

Moth monitoring



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Importance of moths as pollinators

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OPEN

Addition of nocturnal pollinators modifies the structure of pollination networks

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Although the ecological network approach has substantially contributed to the study of plant-pollinator interactions, current understanding of their functional structure is biased towards diurnal pollinators. Nocturnal pollinators have been systematically ignored despite the publication of several studies that have tried to alleviate this diurnal bias. Here, we explored whether adding this neglected group of pollinators had a relevant effect on the overall architecture of three high mountain plant-pollinator networks. Including nocturnal moth pollinators modified network properties by decreasing total connectivity, connectance, nestedness and robustness to plant extinction; and increasing web asymmetry and modularity. Nocturnal moths were not preferentially connected to the most linked plants of the networks, and they were grouped into a specific “night” module in only one of the three

and comparative studies of taxa with divergent niches are lacking. Here, for the first time, we simultaneously compare nocturnal moth and diurnal bee pollen-transport networks using DNA metabarcoding and ask how pollination networks

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LETTERS WILEY

nocturnal

Helen Hipperson²

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⁴, Yoko L. Dupont¹,

is, Denmark

Basic idea with moth monitoring



- ▶ Comparable with butterfly monitoring, so:
 - ▶ Fixed locations
 - ▶ Always the same trap: standardised trapping
 - ▶ Regular trapping, e.g. one a week or once every two weeks
 - ▶ Always the whole night: standardised trapping
 - ▶ Identification and count the next morning (with help of AI if needed)

By keeping the effort constant, changes come from changes in the number of moths

Sampling



Traps: monitor the whole night



What is a LED-trap?

- Cheap, not very powerful → attracts local moths
- Sensor and powerbank → automatically switched on all night
- Not very notable
- Moths photographed → AI for identification



Manuals with instructions, database, app and website



Manual

Manual trampa LED

Placing the LEDtrap

The following steps must be followed each time the bucket is placed. This has a light sensor so that it can be placed during the day. It will then turn on automatically at dusk.

1. Put the two egg cartons upright in the LEDtrap. The butterflies can hide under these boxes when they land in the bucket.
2. Connect the power bank and place it upright in the bucket. When properly connected, a light will flash near the light sensor.
3. Put the lid on the bucket, but do not click it into place. Otherwise there will be such a shock to the bucket when you try to empty it that the moths will become active and possibly fly away.

Note: There are two different USB connections. The one with one lightning bolt on it consumes much less power than the one with two, so it's recommended to use this connector.

Put two egg cartons upright in the bucket.

- Tips**
- Place the LEDtrap on solid ground.
 - If rain is expected you must protect the powerbank from becoming wet. You can do this by putting it in an enclosed plastic bag or plastic tub.
 - When the LEDtrap overturns, there is the danger that the wires may get damaged. If strong wind is expected, you can put a heavy stone inside or secure the trap with a tent pag through the bottom (by first making a small hole).

Emptying the LEDtrap

What should you do when emptying the LEDtrap:

1. Try to photograph each moth.
2. Check carefully if there are moths outside the trap. Be careful when approaching the LEDtrap, otherwise those on the outside might fly away before you have to chance to photograph them.
3. Be aware that sometimes moths settle just below the lid of the bucket, so be careful when opening the trap.
4. When recording species and their abundance please distinguish between moths inside and outside the trap.
5. Empty the LEDtrap early in the morning. If the sun shines on the bucket, the moths might become active and fly away when you open the trap.



Moths resting on the inside of the funnel.



Moths like to sit in the deepest recesses of the egg boxes.

Kijk eerst goed wat voor vlinders er buiten de emmer zitten.



This is the screw for the light sensor.

The light sensor is attached to the screw.

6. There is a screw on the side of the bucket to which the light sensor can be attached.
7. If necessary, pull the cord at the top of the LED strip a little tighter, so that the tube with the LED strip stands upright between the three Plexiglas plates.
8. Place the LEDtrap at the same location each time.



