FunDive

FunDive: europejski monitoring różnorodności grzybów z zaangażowaniem nauki obywatelskiej





biodiversa+
European Biodiversity Partnership

Co-funded by the European Union

MycoWro2026

UNIWERSYTET WARSZAWSKI

Julia Pawłowska i wsp.

Bundesministerium für Bildung und Forschung
Eesti Teadusagentuur Estonian Research Council
Republic of Estonia Ministry of Climate
TA CR Technology Agency of the Czech Republic
fwo Research Foundation Flanders Opening new horizons
FCT Fundação para a Ciência e a Tecnologia
National Research, Development and Innovation Office
National Science Centre Poland
The Research Council of Norway
anr agence nationale de la recherche
DFG Deutsche Forschungsgemeinschaft German Research Foundation
GSRI General Secretariat for Research and Innovation
Swiss National Science Foundation
NWO Netherlands Organisation for Scientific Research
Academy of Finland
MUR
AEI Agencia Estatal de Investigación
Innovation Fund Denmark

Różnorodność grzybów

Table 1 Extended list of global fungal diversity predictions, proposed corrections, and proposed totals including fungal groups (largely) not considered in prediction methods[a]

Reference	Approach	Original	Adjusted	Total adjusted
Martin (156)	F:P ratio (pathogens)	0.25 million	1.20 million	3.10–3.17 million
Pascoe (73)	F:P ratio (pathogens)	2.70 million	0.94 million	2.45–3.01 million
Hawksworth (44)	F:P ratio (general)	1.50 million	1.63 million	2.30 million
Hawksworth (44)	F:P ratio (general), F:I ratio	3.00 million	2.13 million	2.30 million
Hywel-Jones (162)	F:I ratio	1.50 million	0.55 million	2.77 million
Shivas & Hyde (74)	F:P ratio (tropical pathogens)	0.27 million	0.40 million	2.57 million
Hawksworth & Lücking (42)	Hidden diversity (known taxa)	1.70 million	1.47 million	1.57 million
Wu et al. (46)	Metabarcoding versus culturable fungi	11.7–13.2 million	3.06 million	3.23 million
Baldrian et al. (43)	Metabarcoding (general; 97%)	6.28 million	1.66 million	1.73 million
Tedersoo et al. (40)	Metabarcoding	>1.53 million	>1.53 million	>3.03 million
Tedersoo et al. (41)	Metabarcoding (98%); hidden diversity	19.35 million	2.28 million	3.83 million

(Niskanen et al. 2023)

Różnorodność grzybów

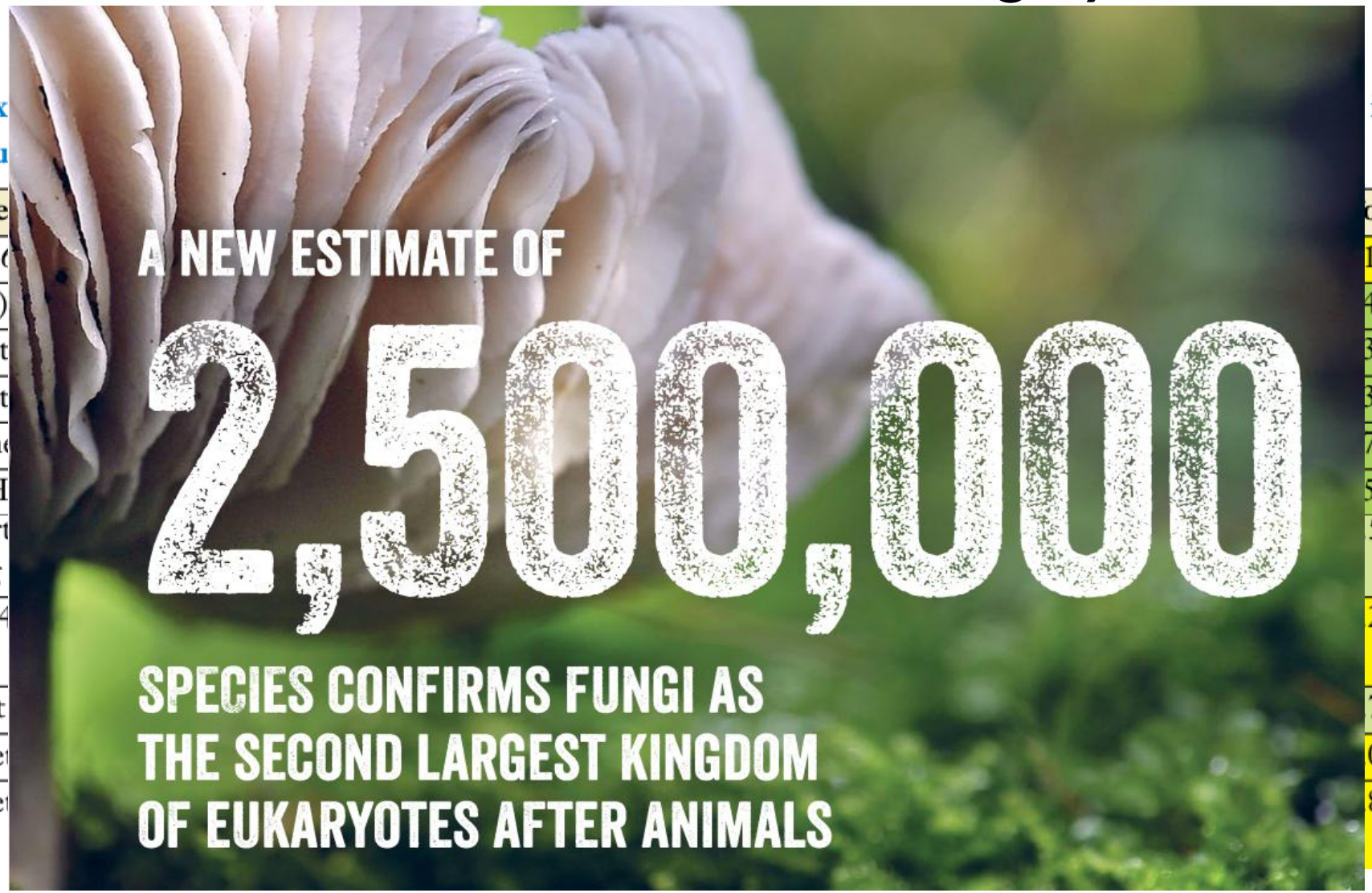


Table 1 Ex … including fungal grou …

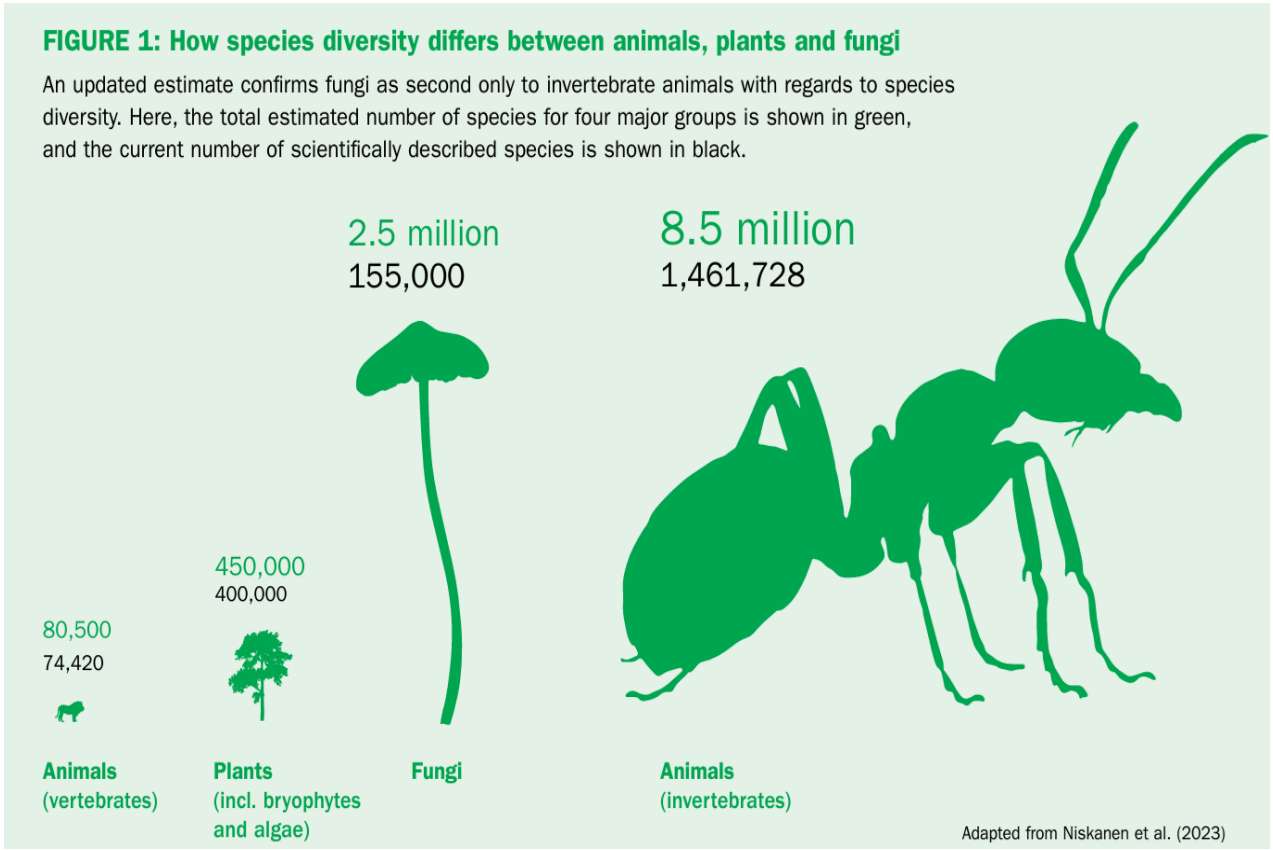
Refere…	…otal adjusted
Martin (15…	…10–3.17 million
Pascoe (73)	…45–3.01 million
Hawkswort…	…30 million
Hawkswort…	…30 million
Hywel-Jone…	…77 million
Shivas & H…	…57 million
Hawksworth… Lücking	…57 million
Wu et al. (4…	…23 million
Baldrian et…	…73 million
Tedersoo et…	…03 million
Tedersoo et…	…83 million

