

Seminar Series **Reflection on the Future of Biomonitoring**

Citizen Science: participatory approaches in biomonitoring

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IABEP - International Association for Biomonitoring of Environmental Pollution

Citizen Science? What?



One, two, tree... dozens of definitions

Oxford dictionary: "Citizen science" is a "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions".

European Commission: Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources.

Citizen Science Italy web portal: Citizen science, or participatory science, is the active involvement of citizens in the collection, analysis and interpretation of data for scientific purposes.

ECSA FAQ: Citizen science, in general, means the participation of the public in science and research. It is an open and inclusive approach, with key characteristics including: (1) citizens are actively involved in research; and (2) there is a genuine science outcome, such as new scientific knowledge, conservation action or policy change.

However (in the very same FAQ): The term 'citizen science', however, is broad and always changing, meaning that it is hard to narrowly define.

Table 2.1 Selected definitions of citizen science

From: What Is Citizen Science? The Challenges of Definition

1	Oxford English Dictionary (2014)	Scientific work undertaken by members of the general public often in collaboration with or under the direction of professional scientists and scientific institutions
2	Wikipedia (2005)	A project (or ongoing program of work) which aims to make scientific discoveries or verify scientific hypotheses
3	Wikipedia (2019)	Scientific research conducted, in whole or in part, by amateur (or nonprofessional) scientists
4	National Geographic Encyclopedia	Citizen science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through citizen science, people share and contribute to data monitoring and collection programs
5	Australian Citizen Science Association	Citizen science involves public participation and collaboration in scientific research with the aim to increase scientific knowledge. It's a great way to harness community skills and passion to fuel the capacity of science to answer our questions about the world and how it works
6	European Citizen Science Association	Citizen Science – the participation of the general public in scientific processes... an open and inclusive approach, for example, by supporting and being part of the exploration, shaping, and development of the different aspects of the citizen science movement, its better understanding, and use for the benefit of decision-making
7	European Citizen Science Association	Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding
8	Citizen Science Association (US)	Citizen science is the involvement of the public in scientific research, whether community-driven research or global investigations
9	Group on Earth Observations Citizen Science Working Group	Citizen science encompasses a range of methodologies that encourage and support the contributions of the public to the advancement of scientific and engineering research and monitoring in ways that may include co-identifying research questions; co-designing/conducting investigations; co-designing/building/testing low-cost sensors; co-collecting and analysing data; co-developing data applications; and collaboratively solving complex problems
10	United Nations Environmental Programme (UNEP) (2019)	Citizen science entails the engagement of volunteers in science and research. Volunteers are commonly involved in data collection but can also be involved in initiating questions, designing projects, disseminating results, and interpreting data
11	UNESCO (2013)	The participation of a range of non-scientific stakeholders in the scientific process. At its most inclusive and most innovative, citizen science involves citizens working as partners in the entire scientific process, including determining research themes, questions, methodologies, and means of disseminating results
12	US Crowdsourcing and Citizen Science Act (15 USC 3724) (2014)	The term citizen science means a form of open collaboration in which individuals or organizations participate in the scientific process in various ways, including (A) enabling the formulation of research questions; (B) creating and refining project design; (C) conducting scientific experiments; (D) collecting and analysing data; (E) interpreting the results of data; (F) interpreting the results of data; (F) developing technologies and applications; (G) making discoveries; and (H) solving problems
13	CitizenScience.gov (US)	In citizen science, the public participates voluntarily in the scientific process, addressing real-world problems in ways that may include formulating research questions, conducting scientific experiments, collecting and analysing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems
14	US National Institutes of Health	Citizen science efforts are driven by community concerns. These community-led projects may involve a partnership with an academic or research institution, where both parties work together to collect and share data. The goal is to address a community concern through collaborative research and to translate the research findings into public health action that benefits the community
15	US Environmental Protection Agency (EPA) (2018)	Citizen science is a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways, including collecting and analysing data. Citizen science provides a way for members of the public to participate and support EPA programs
16	The US National Aeronautics and Space Administration (NASA)	Citizen science is defined as a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways. This policy defines citizen science projects as science projects that rely on volunteers
17	US National Oceanic and Atmospheric Administration (NOAA)	Citizen science is defined as a form of open collaboration where members of the public participate in the scientific process to address real-world problems in ways that include identifying research questions, collecting and analysing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems
18	The US National Academies of Science (2018)	The involvement of the broader public in the research enterprise
19	EC Environment (2013)	Citizen science encompasses many different ways in which citizens are involved in science. This may include mass participation schemes in which citizens use smartphone apps to submit wildlife monitoring data as well as smaller-scale activities
20	Socientize (2014)	Citizen science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources
21	EU (2016)	Inclusion of non-institutional participants, in other words the general public, in the scientific process
22	EU (2017)	Citizen science – where citizens become providers and users of data. This will reinforce and give new meaning to the policy of open access to publications and data; this openness should enable citizens and citizen groups to participate in evidence-based policy and decision-making

