Web application for recognition of Greek butterflies – a review

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Resumé. Artiklen omhandler en analyse af et webbaseret program til automatisk genkendelse af de græske dagsommerfuglearter ved hjælp af kunstig intelligens. Programmet arbejder ud fra en database med fotos af alle 236 kendte græske arter.
Vi afdækker funktionaliteten i programmet og viser også, at det har visse svagheder, som i mange tilfælde giver forkert artsbestemmelse ved arter, som ligner hinanden.
Programmet skal forbedres for at give pålidelig bestemmelse af alle de græske arter. Først og fremmest bør fotodatabasen forøges med fotografier af korrekt bestemte dyr. Med tilstrækkeligt fotomateriale af over- og undersider af begge køn samt variation kan en højere nøjagtighedsrate forventes. For meget lignende arter erstatter det dog stadig ikke behovet for manuel artsbestemmelse.
Funktionaliteten kan relativt enkelt udvides til alle Balkans dagsommerfuglearter.

Artificial intelligence has been introduced for various applications and recently also for field identification of plant and animal species (e.g. the app "Obsidentify"). In 2020 a web application has been developed for recognition with artificial intelligence of butterfly species in Greece. The system is developed by the Greek lepidopterist Lazaros PAMPERIS together with an IT developer from India, Hari THEIVAPRAKASHAM.

http://www.pamperis.gr/recognition/index.html

Greece has 236 butterfly species which are also listed on the website. In this website a butterfly photograph can be uploaded. It is written on the website, that currently it does not store the uploaded photos of the users, but in the near future, an option will be added to upload the photo directly into the database.
In a square the photo can be cropped and resized (Fig. 1).