(Niskanen et al. 2023)

https://www.kew.org/sites/default/files/2023-10/State%20of%20the%20World%27s%20Plants%20and%20Fungi%202023_V2.pdf

Grzyby słabo poznane

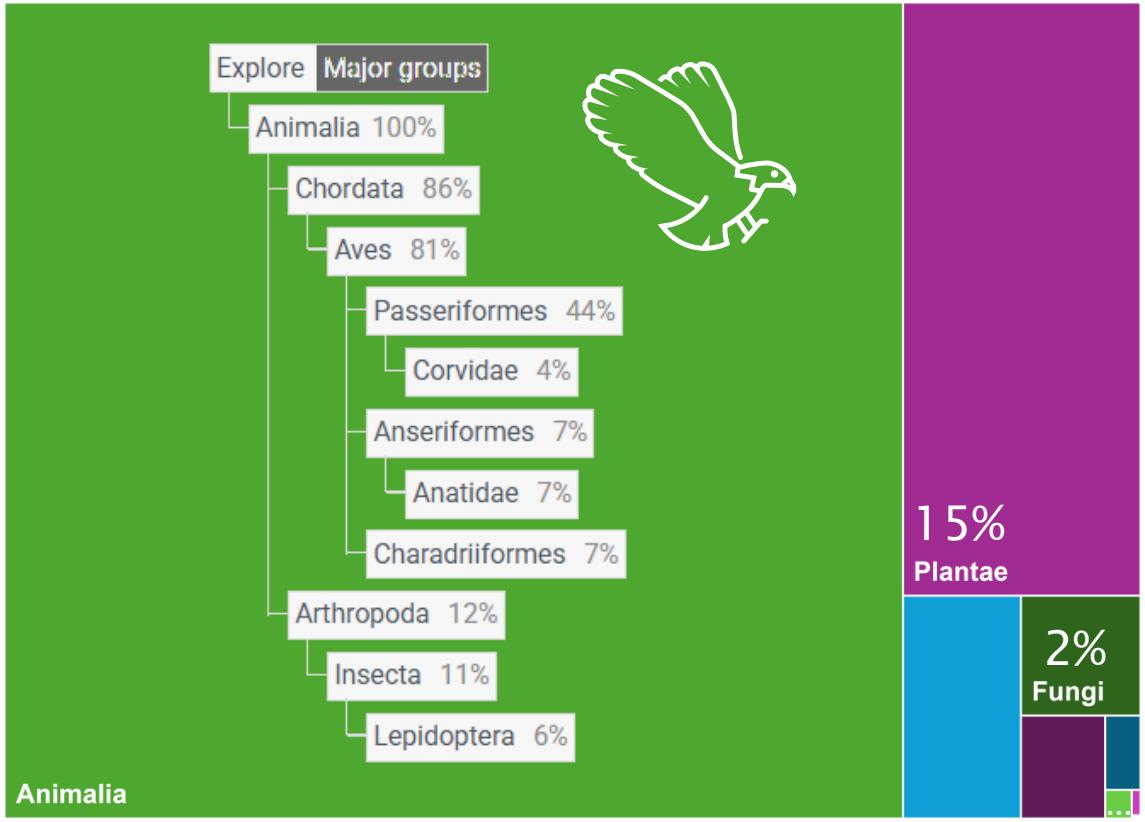
Opisana vs szacowana liczba gatunków



https://www.kew.org/sites/default/files/2023-10/State%20of%20the%20World%27s%20Plants%20and%20Fungi%202023_V2.pdf

Wystąpienia w GBIF

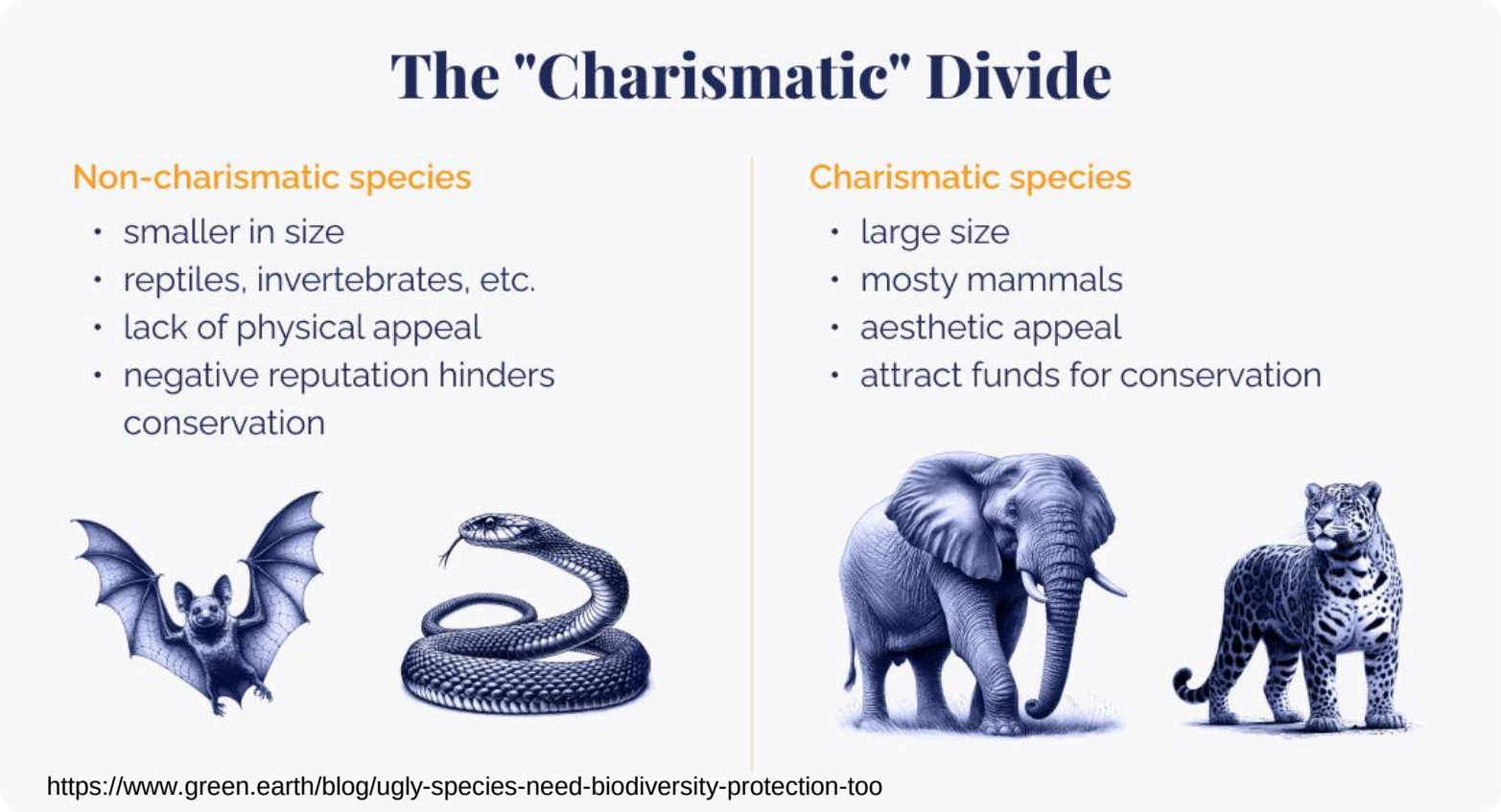
GBIF Global Biodiversity Information Facility



https://www.gbif.org/occurrence/

Dlaczego grzyby są słabiej poznane niż rośliny i zwierzęta?

- efemeryczna natura
- trudna identyfikacja
- krótsza historia badań
- mniejsza popularność
- ...



https://www.green.earth/blog/ugly-species-need-biodiversity-protection-too

Grzyby są najczęściej „niewidoczne i niecharyzmatyczne”