6. Remove the Plexiglas plate and the funnel. Beware: sometimes moths rest on the inside of the funnel.
7. Carefully remove the egg boxes from the bucket. The moths often like to rest in the deepest recesses of the egg box. When you can't view them properly, first try photographing all the other moths, and then carefully try to remove the moth by gently tapping the egg box against your hand and then take your photograph.
8. Check the inside of the bucket and make photos of all moths present.
9. Clean and store the LEDtrap and charge the powerbank immediately, so it is ready to use on your next trapping night.



Anyone can join, e.g. farmers in the Netherlands



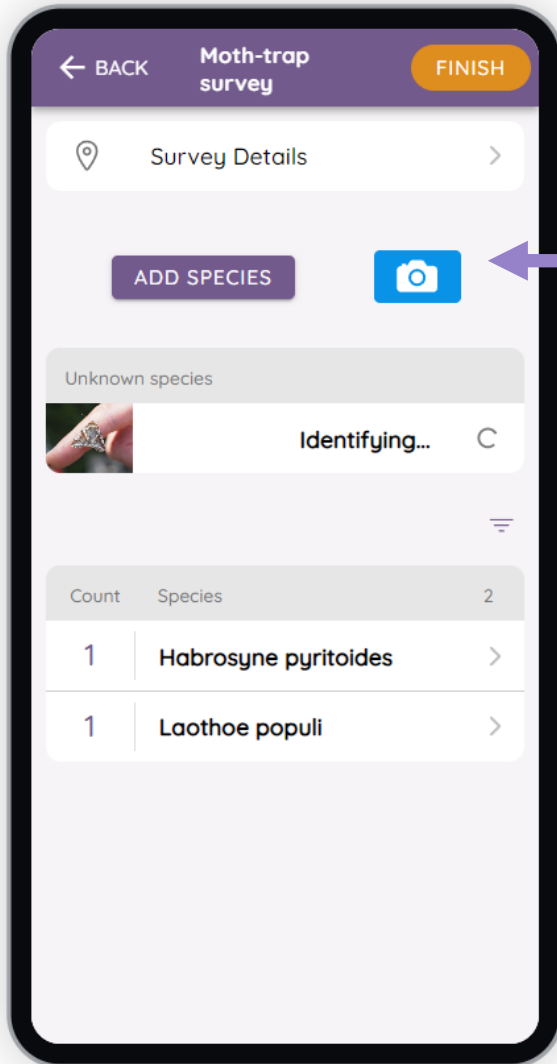


eBMS





ButterflyCount: also for moth monitoring



Adding a photo will start image recognition and will add species and counts



correct identification of 95% of moths in North-Western Europe



Reliable moth monitoring by citizens with limited need of experts



Coordinators for moth monitoring are needed

Testing the moth module

Validation

- 5 series of 5 traps,
- each series in another habitat
- sample 12 times/year
- traps were provided

