Join the sampling of parasitic fungi on ladybirds!

Project FunDive

In FunDive we work towards putting fungal diversity on the map to enhance European conservation efforts. Fungi are essential for our ecosystems but have often been neglected in monitoring efforts and conservation practices, leaving them vulnerable to threats and habitat loss. We would like to engage you to change this.

For more information, please visit https://fun-dive.eu/

FunDive is a pan-European initiative funded by Biodiversa+ that brings together 42 partners in 26 countries to improve fungal monitoring across the continent. The goal of FunDive is to close the knowledge gap dealing with fungal distributions to improve fungal conservation using the help from you and other citizen scientists.

Why is fungal monitoring important?

Fungi are generally under-studied. Their global distribution patterns are poorly resolved. Also in Europe, despite centuries of fungal research, there is a lack of the distribution patterns of many fungal species. However, this knowledge is very important for effective conservation practices. For example, assessments of species for the IUCN Red List require an understanding of the distribution of said species.

What can you do?

FunDive is structured in different projects, each focusing on a specific target group of fungi. You can engage in each project by documenting and collecting fungal specimens. The process is simple:

- **Select** the project you would like to join
- **Join** the 'Citizens for FunDive' project in PlutofGO app, following FunDive step-by-step joining guide:

  https://fun-dive.eu/wp-content/uploads/2024/08/FunDive_Joining-guide.pdf
- **Find** target species – in this case ***Hesperomyces* spp.** (green beetlehangers) associated as ectoparasites with ladybirds
- Make an informative **photo** of your infected ladybird
- **Register** your record in **PlutofGO** app, completing as many metadata as possible and following the FunDive step-by-step Specimen registration guide:

  https://fun-dive.eu/wp-content/uploads/2024/08/How-to-register-specimen.pdf
- Alternatively, **register** your record in **iNaturalist** app or website: https://www.inaturalist.org/. You can track *Hesperomyces* on iNaturalist in the "Beetlehangers" project: https://www.inaturalist.org/projects/beetlehangers.
- If you want to send your specimen for DNA barcoding, place the infected ladybird in a vial filled with preferably 96% ethanol.
- **Send** your *Hesperomyces*-infected ladybird to**:**

  Michiel de Groot and Danny Haelewaters

  Ghent University, Department of Biology, Research Group Mycology

  K.L. Ledeganckstraat 35

  9000 Ghent, Belgium
- You can follow your fungus on FunDive records: https://fun-dive.eu/dataportal/.
- More information on how to collect and preserve them can be found in this booklet.
- In case of any questions feel free to contact your country representatives.

For more information on how to document your records, please visit https://fun-dive.eu/get-involved/how-to-engage/

Hesperomyces

is one of the target genera for the 2025 FunDive projects aimed at mapping the biodiversity of fungi in Europe

***Hesperomyces* – green beetlehangers** – have the appearance of small banana-shaped protrusions (thalli) on the outside of a ladybird (Fig. 1), which can be seen with the naked eye if mature. A mature thallus is between around 0.3 and 0.7 millimetres in length, and has a green to yellowish, translucent colour. If looked at under a microscope, you can see that it has a black tip (the foot) where the thallus is attached to the ladybird (Fig. 2). Mature thalli have antenna-like lobes on top of the thallus. The thallus is filled with elongated two-celled ascospores, which eject when the thallus comes into contact with another surface – such us another ladybird. Typically, *Hesperomyces* is transferred between individual hosts by touch, for example when the ladybirds mate or huddle together during hibernation. The easiest way to see *Hesperomyces* is usually on the outside of the elytra (hardened forewings, usually the most colourful) of the ladybird, but can grow anywhere on the outside of its host. There can be many, but also only a few thalli present.