Niektórzy uwielbiają i znają grzyby



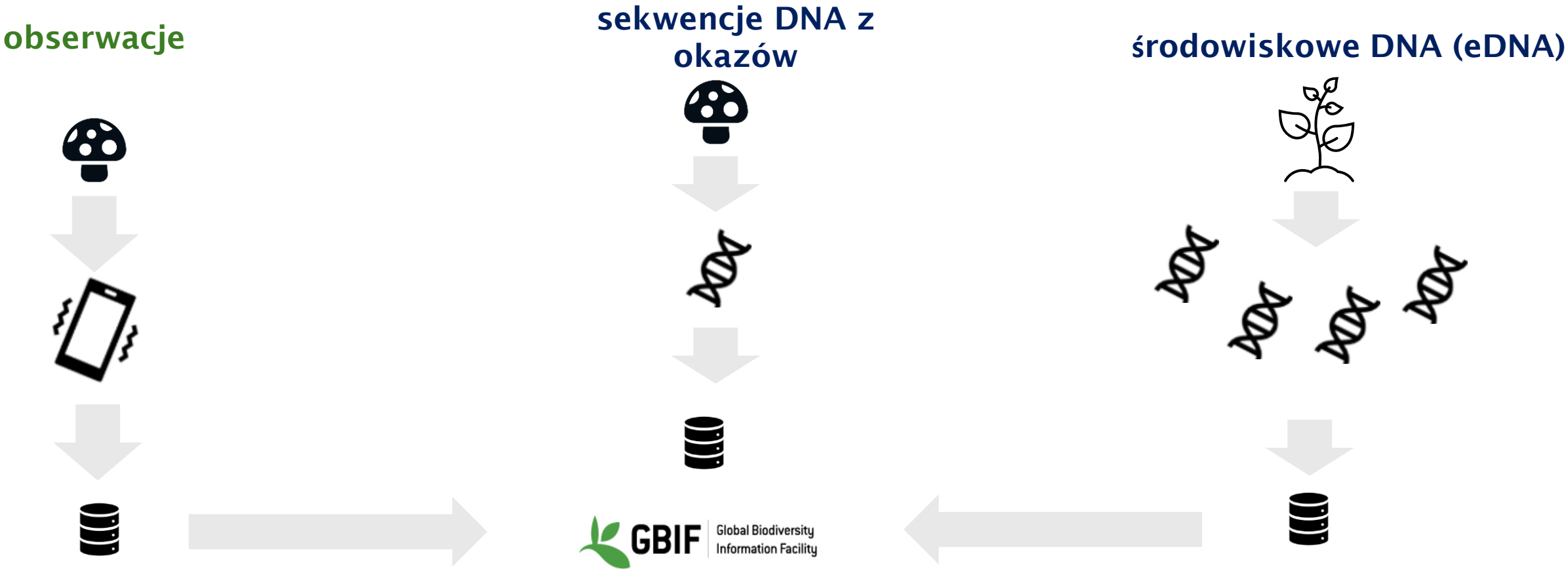


Zervynos, Varėna District | I. Videikaitė / Varėna Municipality



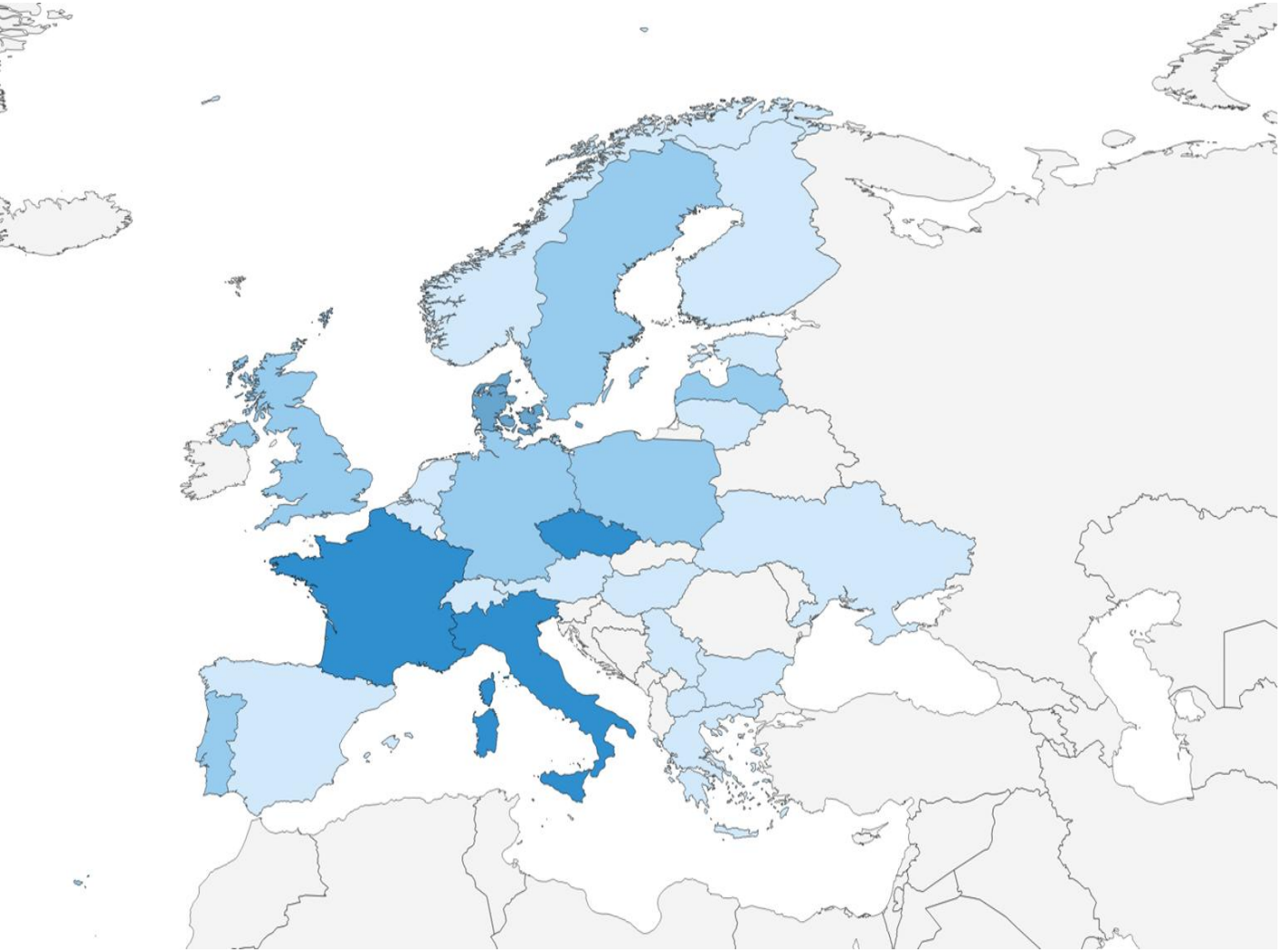
Varėna Municipality

Rosnąca rozbieżność między danymi o występowaniu grzybów pochodzącymi z różnych źródeł



FunDive

Europejskie konsorcjum FunDive



2024: 26 partnerów w 16 krajach
2026: 43 partnerów w 24 krajach

FunDive

Włączenie ukrytej różnorodności grzybów w działania na rzecz ochrony przyrody, łącząc lokalną wiedzę z infrastrukturą naukową w skali całej Europy.

FunDive



Empower & involve citizen scientists



Test & develop eDNA techniques



Picture recognition apps



Recording & sequecing missions

Clavulina	Symbiotroph	Ectomycorrhizal	OTU93
Inocybaceae	Symbiotroph	Ectomycorrhizal	OTU78
Laccaria	Symbiotroph	Ectomycorrhizal	OTU1159
Scleroderma	Symbiotroph	Ectomycorrhizal	OTU201
Thelephoraceae	unassigned	Undefined	OTU248
Tomentella	Symbiotroph	Ectomycorrhizal	OTU1480
Tomentella	Symbiotroph	Ectomycorrhizal	OTU58
unclassified	unassigned	Undefined	OTU61
unclassified	unassigned	Undefined	OTU148