23	EU (2019)	More and more Europeans hold higher education degrees. Enabled by digitalisation and knowledge, citizens are today prosumers capable of shaping the innovation process and bypassing restrictive practices of established sectors and governments. This goes well beyond citizen science and covers the entire research and innovation process
24	OSPP (2018)	Broadly defined, citizen science is 'scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions'. Citizen science is an already very diverse practice, encompassing various forms, depths, and aims of collaboration between academic and citizen researchers and a broad range of scientific disciplines. Civic participation in research can range from short-term data collection to intensive involvement in the research process, from technical contribution to genuine research, and from collaboration to co-creation of knowledge. Yet, there is still a need to define and establish citizen science as a genuine, open research approach
25	G7 Science Academies (2019)	... Two categories of citizen science. The first one, which is predominant, is participatory research done by citizens who have not necessarily received training in scientific research. It was this activity that has been historically named 'citizen science' ... A second and more recent category of citizen science involves scientifically trained individuals working in isolation, or in virtual communities, to develop projects outside established controlled environments (university, government, or industry research system)
26	OECD (2017)	At the heart of the scientific process, it can be more narrowly understood as people, who are not professional scientists, taking part in research, i.e. co-producing scientific knowledge. This involves collaborations between the public and researchers/institutes but also engages governments and funding agencies
27	Science Europe (2018)	The practice of citizens performing science and of scientists working together with citizens
28	LERU (2016)	Citizen science, the active involvement of nonprofessional scientists in research... The boundaries of what can rightly be termed citizen science are debatable, but there is broad consensus that projects should involve voluntary and active public engagement with research
29	RAND Corporation (2017)	Citizen science takes open science activities beyond the purview of professional scientist circles by exploring the involvement of citizens in scientific research and the implications of these activities on and within society
30	Green Paper Citizen Science Strategy 2020 for Germany (2016)	Citizen science describes the process of generating knowledge through various participatory formats. Participation can range from the short-term collection of data to the intensive use of leisure time to delve deeper into a research topic together with scientists and/or other volunteers, to ask questions, and to get involved in some or all phases of the research process
31	UK Parliamentary Office of Science and Technology (POST) (2014)	Environmental citizen science – the involvement of volunteers in environmental monitoring
32	UK Environmental Observation Framework (2012)	Citizen science, broadly defined as the involvement of volunteers in research
32	UK Environmental Observation Framework (2012)	Citizen science, broadly defined as the involvement of volunteers in research
33	Nesta (2019)	Citizen science is any process where scientists and the public process scientific data or observations. Citizen science (usually unpaid) volunteers work together to collect or unlock new resources for research, experimentation, and analysis by opening the process to everyone
34	Environmental Science & Technology journal (2007)	According to Wikipedia, the term citizen science refers to a program in which a network of volunteers, many of whom have little or no specific scientific training, perform or manage research-related tasks, such as observation, measurement, or computation

For the sources of these definitions, please see the information on GitHub (Haklay et al. 2019)

PS: It seems that the first use of the term "citizen scientist" can be found in the magazine New Scientist in an article about ufology from October 1979.