***Fig. 1*. A harlequin ladybird (*Harmonia axyridis*) infected with *Hesperomyces harmoniae* (photo Gilles San Martin).**

Hesperomyces can be found throughout the year where there are suitable hosts but is most common in spring, after the ladybirds emerge from hibernation. The very common invasive harlequin ladybird, *Harmonia axyridis*, has its own species of *Hesperomyces, Hesperomyces harmoniae*, which is by far the most commonly encountered species and easy to recognize. However, many different ladybirds host their own species of *Hesperomyces.*

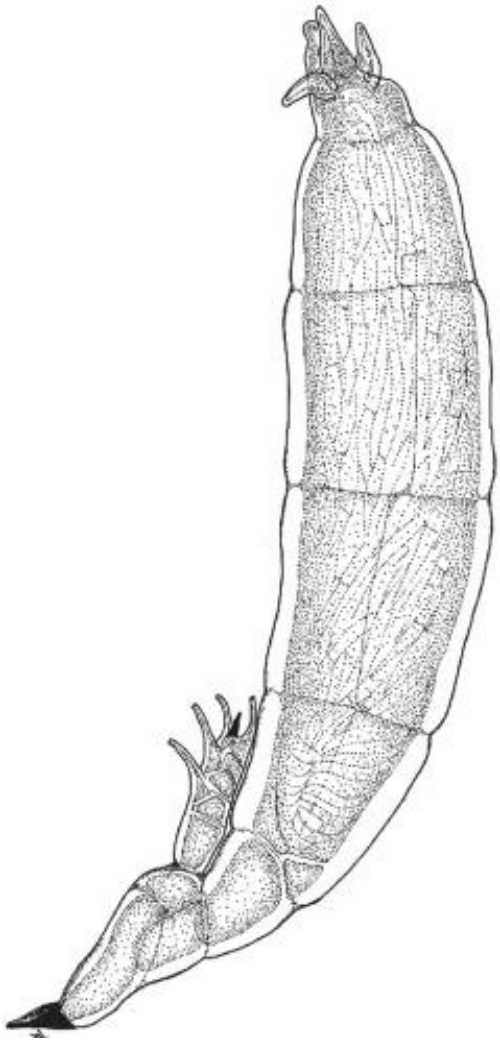

***Fig. 2*. Schematic drawing of a mature thallus of *Hesperomyces harmoniae*. Note the lobes on top, the appendages to the side, black foot and ascospores inside (drawing by André De Kesel).**

The best way to look for *Hesperomyces* is to look for ladybirds, specifically harlequin ladybirds. Harlequin ladybirds are very common in a large variety of habitats throughout Europe. These ladybirds are a polymorphic species, i.e., they come in many different colours and patterns (Fig. 3). Originally from Eastern Asia, it was introduced as a biocontrol but has since become invasive in many parts of the world. They are 5-8 mm in length and have orange legs. The most common form has 6-21 spots on an orange elytron, and has a black “M” shape on its white pronotum.

Harlequin ladybirds easily found by collecting from broad-leaved trees and shrubs, by hand, net, or beating sheet. In winter, harlequin ladybirds can often be found inside homes and other buildings, especially around windowsills, ceilings, and in attics. They are also attracted to light and can often be found in light traps for moths.

To check ladybirds for *Hesperomyces,* check if there are any green-yellowish protrusions anywhere on its outer side, by eye or with a hand lens. Immature thalli can be seen with a loupe or microscope and are easiest to identify by their black foot which attached itself to the host.

***Fig. 3*. The many forms of *Harmonia axyridis*, the harlequin ladybird. (Photo by Entomart)**

In addition to harlequin ladybirds, other species of *Hesperomyces* can also be found on different ladybird hosts, such as the two-spot and ten-spot ladybird (*Adalia bipunctata* and *Adalia decempunctata*), orange ladybird (*Halyzia sedecimguttata*), spider mite destroyer ladybirds (*Stethorus* sp.), among many other ladybird hosts. Many of these are currently undescribed species, so if you see a ladybird, please check it for fungal infection!

By reporting your findings, you will add to the knowledge of this species group and your records will be important contributions to nature conservation.