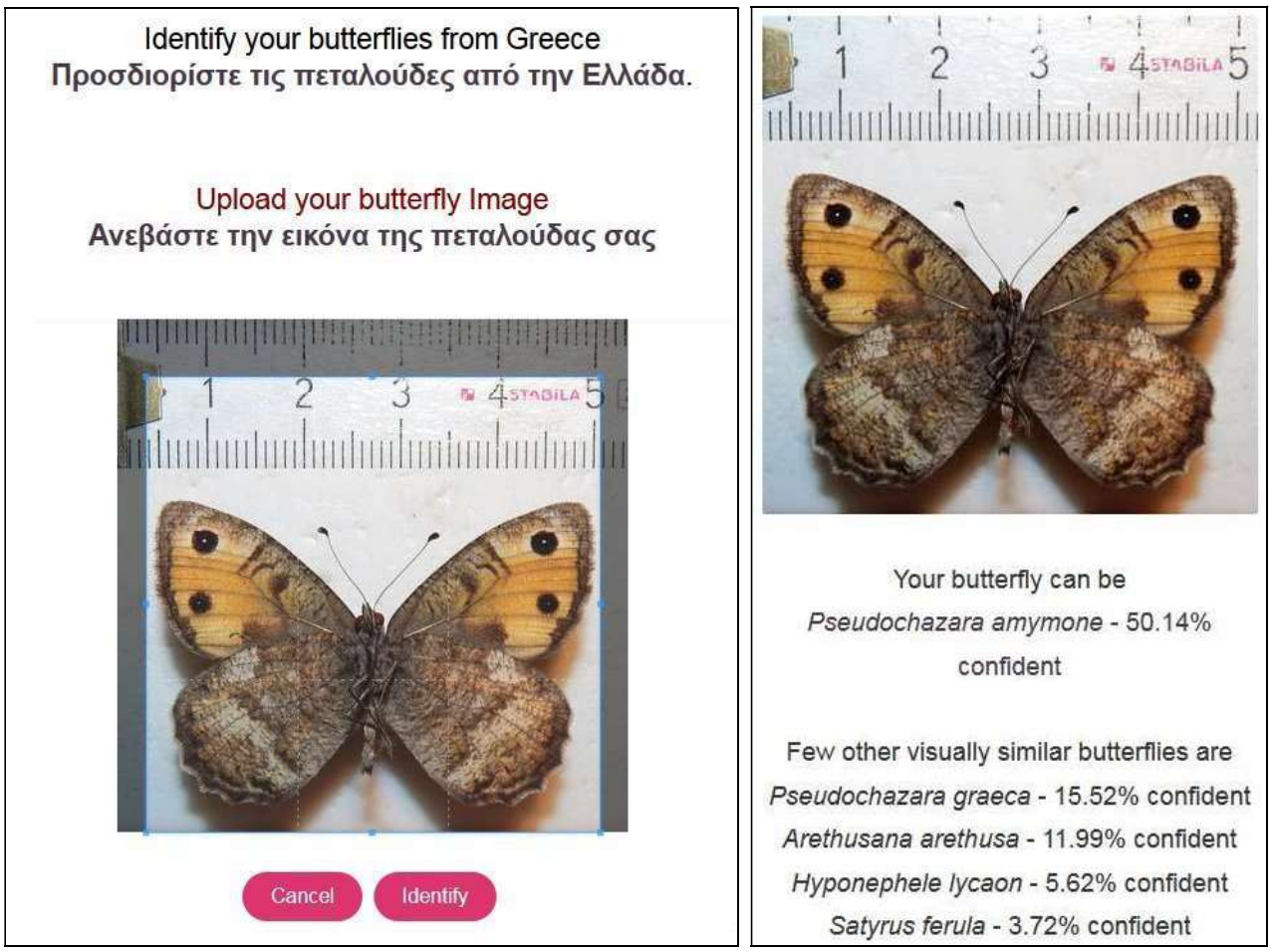

Fig. 1. a. Screen image with square for cropping the photo. b. Result displayed on the website.

When you click on the Identify button, after a moment the result appears. It is recognition calculated from a photo database of all Greek butterfly species. The species with the highest recognition percentage is given first, followed by 3 or 4 other more or less similar species with recognition percentage of each.

L. PAMPERIS lists 11 points of criteria for optimal recognition in the application. We resume them here in short points:

1. Butterfly must be properly focused
2. It must not be dimly or over lighted, correct colour temperature, flash recommended
3. Wings must be evenly lit
4. Avoid backlight through the wings
5. Butterfly must occupy largest part of the photo and wings must not be damaged
6. No other objects must cover the wings
7. Butterfly must not be very old (worn)

8. No abnormally extended wings
9. Aberrant specimens affect the identification
10. Best possible cropping of photo for best identification
11. Try to have several photos of the same butterfly from different angles

It is difficult to fulfill all of these criteria. Many photos will meet only fewer of these conditions. For example, when is the colour temperature optimal? Wings evenly lit? Natural light or artificial light? Clearly many factors in the 11 points can disturb the recognition. In addition the high variability of *Pseudochazara* complicates the recognition.

In order to test the web application we used a series of Albanian *Pseudochazara amymone* Brown, 1976, a species that has also been found in Greece.
The specimens were photographed and called MM (Morten Mølgaard) or SC (Sylvain Cuvelier) followed by numbers from 1 upwards.
As test material we used all 38 ♂♂ and 19 ♀♀ from our Nota Lepidopterologica 2015 publication: "*Pseudochazara amymone* (Lepidoptera, Nymphalidae) in Albania: Variability analysis, androconial scales and new distributional data" (https://nl.pensoft.net/articles.php?id=4625).
For each specimen we cropped the photo as much as possible and made the test. We saved screen dumps of each test (Fig. 2) and noted the results into an Excel sheet.