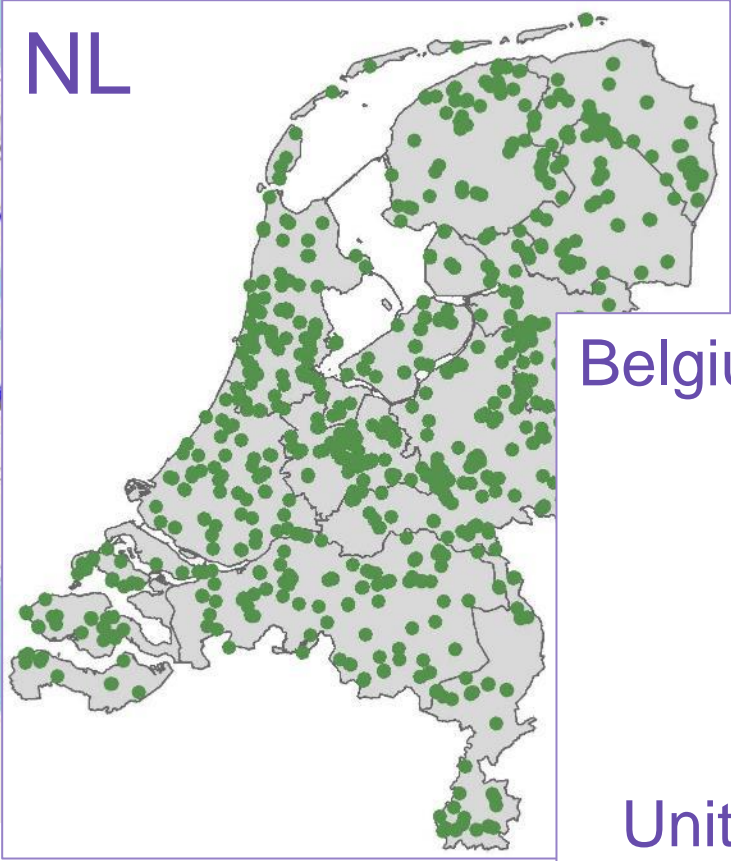
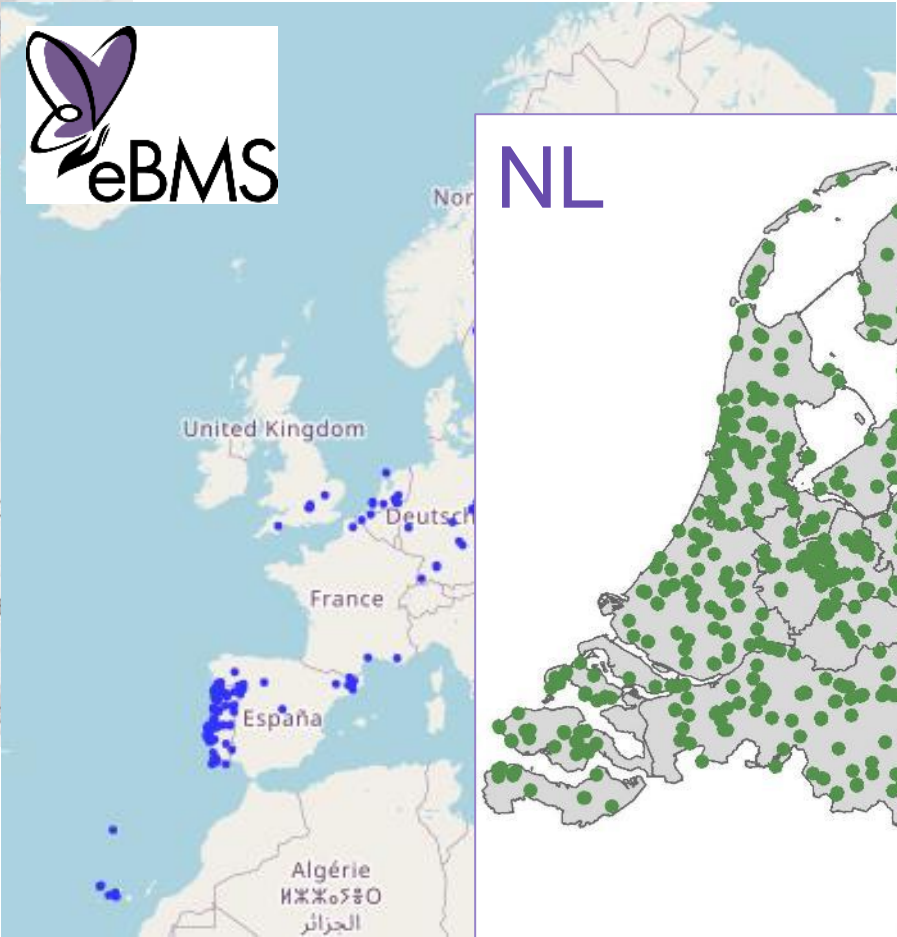