Common eDNA mission – Pine forests



unite community
a non-profit association



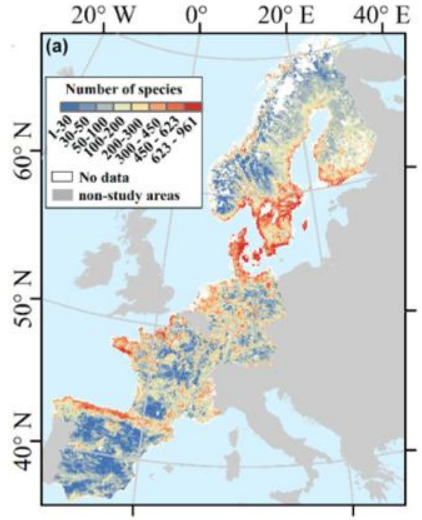
DNA barcoding and annotation

GBIF

Evaluate conservation status

The Global Fungal Red List Initiative

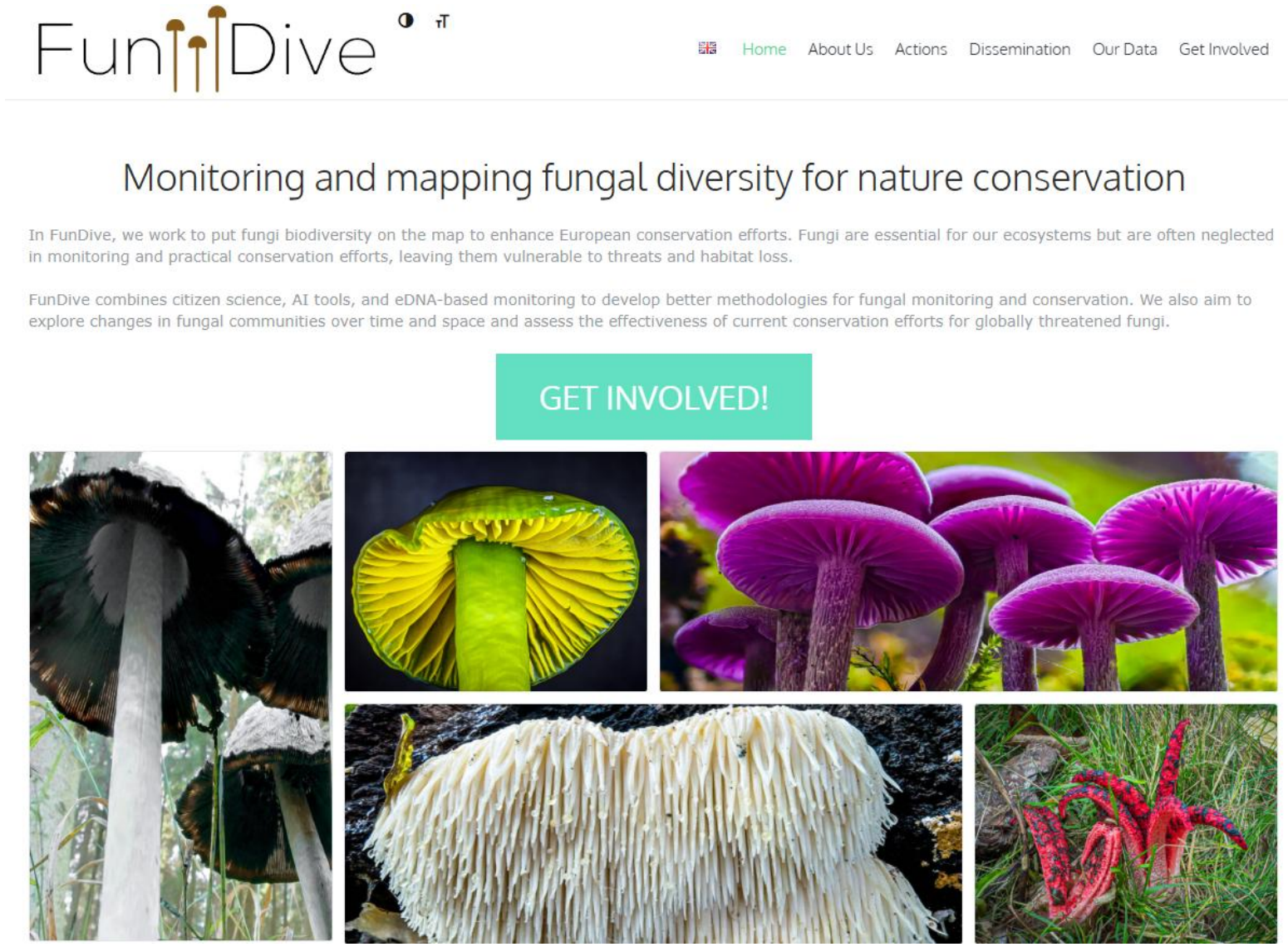
NATURA 2000



Investigate biodiversity patterns

Bundesministerium für Bildung und Forschung
Eesti Teadusagentuur Estonian Research Council
Republic of Estonia Ministry of Climate
TA CR Technology Agency of the Czech Republic
fwo Research Foundation Flanders Opening new horizons
FCT Fundação para a Ciência e a Tecnologia
National Research, Development and Innovation Office
National Science Centre Poland
The Research Council of Norway
anr agence nationale de la recherche
DFG Deutsche Forschungsgemeinschaft German Research Foundation
GSRI General Secretariat for Research and Innovation
Swiss National Science Foundation
NWO Netherlands Organisation for Scientific Research
Academy of Finland
MUR
Agencia Estatal de Investigación
Innovation Fund Denmark

Zaangażowanie nauki obywatelskiej



Ogólnoeuropejskie „discovery missions”



- wkład w europejską Czerwoną listę IUCN
- zwiększenie liczby sekwencji referencyjnych DNA dla europejskich gatunków
- zwiększenie liczby wiarygodnych danych o wybranych grupach grzybów z Europy

Zapraszamy na stronę
https://fun-dive.eu/get-involved/

CURRENT PROJECTS

HOW TO ENGAGE?

16 projektów na stronie


CHROOGOMPHUS


DERMATOCARPON


EYES ON ALIEN MUSHROOMS


TRICHOLOMA EUCALYPTICUM


TRUFFLE-LIKE RUSSULACEAE


TULOSTOMA


GEASTRUM


HESPEROMYCES


HYGROPHORUS


HYPOMYCES


MISSION: URBAN MUSHROOMS


MOST WANTED

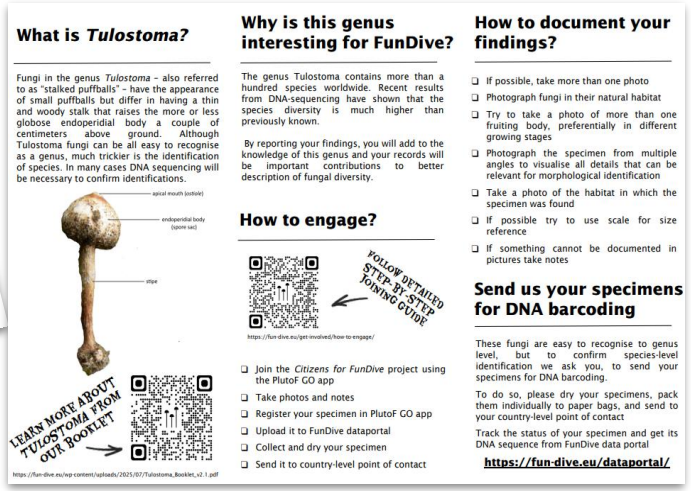

PAXILLUS


PINE FOREST FUNGI


SLIME MOULDS

czerwone – zaawansowane
żółte – średnie
zielone - łatwe





FunDive

Jak dołączyć?

Select project and read online materials

https://fun-dive.eu/en/get-involved/current-projects/


FunDive

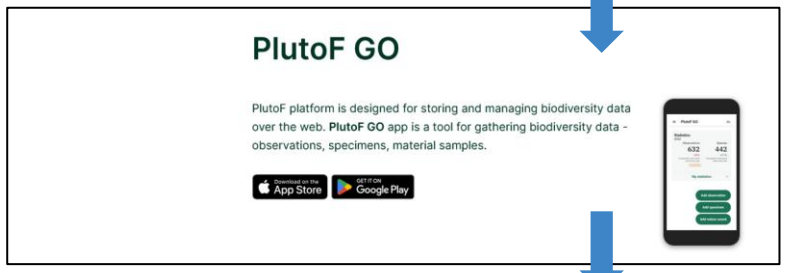
Geastrum

is one of the target genera for the 2024 FunDive projects aimed at supporting assessments of gasteromycetes for the European IUCN Red List

***Geastrum* – earthstars** – have the appearance of small puffballs but differ in having an outer tissue that splits up in a starlike pattern (Fig. 1). When fully expanded, some earthstars can reach a diameter of 10–12 cm, but most are smaller, measuring up to 1–5 cm in diameter. The spores are contained in a small, rounded structure in the centre of the basidioma, called the endoperidial body. When the spores are ripe, they constitute a dry and powdery mass, just like a puffball. The wall of the endoperidial body acts as a bellow's mechanism and when compressed by wind, raindrops, or trampling, the spores are released and dispersed through a small pore at the top of the endoperidial body. The surrounding outer tissue with its more or less acute rays is called the exoperidium.

Fig. 1. Representatives of *Geastrum* genus (from the left): *G. coronatum*, *G. schmidelii*, *G. melanocephalum* (photo Jörgen Jeppson).




PlutoF GO

PlutoF platform is designed for storing and managing biodiversity data over the web. **PlutoF GO** app is a tool for gathering biodiversity data - observations, specimens, material samples.

Download on the App Store | GET IT ON Google Play



FD00009	Sequenced	*Tulostoma brumale*
FD00008	Sequenced	*Tulostoma brumale*
NATSTO2109_1	Sequenced	*Geastrum floriforme*