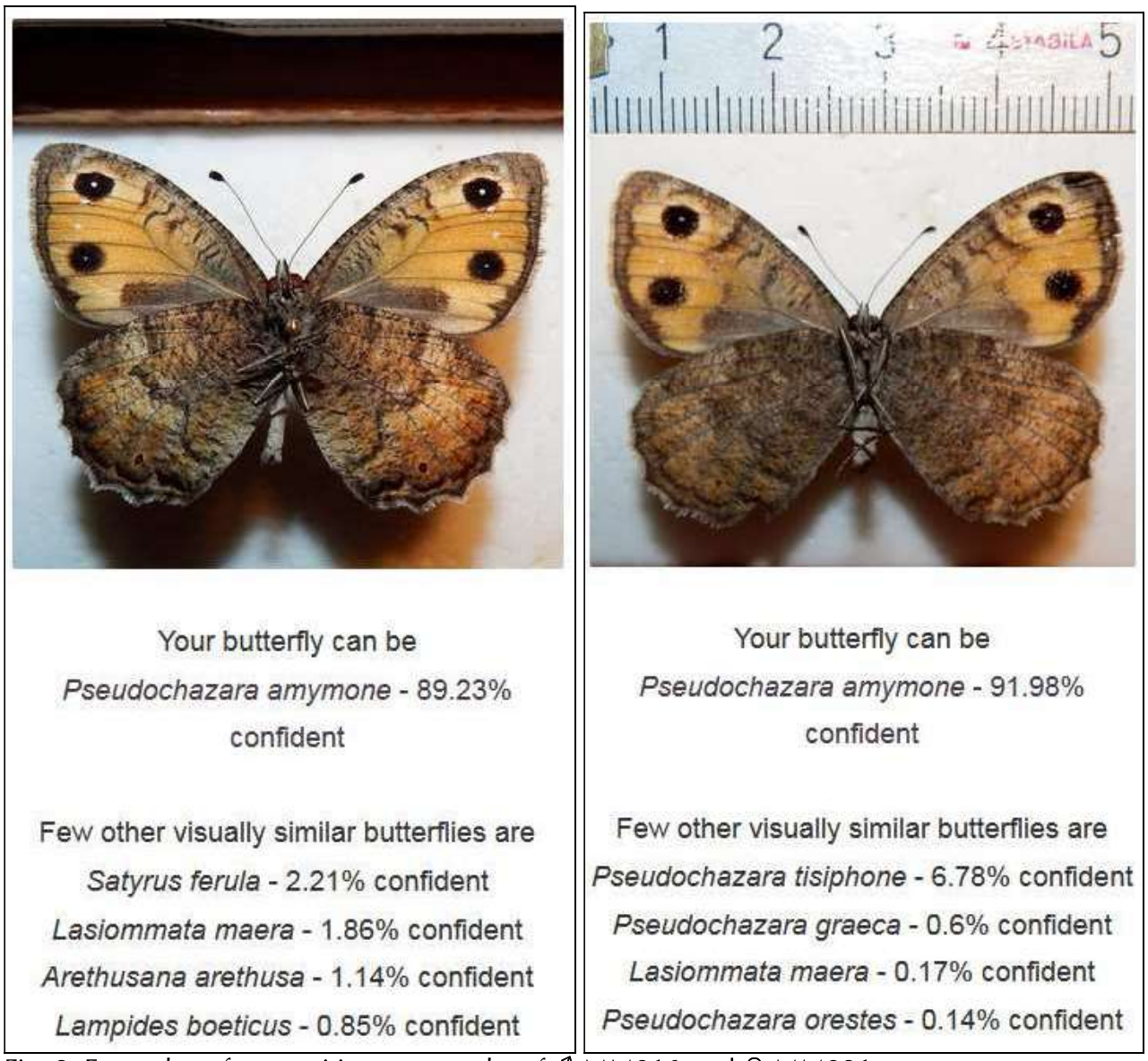

Fig. 2. Examples of recognition test results of ♂ MM016 and ♀ MM021.

First we analyzed the recognition percentage of all ♂♂ and all ♀♀ (Fig. 3).