Collecting ladybirds

Collecting ladybirds can be easy or tricky, depending on the species. Most ladybirds will let themselves fall down whenever they sense danger, so the easiest way to collect them is by hand by holding one hand under them and collecting them with the other. You can also use sweep netting, beating, or traps to collect them.

Instructional video with background on *Hesperomyces* and how to catch ladybirds! https://www.youtube.com/watch?v=HXfhY00U6M4

Collecting *Hesperomyces*

If you want to not just upload a photo observation, but also send us the specimen itself, great! Here's how you can preserve the ladybird and the fungus on it:

- If possible, put the specimen in ethanol in a plastic container such as an Eppendorf tube. Either 70% or 96% is fine. This also works for ladybirds caught in a Malaise or pitfall trap.
- If you don't have ethanol, you can also freeze them by putting them into your freezer in a Ziploc bag or plastic container overnight.
- When shipping, the specimens are best preserved by 1) putting them on ethanol or 2) freezing them and then shipping them either pinned to a piece of styrofoam or cardboard with entomological pins. Alternatively, you can add silica gel to a specimen in a plastic container. You can buy silica gel in most DIY stores.
- Please ship them to:

Michiel de Groot and Danny Haelewaters
Ghent University, Department of Biology, Research Group Mycology
K.L. Ledeganckstraat 35
9000 Ghent, Belgium

Be sure to add details about where, when and who collected the specimen. If you need additional help, contact your national FunDive point of contact.

Additional information and identification:

- de Groot, M. D., Christou, M., Pan, J. Y., Adriaens, T., Maes, D., Martinou, A. F., ... & Haelewaters, D. (2024). Beetlehangers. org: harmonizing host–parasite records of *Harmonia axyridis* and *Hesperomyces harmoniae*. *Arthropod-Plant Interactions*, 1-15.
- Haelewaters, D., Zhao, S. Y., Clusella-Trullas, S., Cottrell, T. E., De Kesel, A., Fiedler, L., ... & Roy, H. E. (2017). Parasites of Harmonia axyridis: current research and perspectives. *BioControl*, *62*, 355-371.
- Haelewaters, D., & Caenegem, V. (2022). *Hesperomyces harmoniae*, a new name for a common ectoparasitic fungus on the invasive alien ladybird *Harmonia axyridis*. *Sydowia*, *75*.
- Roy, H. E., Brown, P. M., Adriaens, T., Berkvens, N., Borges, I., Clusella-Trullas, S., ... & Zhao, Z. (2016). The harlequin ladybird, Harmonia axyridis: global perspectives on invasion history and ecology. *Biological invasions*, *18*, 997-1044.

Text by: Michiel de Groot

Edited by: Danny Haelewaters

Photos by: Gilles San Martin, Kalin Radkov, Trey Wardlaw

Version 1.2, published online, 24.07.2025

For more information on FunDive, please visit https://fun-dive.eu/get-involved/

This research was funded by Biodiversa+, the European Biodiversity Partnership, in the context of the “FunDive: Monitoring and mapping fungal diversity for nature conservation“ project under the 2022–2023 BioDivMon joint call. It was co-funded by the European Commission (grant agreement No. 2128-00020A - Biodiversa2022-640) and the following national funding agencies: Research Foundation Flanders (Belgium), Technology Agency of the Czech Republic (Czechia), Innovation Fund Denmark (Denmark), Estonian Research Council (Estonia), Republic of Estonia - Ministry of Climate (Estonia), Academy of Finland (Finland), Agence National de la Recherche (France), German Research Foundation (Germany), Bundesministerium für Bildung und Forschung (Germany), General Secretariat for Research and Innovation (Greece), National Research, Development and Innovation Office (Hungary), Ministero dell'Università e della Ricerca (Italy), Netherlands Organisation for Scientific Research (the Netherlands), Research Council of Norway (Norway), National Science Centre (Poland), Fundação para a Ciência e a Tecnologia (Portugal), Agencia Estatal de Investigación (Spain), and Swiss National Science Foundation (Switzerland).