Refinement of field protocol

- In NL, 25 traps > 3 times/week in different habitats
- Info on variation in time and space

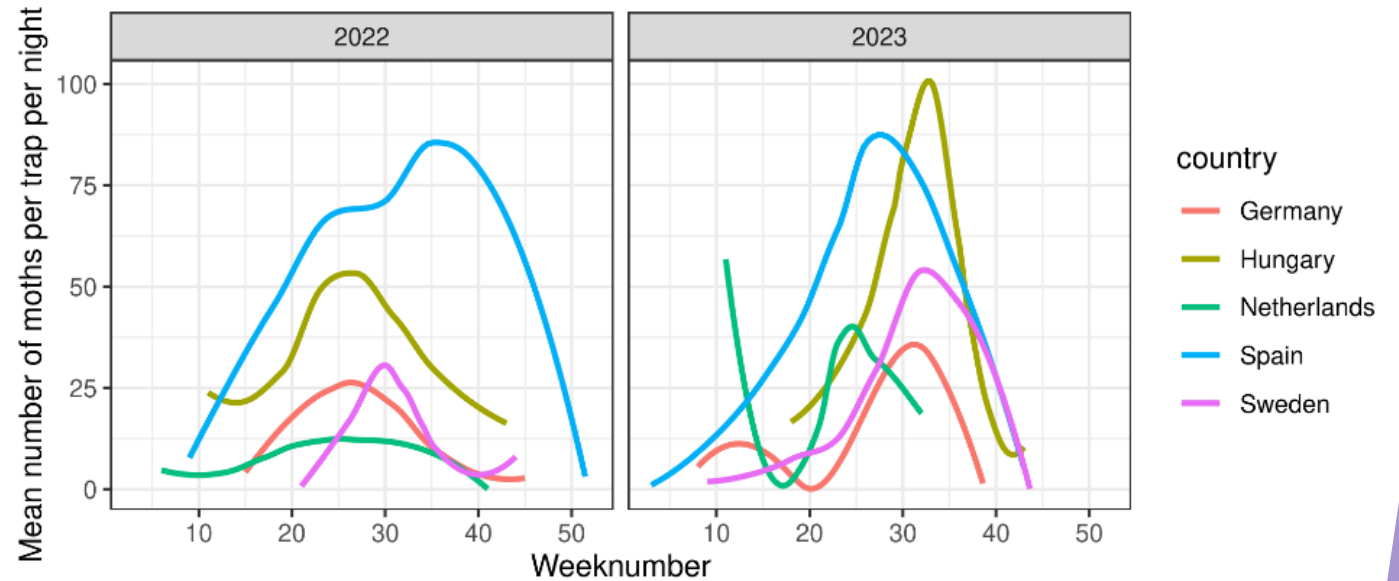
Climate	Country	Partner
Continental	Germany	UFZ
Mediterranean	Spain	CREAF
Pannonian	Hungary	Centre for Ecological Research
Boreal	Sweden	Lund
Atlantic	NL	De Vlinderstichting

Sampling locations moth monitoring (LED-traps)



- Belgium (Flanders)
- Estonia
- Finland
- Ireland
- Hungary
- Portugal
- United Kingdom
- The Netherlands