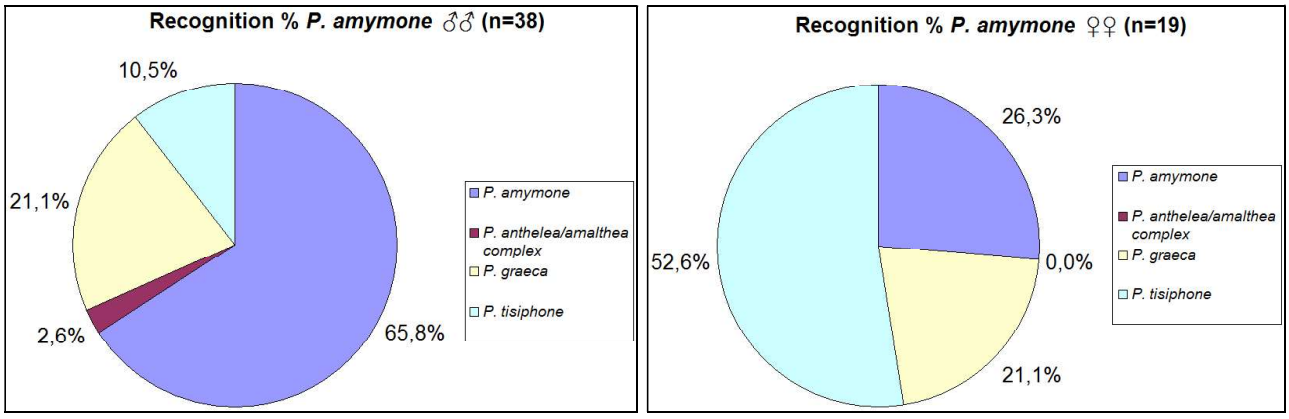

Fig. 3. Mean recognition (%) of ♂♂ and ♀♀ *P. amymone* in the butterfly web application.

Fig. 3 shows a striking difference of correct species recognition between ♂♂ and ♀♀. 65,8% of all ♂♂ are first choice *P. amymone* and correctly identified, but only 26,3% of ♀♀. In general for the ♀♀ *P. amymone* was only the second choice. 52,6% of ♀♀ are first choice recognized as the closely related species *Pseudochazara tisiphone* Brown, [1981].
Pseudochazara species are very variable and difficult to identify. In 2011 *P. amymone* was discovered in Albania (ECKWEILER, 2012), but hardly any photographs of the species in nature have been published, and some of them are doubtful (CUVELIER, 2010 and ECKWEILER, 2012).
Accordingly, the photo material of *P. amymone* in the application database is supposed to be very limited, and it is unknown how reliable the identification from the material is.
Especially ♀♀ of *P. amymone* have morphological similarities to *P. tisiphone* (CUVELIER & MØLGAARD, 2015), causing a significant degree of uncertainty concerning the recognition.

We only present test data of underside photos. In most cases they provided good genus identification. After testing the *P. amymone* (MM series) upperside photographs, the results were never giving a *Pseudochazara* species as first choice. We therefore decided not to include this in the analysis. In nature butterflies of genus *Pseudochazara* almost never sit with open wings, and by consequence such photographs are very rare.

We also summarized the individual test results of the 38 ♂♂ and 19 ♀♀ as can be seen in the two graphs (Fig. 4).