General Data

Sequence ID
FD00009

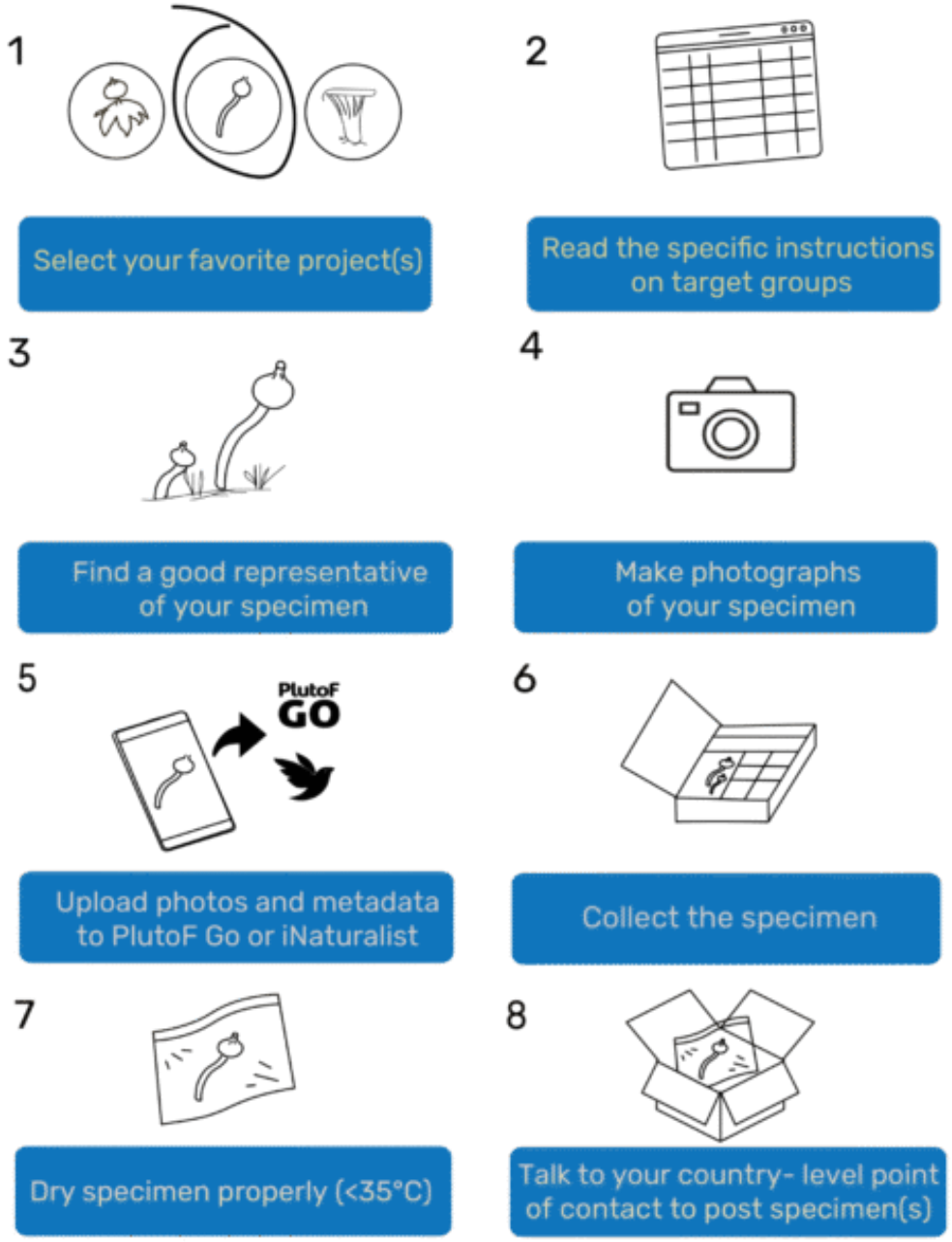
Form name
Sequence: default

Linked to
FD00009

Sequenced regions

Sequence

TCCTCCGCTTATTGATATGCCCTCCGCTTACTTCCTCTAAATGACCAAGACGTTACTTCCTCCGCTTATTGATATGCCCTCCGCTTACTTCCTCTAAATGACCAAGT
CTCCGCTTATTGATATGCTTAAGTTCAGCGGGTAGTCCTACCTGATTTGAGGTCAAGCATTCAAATATATGATTGTCCAAGTAAAGGACGGTTAGAAGCAGAACTACCAGAGAGCAGTTGTCGTTGGCGTAGATAATTATCACACCAGTGACGGGTCCG
AAACGGTTCCGCTAATGCTTTTTAGGGGAGCCGACCTCTGAAGAGGCCCGCAACAATACCCCCACATCCAATCCACCAAGCCAGTCACAAAAACTAGTGGGGATTGAGATTAAATGACACTCAAACAGGCATGCTCCTCGGAATACCAAGGAGC
GCAAGGTGCGTTCAAAGATTTCGATGATTCACTGAATTCTGCAATTCACATTACTTATCGCATTTCGCTGCGTTCTTCATCGATGCGAGAGCCAAGAGATCCGTTGCTGAAAGTTGTATTGTGTTTTATAGACACTGAGGCCCATAAAAACTTTCTATTAC
ATTCGACGTGGTATATGAAAGACATAGACCAAGAGAAACTTGCACTAACATCAAGGAGTGTGATCCCCAAGACGCTTTGCGCTCATTATCTCCAAGACTACAAAGGGTGCACAGGTGGATGGATAAAGATGACAGGTGTGCACATACTTCCGGAGAAGC
CAGCAACAACCCATCAGGTTTATTCAATAATGATCCTTCCGCAGGTTCACCTACGGAAACCTTGTTACGACTTTTACTTCCTCTAAATGACCAAGAA

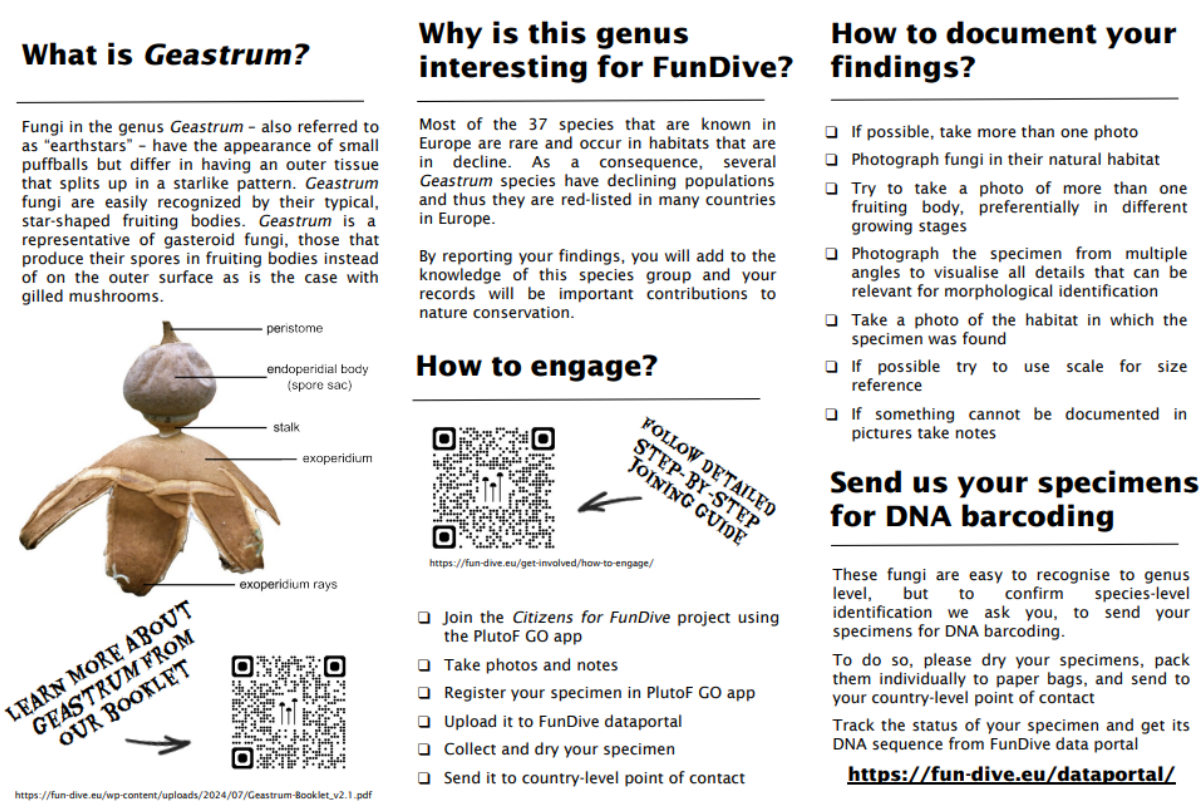


If applicable, receive any permits needed for sampling in your country before going to the field

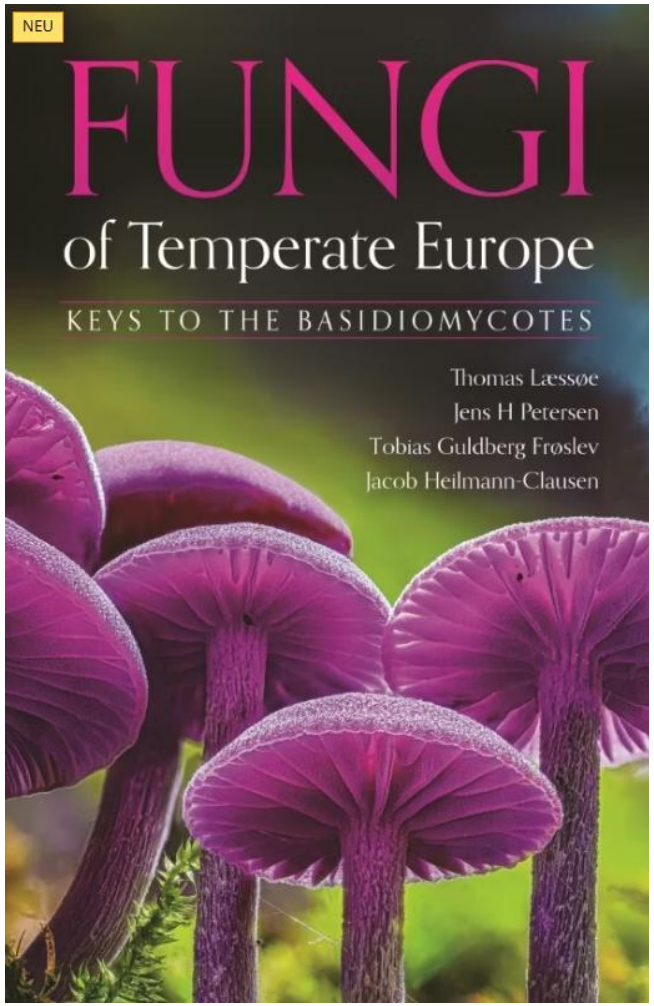
Materiały online

- ulotki
- książeczki
- linki do artykułów naukowych
- klucze do identyfikacji





Klucze do identyfikacji



Key to star-shaped gastromycetes (*Astraeus*, *Geastrum* and *Myriostoma*)
All spore measurements are without ornament.



1. Spore-ball with many openings and with many stems at the bottom. Spores spherical, 4-5 µm, with large, sinuate crests; on warm, calcareous soil in forests and scrubs (southern) ... ***Myriostoma coliforme***
Spore-ball with an opening at the top and with one or no stem ... 2



2. The inner side of the rays cracking in a pale reticulate pattern; fruitbodies very tough; without columella; ectomycorrhizal; spores wider than 6 µm. Spores sperical, 6-10 µm, with markant warted-spiny ornament; on ± sandy soil with *Quercus*; very rare ... ***Astraeus pteridis***
The inner side of the rays not with pale reticulate pattern; fruitbodies less tough, but not fragile; with columella; spores less than 6 µm wide; saprobes ... [stjernebold (*Geastrum*)] ... 3



3. Spore-ball hairy and without an outer wall. Spores 4.5-6 µm; on ± calcareous soil in warm deciduous forests and scrubs; rare ... ***Geastrum melanocephalum***
Spore-ball with well defined an outer wall ... 4



4. Opening zone with furrows ... 5
Opening zone smooth to somewhat fluffy ... 18



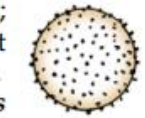
5. Surface of the spore-ball rough (lens!); spore-ball with a short stem ... 6
Surface of the spore-ball smooth or mealy; spore-ball with or without a short stem ... 10

6. Fruitbody not hygroscopic (permanently open at maturity) ... 7
Fruitbody ± hygroscopic (curled up in dry weather) ... 8



7. Spore-ball 15-25 mm wide; spores on average 4.3 µm. Spores 3.5-4.5 µm, coarsly warted; in lush forests; rare ... ***Geastrum berkeleyi***
Spore-ball 5-10 mm wide; spores on average 4.8 µm. Spores 4.5-5.5 mm, warted-spiny; in open warm environments; rare ... ***Geastrum pseudostriatum***





