

Hitchhiking freshwater clams: First report of *Sphaerium nucleus* attached to *Lissotriton helveticus* in France

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Phoresy is a specific form of commensalism where a mobile organism affords transport to a less mobile one (White et al., 2017). Many phoretic associations have been described (Clausen, 1976; Binns, 1982; Bartlow & Agosta, 2021) of which several examples involve freshwater molluscs; presumably because they have limited ability for long distance dispersal by themselves. Charles Darwin (1882) made pioneering observation of such dispersal in the freshwater mussel *Unio complanatus* attached to the toe of a duck, as well as supposedly *Sphaerium corneum* (then named *Cyclas cornea*) caught on the toes of newts (species not defined). Since then, several studies have reported phoretic associations between freshwater bivalves and lizards (Lopez et al., 2005), frogs and toads (Kolenda et al., 2017) and newts (Audibert et al., 2013).

Among amphibians, newts appear to be often used as 'hosts' by freshwater mussels for two reasons. First, mussels can attach easily to the toes of newts whereas attaching to the skin folds of anurans is more difficult (Kolenda et al., 2017). Second, newt species may move between ponds during the breeding season (Denoël et al., 2018) which would facilitate local mussel dispersal (Lopez et al., 2005). Consequently, there have been several reports of different newt species carrying small freshwater mussels of the genus *Sphaerium*. For instance, *S. corneum* has been found attached to the toes of *Lissotriton helveticus* (Laza-Martínez et al., 2012; Audibert et al., 2013), *Triturus marmoratus* (Boissinot & Migault, 2016), *Ichthyosaura alpestris* (Audibert et al., 2013) and *S. nucleus* was found to be attached to *L. helveticus* and *Triturus cristatus* (Wood et al., 2008). The frequency of this phenomenon may differ widely between sites. For example, in a study in Luxembourg very high mussel densities were found at one site of around 3000 per m², where 23 % of the 161 captured newts had *S. nucleus* or *Pisidium obtusale* attached to their toes while occurrence was less frequent at two other sites where mussel attachment to newt toes was recorded on 3.6 % and 7 % of newts (Wood et al., 2008).

In this study, we report observations of *S. nucleus* attached to the toes of *L. helveticus*. We sampled newts on 15 April 2022 around 23:00 h in two small forest ponds in France – Pond 1 of about 26 m² (0° 25'27.85" W, 46° 8.0'49.56" N, 70 m a.s.l) and Pond 2 of about 75 m² (0° 25'29.28" W, 46° 8.0'45.24" N). In addition to *L. helveticus*, in Pond 1 we observed (but did not capture) *Rana dalmatina* and *Alytes obstetricans* and in Pond 2 *T. marmoratus*, *Triturus x blasii*,



Figure 1. *Sphaerium nucleus* found on a female *Lissotriton helveticus* in a pond in the Deux-Sèvres department, France

Bufo spinosus, *R. dalmatina*, *A. obstetricans* and *Pelophylax esculentus*. Both ponds were host to several aquatic plant species. In Pond 1, we captured 37 *L. helveticus* (21 females and 16 males), out of which 8 (21.6 % of individuals, 5 females and 3 males) had clams attached to their toes (Fig. 1) and 13 had wounded toes (35.1 % individuals, 8 females and 5 males). Clams were attached to the toes of forelegs (4 females and 2 males) and hind legs (1 female and 1 male). All individuals had only one clam attached. In Pond 2 we caught 69 *L. helveticus* individuals (57 females and 12 males). Surprisingly, while this pond was situated a hundred metres from the first pond and free living mussels were seen at the bottom, we did not find clams attached to *L. helveticus* toes.

Freshwater clams clamped onto newt toes were collected and subsequently identified as belonging to the *S. corneum* group, within which it is sometimes difficult to assign a species name based on morphological characters alone. The specimens sampled exhibited a general shell shape intermediate between *S. corneum* (Linnaeus, 1758) and *S. nucleus* (Studer, 1820). However, the high porosity of the shells and the size and shape of the hinge teeth allowed these specimens to be assigned to *S. nucleus* (Kořínková et al., 2008).

To our knowledge, this is the first report of *S. nucleus* attached to *L. helveticus* in France although this clam species has been observed attached to *L. helveticus* in Luxembourg

(Wood et al., 2008). In the same geographic area of our observation (6 km from our study sites), the closely related *S. corneum* was found on larger newt species (e.g. Boissinot & Migault, 2016), while in other parts of France and Spain, *S. corneum* has been found on *L. helveticus* (Laza-Martínez et al., 2012; Audibert et al., 2013). Such observations highlight the fact that both *Sphaerium* species can attach to different newt species, regardless of their size. However, we emphasise the complex identification of species from the *S. corneum* group which also include a third species, *S. ovale* (Férussac, 1807), whose taxonomic validity is still debated (Prié et al., 2021). The morphologic similarities of these taxa may obscure the identification of, but also the true diversity of, the freshwater clam species involved in these phoretic interactions.