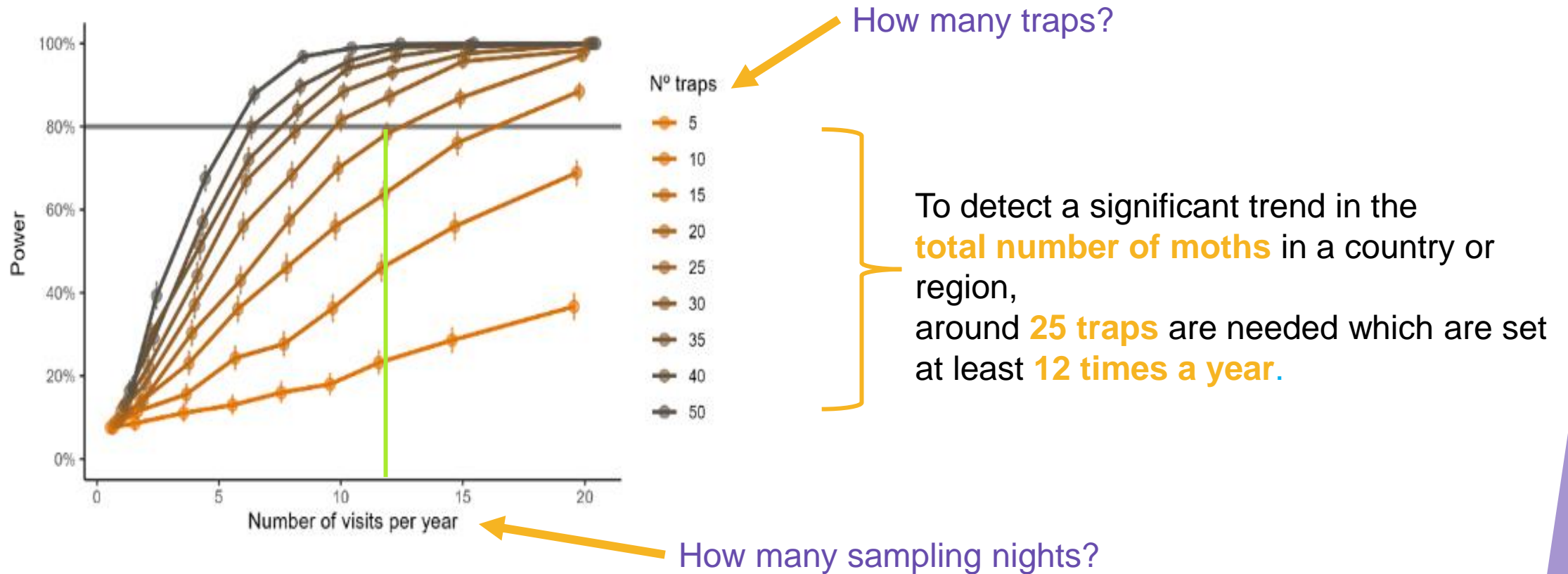
SPRING: Results moth monitoring 2022 and 2023



- ★ Almost 70.000 moths in 2022 and 2023
- ★ Mean 23.1 moths per trap per night
- ★ 1506 species
- ★ Most species per trap: 275 (Spain)
- ★ Most species per trap per night : 62 (Spain)