The definition I do prefer is:

Citizen Science is the involvement of volunteers and scientists in collaborative research activities, to generate new knowledge based on scientific evidence.

Citizen Science approaches are applied in diverse fields of research (even if mostly in environmental sciences).

The OPAL project in the UK is an example of the wide array of these approaches.

But what in the field of biomonitoring?



Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Bridging science and society: Developing a citizen science biomonitoring approach for river ecosystems in Italy

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ARTICLE INFO

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ABSTRACT

Rivers are among the most altered and impacted freshwater ecosystems on Earth, so that collective efforts should be fuelled by professionals and societies to implement their biomonitoring and conservation. Citizen science is recognized as a powerful approach but its application in river biomonitoring is still scarce, especially in Italy. This study was aimed at developing and validating a citizen science biomonitoring approach for river ecosystems based on the analysis of benthic macroinvertebrate communities. By using a calibration dataset composed of 932 sampling events performed by professionals, a simplified macroinvertebrate community was first obtained by selecting only 36 representative taxa. Four different, but routinely applied, metrics were calculated on both the simplified and calibration communities and showed strong and significant correlations. Thresholds for the four selected metrics were statistically derived and offered a good agreement in discriminating not-impacted and impacted conditions according to the official methodology. The performance of the proposed approach was validated on ten independent sampling campaigns with citizen science volunteers and compared to benchmark sites. Since 33 out of 36 taxa were recorded at least once, results showed that the simplified macroinvertebrate community was effective and representative. The ecological status assessment and the selected metrics were generally comparable to the values of the benchmark sites, despite some differences being observed depending on the metric. This study represents one of the first efforts in the direction of developing a citizen science macroinvertebrate-based methodology for river biomonitoring in Italy and it supports the adoption of a multi-metric approach.





Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



The Citizen Science Stream Index - a simple and effective citizen science biomonitoring protocol using six key macroinvertebrate indicator taxa

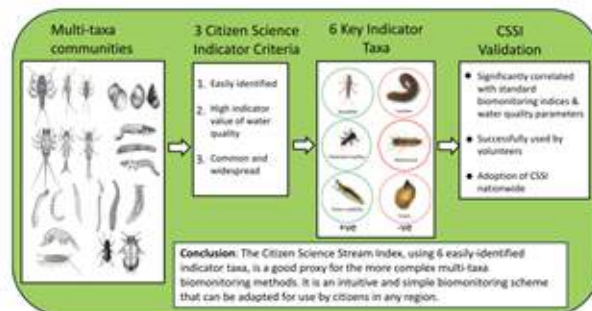
Simon Harrison^{a,*}, Brendan McSorley^a, Tim Sullivan^a

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HIGHLIGHTS

- Development of a novel citizen science macroinvertebrate biomonitoring index (CSSI)
- Six key macroinvertebrate indicator taxa selected for use in CSSI
- CSSI scores correlated with standard biomonitoring indices and water quality
- Volunteer CSSI scores correlated with standard biomonitoring indices
- The CSSI is a valuable tool for citizens to assist in achieving the aims of the WFD in Ireland.

GRAPHICAL ABSTRACT



Review

Citizen Science for Monitoring Plastic Pollution from Source to Sea: A Systematic Review of Methodologies, Best Practices, and Challenges

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Abstract

Citizen science provides a valuable approach for tracking plastic pollution; however, its effectiveness is often limited by methodological inconsistencies, concerns about data quality, and a persistent gap between data collection and policy implementation. This systematic review addresses the key question: What constitutes a comprehensive set of best practices for addressing these issues and enhancing the scientific and societal impact of citizen science in monitoring plastic pollution from source to sea? Analyzing 84 studies, from beach cleanups to microplastic sampling, this review synthesizes best practices and identifies