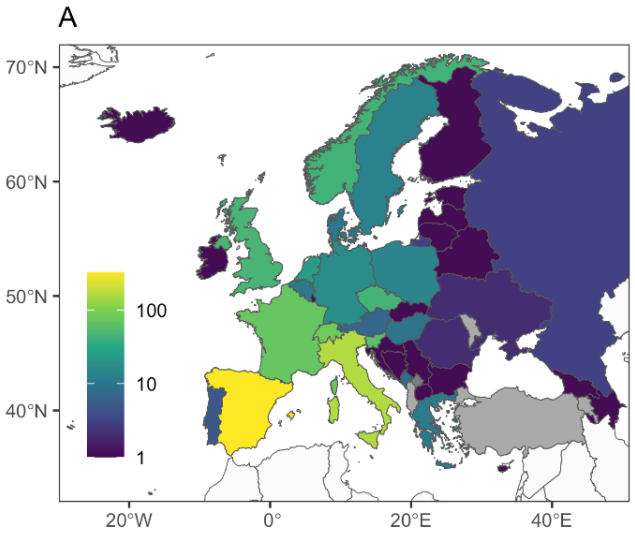


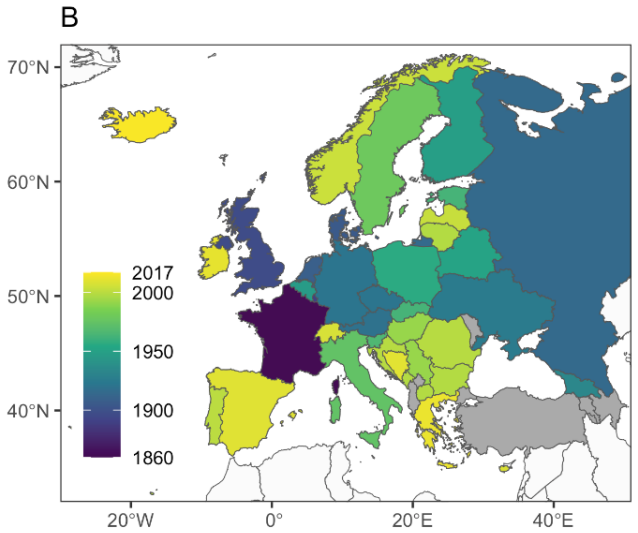




Ponad 1500 organizacji mykologicznych w Europie

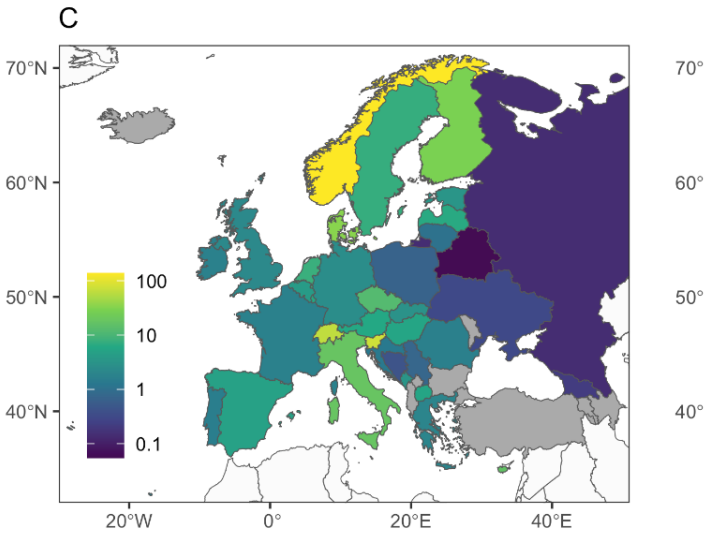
Liczba organizacji mykologicznych





Rok powstania najstarszego towarzystwa mykologicznego

Liczba członków w organizacjach mykologicznych



(Haelewaters et al. 2025)

Lokalni koordynatorzy kampanii

Różnorodne sposoby angażowania

Zorganizowane spacery w Grecji

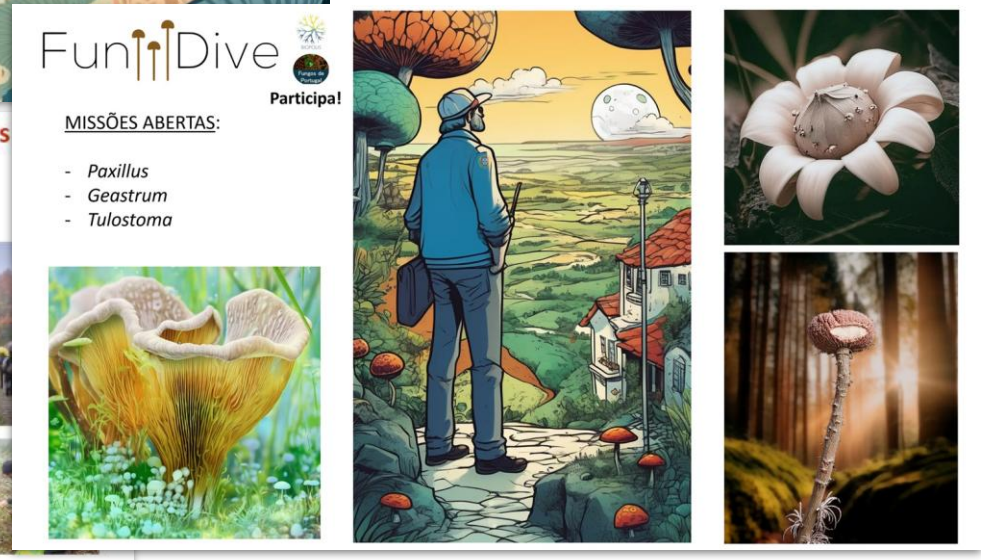


Festiwale i wystawy we Włoszech





kampanie w social mediach w Portugalii



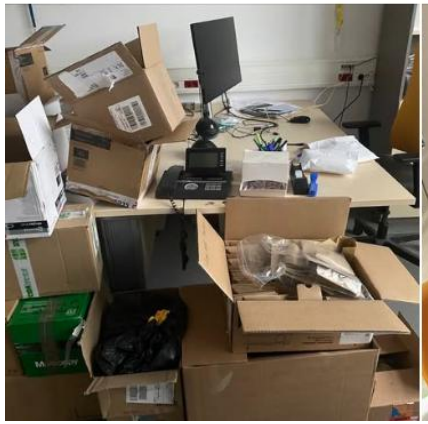
Angażowanie różnych grup
Różnorodność aktywności

- warsztaty i szkolenia
- artykuły w prasie
- aktywność w social mediach

Zaangażowanie seniorów w przygotowywanie okazów do zielnika

This process is massive and time-consuming, and last season we were lucky to have several volunteers helping us every step of the way. Among them was pani Mirosława Lisiecka.
A huge thank you to all collectors and volunteers!