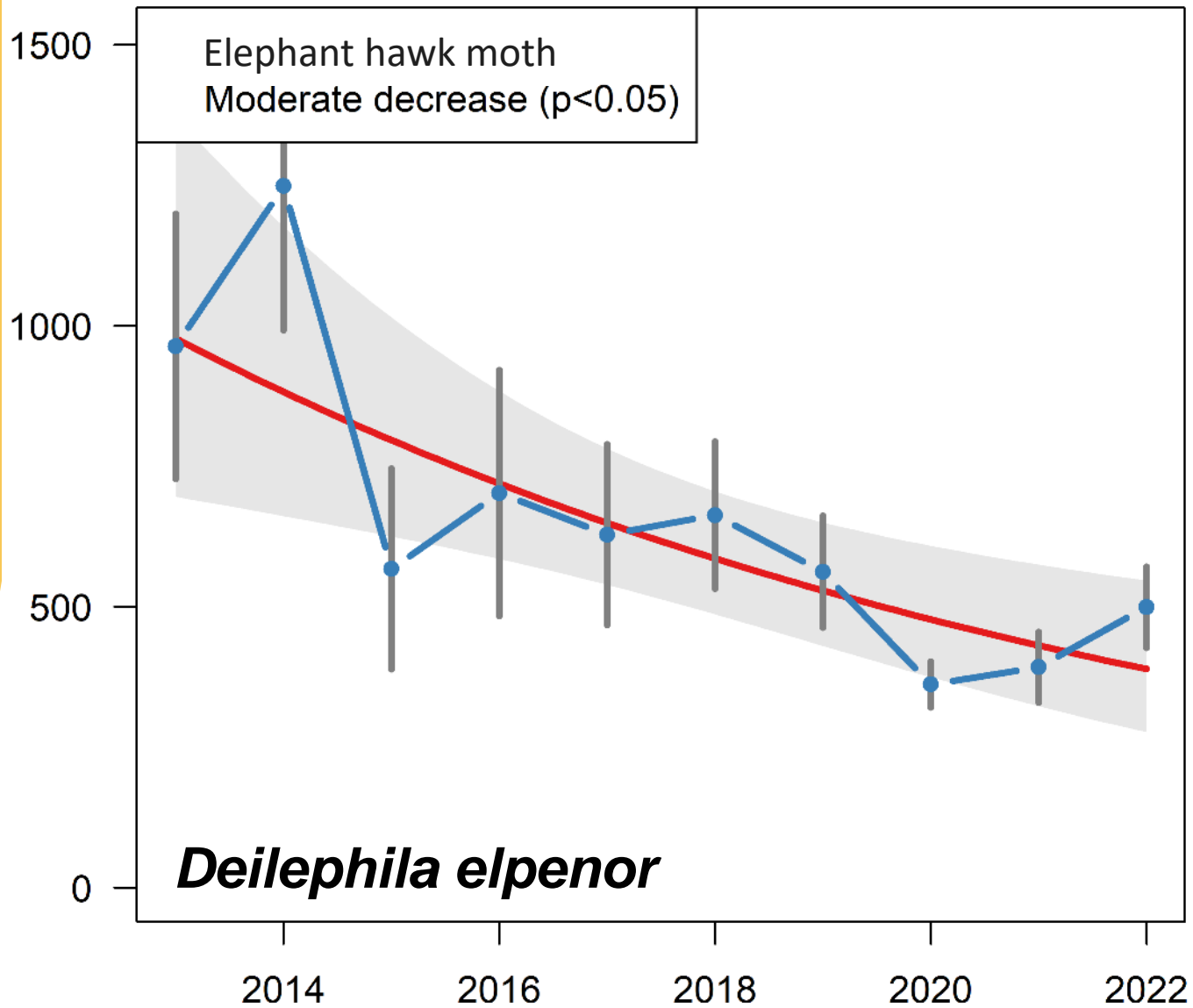


SPRING: Power analysis moth monitoring



*All observations of macro moths in the Dutch moth monitoring scheme. Power analysis results for a generalized linear mixed model with year as factor with repeated contrasts.
Grey line: threshold of 80%*

Calculation of trends same as for butterflies



Summary

- Moths have a **high number of species**.
- Scientific evidence: very **important pollinators** so far forgotten
- We have a **tested method** to monitor them -> can easily be enrolled
- Moth traps are deployed for a **full night**, all moths identified or photographed
- Easy identification by AI -> **citizens** can participate (volunteers, farmers, etc.)
- To detect a significant trend in the total number of moths in a small country or region, around **25 traps** are needed which are set at least **12 times a year**.
- There is a **website** and an **app** to enter all data into the eBMS **database**.
- **Trends** can be calculated using the same methods as for butterflies.
- These trends can be combined to **indicators**, just as we already do for butterflies.



Recommendations

Monitoring of moths is ready to be used on a European level

- If we had the resources for coordinators, validators, traps, training materials and data analysis
- A full moth monitoring scheme could be running this year
- Would give trends and indicators for the EU Biodiversity Strategy in 2030.

Everything is ready to start monitoring moths at a European or EU scale









Thank you