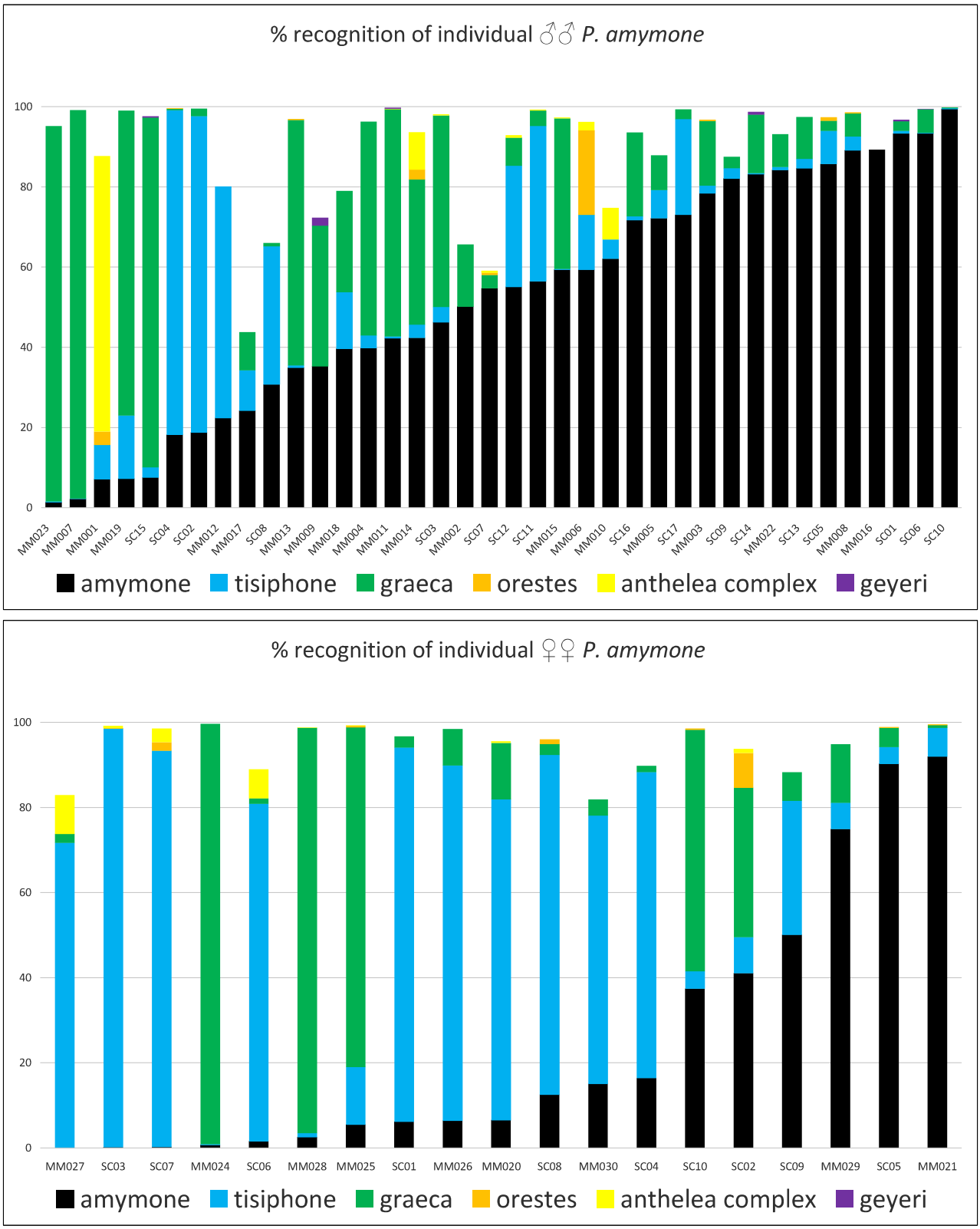

Fig. 4. Recognition (%) of individual *P. amymone*. a. ♂♂ , b. ♀♀.

During the testing we encountered several strange results which we would like to mention:

- ♂ MM001 (Fig. 5a) first choice is 68,7% *P. anthelea/amalthea* and 7,08% *P. amymone*

- ♂ MM007 (Fig. 5b) first choice is 96,68% *P. graeca* and 2,15% *P. amymone*
- ♂ MM012 first choice is 57,74% *P. tisiphone* and 22,33% *P. amymone*
- ♂ MM017 first choice is *P. amymone* but only for 24,17% and only 56,2% *Pseudochazara* identification
- ♀ MM027 (Fig. 5c) first choice is 71,74% *P. tisiphone* and 0% *P. amymone*
- ♀ MM030 first choice is 63,05% *P. tisiphone* and 15,09% *P. amymone*