Our report suggests that phoresy may be site specific. Indeed, this phenomenon can either be rare (Audibert et al., 2013) or frequent (Wood et al., 2008) within a population and with variations between sites (Wood et al., 2008). The observed differences between the two ponds in the frequency of mussel attachment to newts may be explained by the density of the mussel populations (a parameter we did not assess) and of the presence of other amphibian species.

'Host' selection by phoretic bivalves, if any, still needs to be explored. Indeed, Boissinot & Migault (2016) have shown that in a pond where *L. helveticus*, *T. cristatus* and *T. marmoratus* co-occurred, only *T. marmoratus* was affected, despite the fact that *L. helveticus* and *T. cristatus* were more abundant. This suggests that 'host' selection may occur, a process for which chemical orientation of the phoront has already been assessed to play a role in frog and lizard 'hosts' (Lopez et al., 2005). Wood et al. (2008) suggest alternatively that newt species behaviours and habitat use, or simply toe size and structure, must also impact the likelihood of attachment of sphaerid mussels. As mussel attachment can cause damage to individuals toes (Wood et al., 2008), this makes the relationship appear to be parasitic, because the mussels benefit by being facilitated in dispersal while the newts are harmed. Indeed, such damage may interfere with oviposition (Wood et al., 2008) and eventually reduce newts displacements; however these potential disadvantages are likely to be temporary as newts are capable of limb regeneration (Scadding, 1981).

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REFERENCES

- Audibert, C., Michelot, L. & Prunier, J. (2013). Tritons et Sphaeriidae. *Folia Conchylologica* 3–6.
- Bartlow, A.W. & Agosta, S.J. (2021). Phoresy in animals: review and synthesis of a common but understudied mode of dispersal. *Biological Reviews* 96: 223–246.
- Binns, E.S. (1982). Phoresy as Migration - Some functional aspects of phoresy in mites. *Biological Reviews* 57: 571–620.
- Boissinot, A. & Migault, L. (2016). Observations de Cyclades communes *Sphaerium corneum* (Linnaeus, 1758) sur des Tritons marbrés *Triturus marmoratus* (Latreille, 1800). *Bulletin de la Société Herpétologique de France* 157: 52–54.
- Clausen, C.P. (1976). Phoresy among entomophagous insects. *Annual Review of Entomology* 21: 343–368.
- Darwin, C. (1882). On the dispersal of freshwater bivalves. *Nature* 25: 529–530.
- Denoël, M., Dalleur, S., Langrand, E., Besnard, A. & Cayuela, H. (2018). Dispersal and alternative breeding site fidelity strategies in an amphibian. *Ecography* 41: 1543–1555.
- Kolenda, K., Najbar, A., Kusmierek, N. & Maltz, T.K. (2017). A possible phoretic relationship between snails and amphibians. *Folia Malacologica* 25: 281–285.
- Kořínková, T., Beran, L. & Horsák, M. (2008). Recent distribution of *Sphaerium nucleus* (Studer, 1820) (Bivalvia: Sphaeriidae) in the Czech Republic. *Malacologica Bohemoslovaca* 7: 26–32.
- Laza-Martínez, A., Sanz-Azkue, I. & Gosá, A. (2012). Anfíbios y reptiles como potenciales agentes de dispersión de moluscos en el norte ibérico. *Boletín de La Asociación Herpetológica Española* 23: 43–51.
- Lopez, L.C.S., Filizola, B., Deiss, I. & Rios, R.I. (2005). Phoretic behaviour of bromeliad annelids (*Dero*) and ostracods (*Elpidium*) using frogs and lizards as dispersal vectors. *Hydrobiologia* 549: 15–22.
- Prié, V., Valentini, A., Lopes-Lima, M., Froufe, E., Rocle, M., Poulet, N., Taberlet, P. & Dejean, T. (2021). Environmental DNA metabarcoding for freshwater bivalves biodiversity assessment: methods and results for the Western Palearctic (European sub-region). *Hydrobiologia* 848: 2931–2950.
- Scadding, S.R. (1981). Limb regeneration in adult amphibia. *Canadian Journal of Zoology* 59: 34–46.
- White, P.S., Morran, L. & Roode, J. de (2017). Phoresy. *Current Biology* 27: R578–R580.
- Wood, L., Griffiths, R., Klaus, G., Engel, E. & Schley, L. (2008). Interactions between freshwater mussels and newts: A novel form of parasitism? *Amphibia-Reptilia* 29: 457–462.

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