#FunDive #Biodiversa #CitizenScience





genetyczne grzybobranie

CENTRUM NAUKI KOPERNIK

- 2024-2025
- wyizolowane DNA z 250 okazów
- optymalizacja protokołów







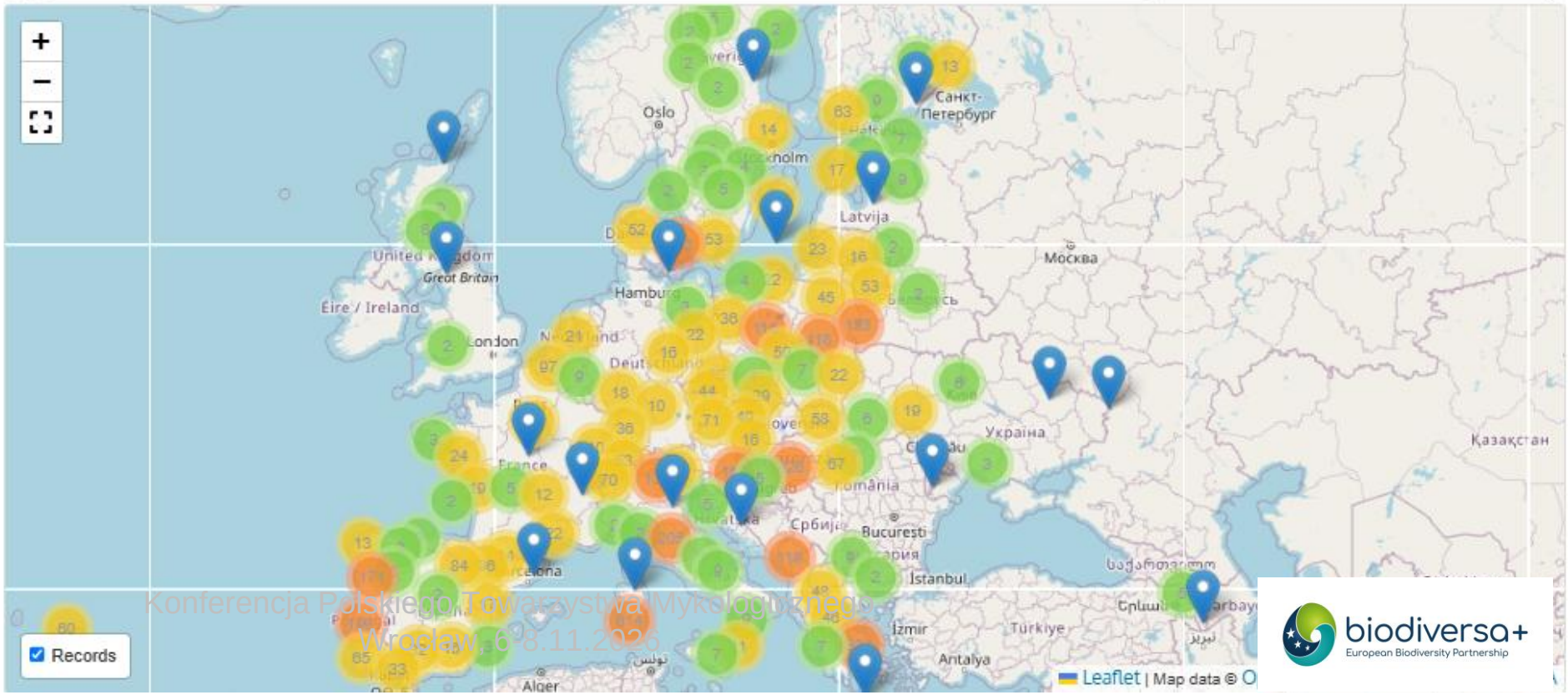
FunDive

Efekty

6505 zgłoszeń
- 5615 okazów
- 890 obserwacji
- 845 sekwencji DNA

607 zaangażowanych osób
34 kraje

#	Country	Records	#	Country	Records	#	Country	Records
1	Italy	1012	11	Slovenia	142	21	Ukraine	37
2	Poland	819	12	Sweden	135	22	North Macedonia	32
3	Finland	793	13	Switzerland	126	23	Netherlands	26
4	Greece	620	14	Germany	118	24	United Kingdom	19
5	Portugal	536	15	Estonia	110	25	Slovakia	18
6	Hungary	515	16	Belgium	101	26	Austria	16
7	Spain	361	17	Lithuania	82	27	Croatia	15
8	Czechia	279	18	Romania	69	28	Republic of Kosovo	10
9	France	217	19	Unspecified	57	29	Bulgaria	10
10	Denmark	158	20	Montenegro	57	30	Armenia	7



Konferencja Polskiego Towarzystwa Mykologicznego
Wrocław, 6-8.11.2026

MycoWro2026

biodiversa+
European Biodiversity Partnership

FunDive

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8	Czechia	279	18		69	28	Republic of Kosovo	10
9	France				57	29	Bulgaria	10
10	Denmark				57	30	Armenia	7

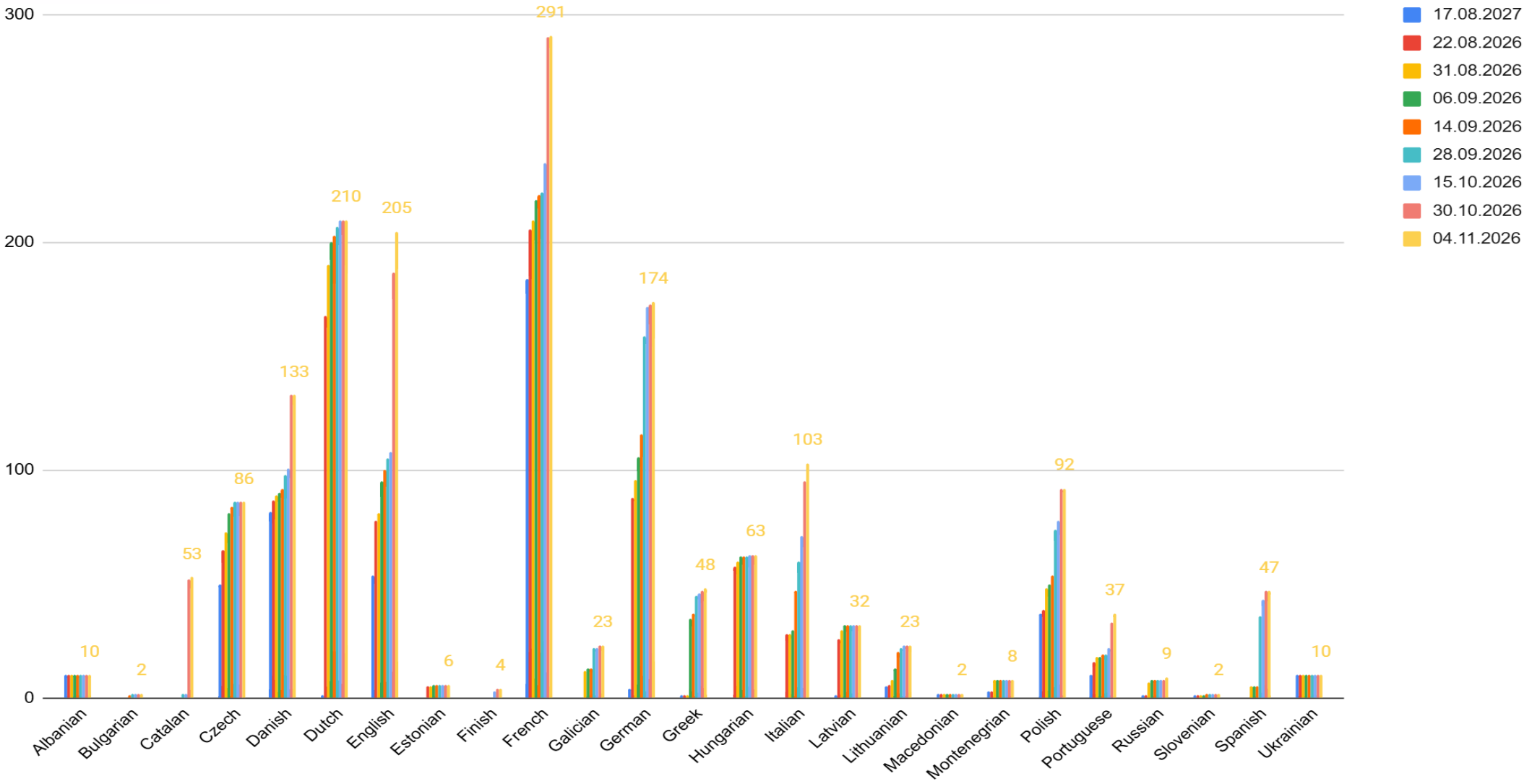
ISTOTNE RÓŻNICE W STOPNIU ZAANGAŻOWANIA



MycoWro2026

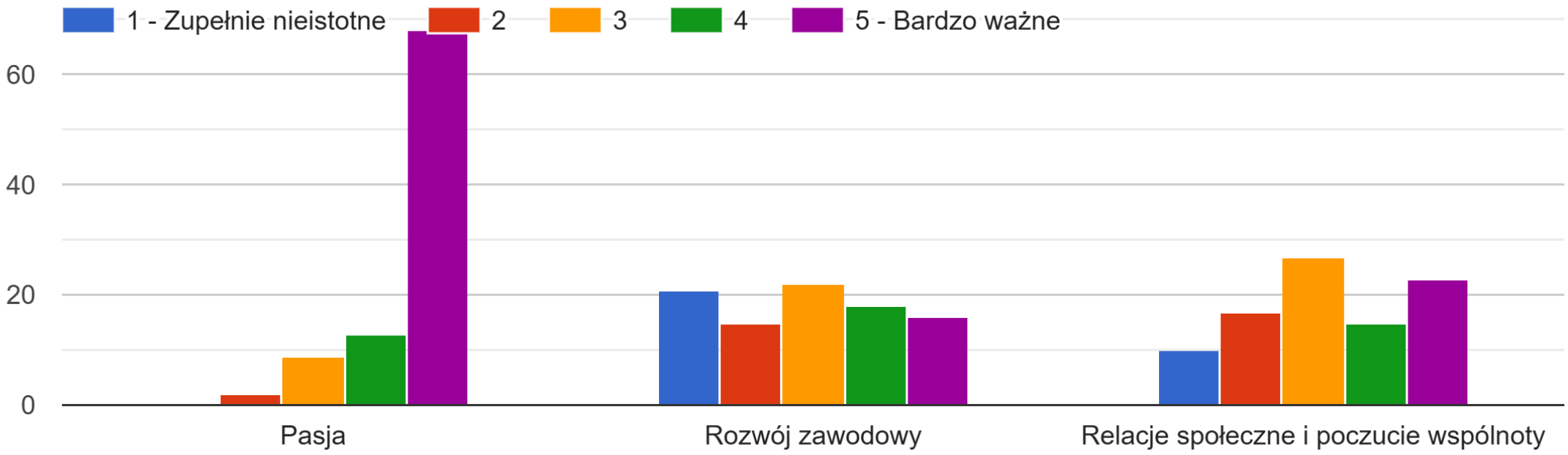
biodiversa+
European Biodiversity Partnership

Różnice w motywacji



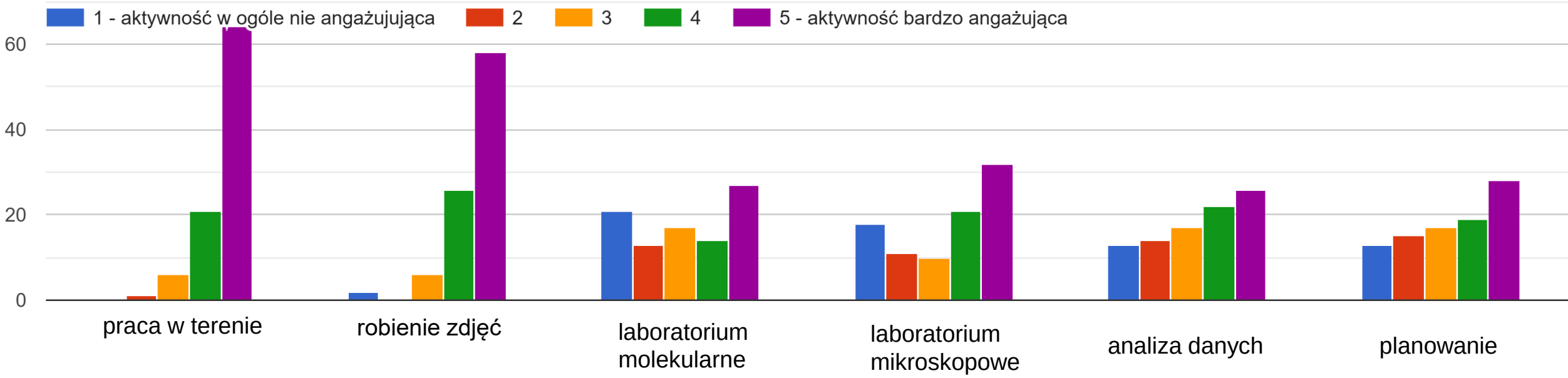
Polska – wstępne wyniki

P12: Jak ważne są dla Państwa poniższe kwestie w odniesieniu do zaangażowania w aktywności mykologiczne. Proszę zaznaczyć odpowiednią ocenę ...cza „zupełnie nieistotne”, a 5 – „bardzo ważne”.