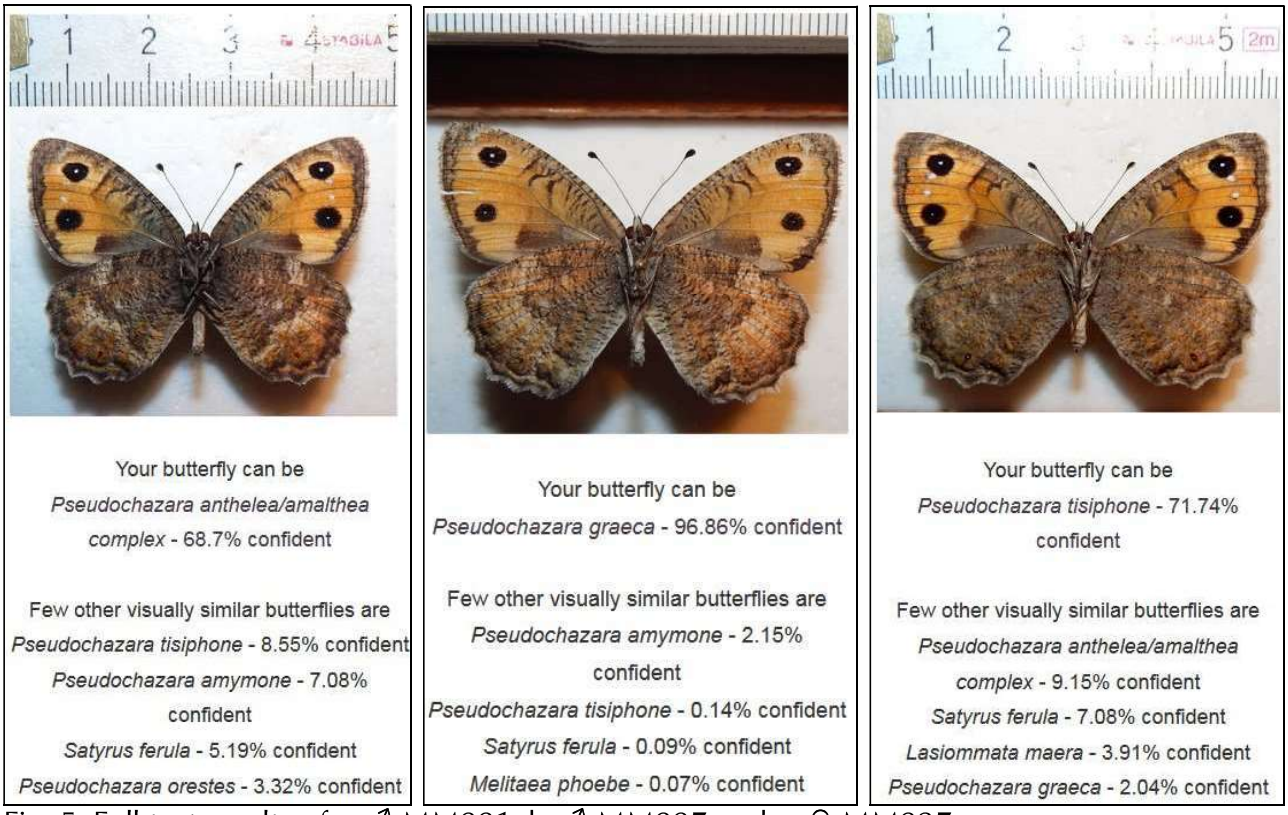

Fig. 5. Full test results of a. ♂ MM001, b. ♂ MM007 and c. ♀ MM027.

It is not possible to compare a personal photograph with the photographs in the database that one supposes well identified, but are they well identified? It would be educative for people to see the database photos.

On the website there is no information about the number of database photographs included per species. We didn't find any input on that. We therefore asked the developer, Hari THEIVAPRAKASHAM. He informed us that he used his previous experience from a similar application of Indian butterflies, which has at least 20 images per species.

Conclusion

The recognition website needs to be improved in order to provide reliable identification of all Greek butterfly species, in particular morphological closely related taxa. Basically the photo database must be enlarged with photographs of specimens that have been correctly identified. With sufficient photo material of upper- and undersides including both sexes and representing the global variation range, a higher accuracy rate can be expected. For very similar species it will not replace the need for detailed identification.

The functionality is limited to Greek species only, but with a little effort it would be useful for all Balkan species.

References

Cuvelier S. 2010. The butterflies of Greece, second edition. Boekbespreking en nota's betreffende *Pseudochazara amymone* Brown 1976. — *Bulletin Belgische Lepidopterologische Kring* **39**: 75–80.

Cuvelier S. & Mølgaard M. 2015. *Pseudochazara amymone* (Lepidoptera, Nymphalidae) in Albania: Variability analysis, androconial scales and new distributional data. — *Nota Lepidopterologica* **38**(1): 1–22. doi: 10.3897/nl.38.9230.

Eckweiler, W. 2012. New discoveries of *Pseudochazara mamurra amymone* Brown, 1976 (Lepidoptera: Nymphalidae, Satyrinae) — *Nachrichten des Entomologischen Vereins Apollo*, N.F. **33**: 1–4.

Pamperis, L. 1997. *The butterflies of Greece*. — Athens (A. Bastas D. Plessas Graphic Arts), 559 pp.

Pamperis, L. 2009. *The butterflies of Greece. Second edition, revised and enlarged*. — Athens (Editions Pamperis), 766 pp.