. Sep. 2021, using different collecting techniques such as sweep netting, hand collecting and suction sampling, no samples of *L. elegans* were found during daytime. We also did not observe any old orb webs of *L. elegans* from the previous night. The only juvenile specimen was found by hand checking at the highest parts of the reeds growing on the ground next to the shore, in reed ears, where it was resting in the silk net. When we returned to the same place at 7:30 pm when it was already dark, we observed a large population of *L. elegans* with already constructed orb webs among the reeds. On 7. Jul. 2022 at 7:45 pm we visited the same locality. Even though it was not completely dark, individuals of *L. elegans* were starting to build their webs. We observed again high number of spiders, but this time a high percentage of them were adult specimens, both male and female. We also observed mating between some of these individuals, which confirms that mating takes place during summer. From an ecological point of view, it is interesting to highlight one case of finding a single female at 7:46 pm, hidden in a freshly folded green reed leaf (Fig. 5b).

### Discussion

The behaviour, time of occurrence and the habitat preferences of *L. elegans* in Czechia and North Macedonia, correspond with previously published studies (Nemenz & Pühringer 1973, Szinetár & Eichardt 2004, Šich & Rückl 2020). This orb-weaver builds its web at night and ingests it in the morning, which can be explained as a means to save water and components for building a new sticky web spiral (Opell 2021, Townley & Tillinghast 2013).

During the night, the web of *L. elegans* is damaged by wind and insects. In addition, the main prey items are members of the order Diptera, which are most active at night. For these reasons, it seems more advantageous for the spider to take its web down in the morning. Unlike *L. elegans*, the co-occurring species *Larinioides suspicax* and *Singa nitidula* C. L. Koch, 1844 do not seem to have their webs exposed to the wind as often (personal observation), thus these spiders leave them until the following evening. According to Nemenz & Pühringer (1973) *L. elegans* does not need any web for hunting. However, these authors did not note at what time they observed the spiders feeding, so they most likely found individuals during the morning ritual of ingesting their webs. Similar nocturnal activity including web building after sunset and removing it in the early morning has been described in, e.g., four members of genus *Neoscona* Simon, 1894 in Japan (Yamanoi & Miyashita 2005).

During the day, specimens of *L. elegans* remain hidden in their nests in reed ears, stumps or leaves mostly growing from water. Their nests in reed ears are similar to those of *Larinioides suspicax*, *Clubiona phragmitis* C. L. Koch, 1843, *Cheiracanthium mildei* L. Koch, 1864 and the salticids of the genus *Marpissa* C. L. Koch, 1846 and *Heliophanus* C. L. Koch, 1833. However, the walls of the nest of *L. elegans* are thicker (Šich & Rückl 2020).

Unlike *L. elegans*, the more numerous *L. suspicax* prefers habitats on the shore than above water. We collected and ob-

served specimens of *L. elegans* only within reach of the mainland, but according to Nemenz & Pühringer (1973) and Szinetár & Eichardt (2004) we assume that they live in the reeds further from the shore as well. The exact reason for life in the eulittoral zone is not yet fully understood. It may represent the occupation of a free ecological niche and greater safety from terrestrial predators.

Similar to *L. elegans*, three Central European members of Tetragnathidae, *Tetragnatha raimoseri* (Roşca, 1939), *T. shoshone* Levi, 1981 and *T. striata* L. Koch, 1862 occur on plants above water bodies (Hajdamowicz 2009, Nentwig et al. 2023). Another elusive spider that inhabits similar areas is *Enoplognatha bryjai* Řezáč, 2016, which also may have been overlooked because of its cryptic way of life in the eulittoral zone right above the water level, often hiding in between the bottom part of reed leaves (*Carex* sp., *Phragmites* sp., *Typha* sp.) (Indzhov 2021, Řezáč et al. 2016, Yanul et al. 2022).

The mentioned record of a *L. elegans* female hidden in a freshly folded green reed leaf is similar to the retreats of the genus *Singa* (Wiehle 1931), in which *L. elegans* was described by Nemenz (1956).

It is interesting to note one case of the presence of several juveniles of *L. elegans* from Nov Dojran on 2. Sep. 2021 after 7:30 pm with already constructed webs, at one particular place where previously, during the daytime, after detailed searching of the reed ears, no specimens were found. This observation shows that the reed ears may not be the most common hiding place during the daytime. Moreover, overwintering in reed stumps is typical for juveniles (Nemenz & Pühringer 1973).

The world-wide distribution of the genus *Larinia*, indicates good long-distance dispersal abilities (Scharff et al. 2020). According to the current distribution of *L. elegans* (Fig. 1), the findings in North Macedonia represent the southernmost records of its distribution and also represent the first record for the spider fauna of the Balkan Peninsula and Southern Europe. Demonstrating the pattern of distribution with occurrence in both the Pontic and Pannonian steppes, the record from North Macedonia might, at first glance, seem strange and unexpected in relation to the relatively large distance from these steppe habitats. However, there are already records of species in North Macedonia with a similar Pontic distributional pattern (Komnenov 2014), as for example *Asagena meridionalis* (Kulczyński, 1894), *Atypus muralis* Bertkau, 1890, *Canariphantes nanus* (Kulczyński, 1898), *Civizelotes gracilis* (Canestrini, 1868), *Drassyllus crimeaensis* Kovblyuk, 2003, *Erigonoplus spinifemoralis* Dimitrov, 2003, *Geolycosa vultuosa* (C. L. Koch, 1838), *Haplodrassus bohemicus* Miller & Buchar, 1977, *Sintula spiniger* (Balogh, 1935), *Tallusia vindobonensis* (Kulczyński, 1898), *Trachyzelotes malkini* Platnick & Murphy, 1984 and *Zelotes hermani* (Chyzer, 1897).

We suspect that the main reason why the populations of *L. elegans* in North Macedonia may have gone unrecorded and untraced for such a long time is due to the spider's nocturnal activity and cryptic way of life.

Southern Moravia presents the north-western tip of the Pannonian Basin, an exclave of the Eurasian steppe (Buchar 1983). Given the araneofauna of the Southern Moravia has been thoroughly investigated in the past (Buchar & Růžicka 2002) and no *L. elegans* were recorded, we propose that the presence of an abundant population of this species at Nové Mlýny – built relatively recently in 1970s and 1980s (Mlej-

ková 2016) – might be a sign of a recent, if not ongoing, areal expansion (Řezáč et al. 2021). Although the current collecting attempts at the nearby localities have not been successful, we are convinced it is only a matter of time until *L. elegans* spreads to other lakes in Southern Moravia.

The nocturnal activity and affinity to biotopes that are not so easy to sample might mean that *L. elegans* has been overlooked by conventional collecting techniques. Therefore, a targeted night collecting and checking of eulittoral reeds should be encouraged at suitable natural and artificial biotopes also in the surrounding countries of the Balkan Peninsula and Central Europe. We expect that it is only a matter of time before this species is found in other regions of Europe, if appropriate night-time collecting techniques are used.

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