Polska – wstępne wyniki

P19: Na ile angażujące są dla Państwa poniższe działania w ramach projektów nauki obywatelskiej? Proszę użyć skali od 1 do 5, gdzie 1 oznacza aktywność w ogóle nieangażującą, a 5 aktywność bardzo angażującą.



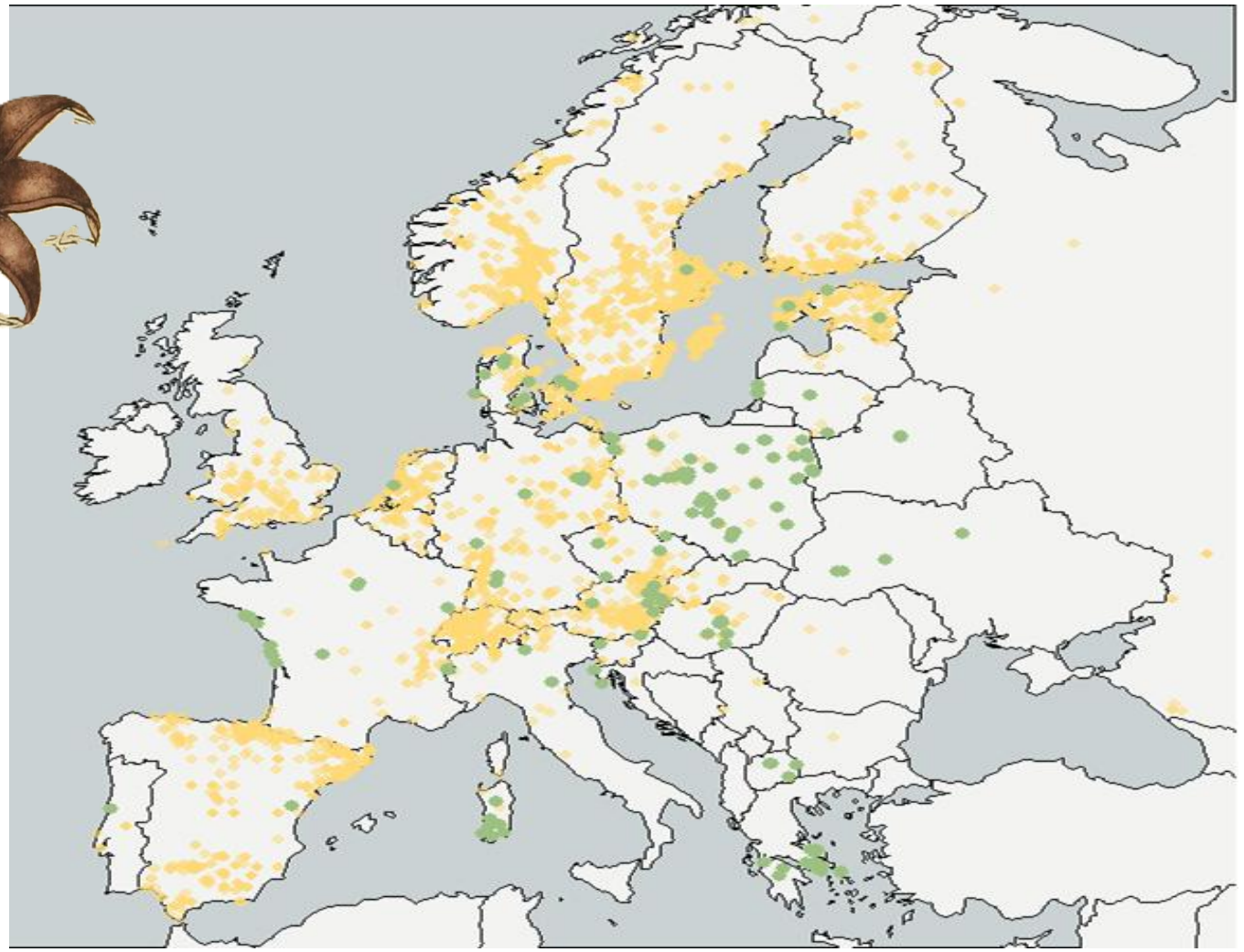
Co to zmieniło?

Przykład gwiazdoszy (*Geastrum*)



- 37 gatunków w Europe
- w ciągu dwóch sezonów
  - 774 okazów
  - 22 krajów
  - wszystkie gatunki
  - wiele nowych lokalizacji
- wykorzystane do oceny stanu zagrożenia przez IUCN
- 3 potencjlanie nowe gatunki





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Top collectors

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Fungarium of the Hungarian Mycologic…	123
M.N.F. - Montenegrin National Fungari…	26
Department of Biomedical Sciences, U…	21
ACAM - Mycological Herbarium Labora…	15
More…	

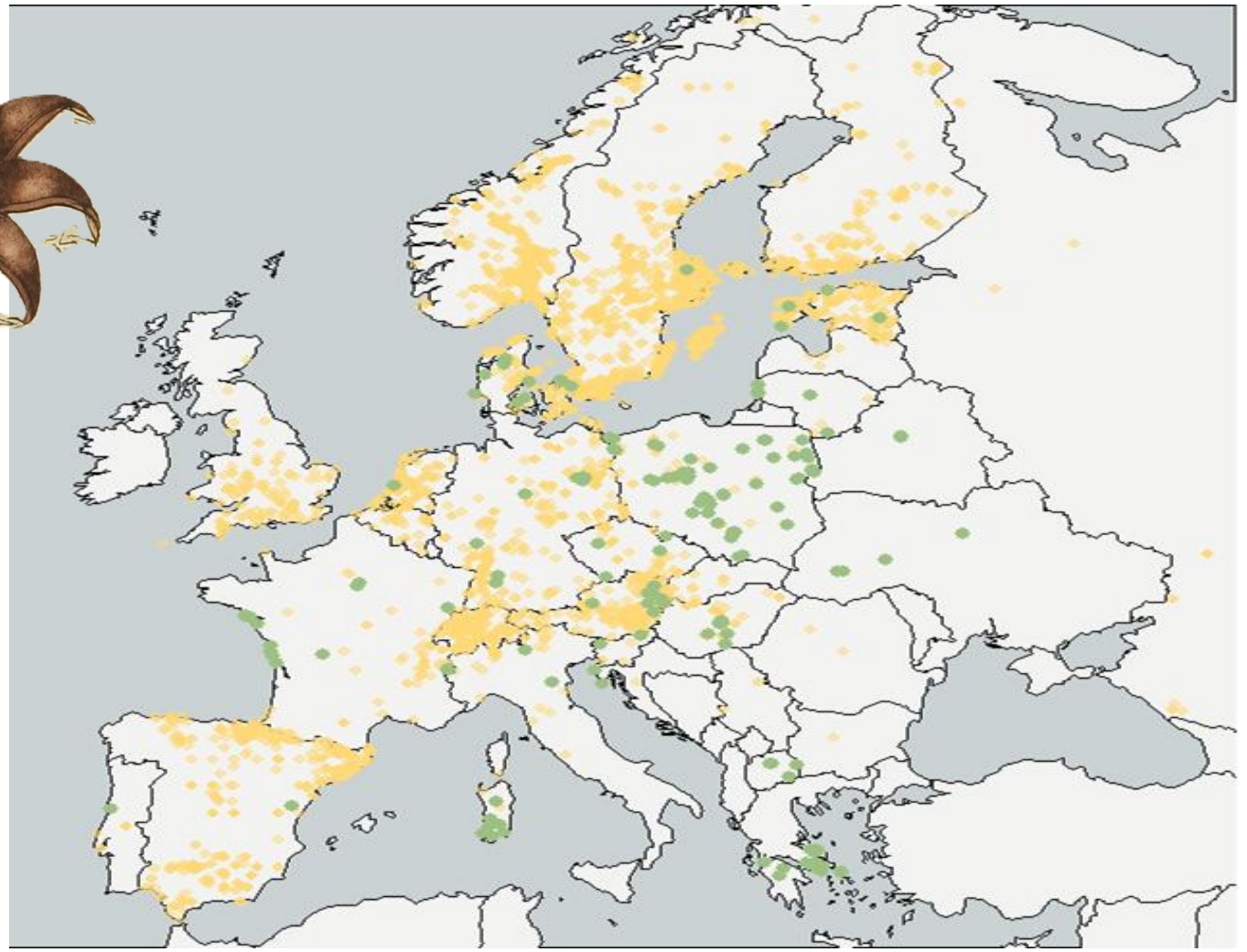
Co to zmieniło?

Przykład gwiazdoszy (*Geastrum*)



- 37 gatunków w Europe
- w ciągu dwóch sezonów
  - 774 okazów
  - 22 krajów
  - wszystkie gatunki
  - wiele nowych lokalizacji
- wykorzystane do oceny stanu zagrożenia przez IUCN
- 3 potencjlanie nowe gatunki





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GBIF Global Biodiversity Information Facility

New data publishers!

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Zapraszamy do kontaktu!

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@FunDive:Monitoring and mapping fungal diversity for nature conservation

@fundive-fungi
(https://www.linkedin.com/company/fundive-fungi/)

https://fun-dive.eu/

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DFG Deutsche Forschungsgemeinschaft German Research Foundation
GSRI General Secretariat for Research and Innovation
Swiss National Science Foundation
NWO Netherlands Organisation for Scientific Research
Academy of Finland
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