Contents lists available at ScienceDirect

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol

Citizen science identifies the effects of nitrogen deposition, climate and tree species on epiphytic lichens across the UK[☆]

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ABSTRACT

A national citizen survey quantified the abundance of epiphytic lichens that are known to be either sensitive or tolerant to nitrogen (N) deposition. Records were collected across the UK from over 10,000 individual trees of 22 deciduous species. Mean abundance of tolerant and sensitive lichens was related to mean N deposition rates and climatic variables at a 5 km scale, and the response of lichens was compared on the three most common trees (*Quercus*, *Fraxinus* and *Acer*) and by assigning all 22 tree species to three bark pH groups. The abundance of N-sensitive lichens on trunks decreased with increasing total N deposition, while that of N-tolerant lichens increased. The abundance of N-sensitive lichens on trunks was reduced close to a busy road, while the abundance of N-tolerant lichens increased. The abundance of N-tolerant lichen species on trunks was lower on *Quercus* and other low bark pH species, but the abundance of N-sensitive lichens was similar on different tree species. Lichen abundance relationships with total N deposition did not differ between tree species or bark pH groups. The response of N-sensitive lichens to reduced nitrogen was greater than to oxidised N, and the response of N-tolerant lichens was greater to oxidised N than to reduced N. There were differences in the response of N-sensitive and N-tolerant lichens to rainfall, humidity and temperature. Relationships with N deposition and climatic variables were similar for lichen presence on twigs as for lichen abundance on trunks, but N-sensitive lichens increased, rather than decreased, on twigs of *Quercus*/low bark pH species. The results demonstrate the unique power of citizen science to detect and quantify the air pollution impacts over a wide geographical range, and specifically to contribute to understanding of lichen responses to different chemical forms of N deposition, local pollution sources and bark chemistry.

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Performance evaluation and applicability of *Lichens GO*, a citizen science-based protocol for urban air quality monitoring

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Urban
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Protocol

ABSTRACT

The *Lichens GO* program is a French citizen science initiative based on the European guidelines that aims to evaluate the lichen diversity for urban air quality monitoring. In this study, we assessed the performance and applicability of the current *Lichens GO* protocol to then propose adaptations to make it more reliable and feasible for citizen science. To achieve this goal, we considered four aspects of the citizen science program: potential protocol simplifications, sampling site availability, observer bias, and volunteer feedbacks. Simulated simplification scenarios from a reference data set highlighted the large influence of reducing the number of sampled trees on taxonomic and functional structure metrics compared to reducing the number of sampled tree exposure sides and considered lichen species list. When considering the *Lichens GO* protocol (i.e., three trees, four exposure sides, *Lichens GO* species list) compared to the reference data set (i.e., five trees, four exposure sides, exhaustive species list), we evaluated an underestimation of lichen species richness (–25%), acidophilous species proportion (–94%), and functional diversity (–21%). In parallel, the maximum distance between sampled trees did not influence the taxonomic and functional structure metrics when considering a homogeneous sampling area (i.e., similar light or shade conditions). Finally, we compared *Lichens GO* relevés from 25 volunteers in the same site to highlight the major identification difficulties that could compromise the ecological interpretation. To improve the quality of data collected by citizens without increasing the sampling effort, we suggest to: (1) increase the maximum distance between trees from 10 to 50 m to extend the sampling site availability; (2) adapt the *Lichens GO* identification key to limit species confusion; and (3) assign an ecological trait to some lichen species groupings to improve the ecological interpretation. The proposed adaptations were tested and showed an improvement in the acidophilous species proportion (from –94 to –13%) and functional diversity (from –21 to –4%).



In general, several recurring patterns emerge in CS biomonitoring actions:

Simplification of protocols

- reduction of taxa / indicators
- use of functional categories (e.g., “sensitive vs tolerant”)

Training and standardization

- visual guides, apps, training (essential for data quality)

Validation with professional data

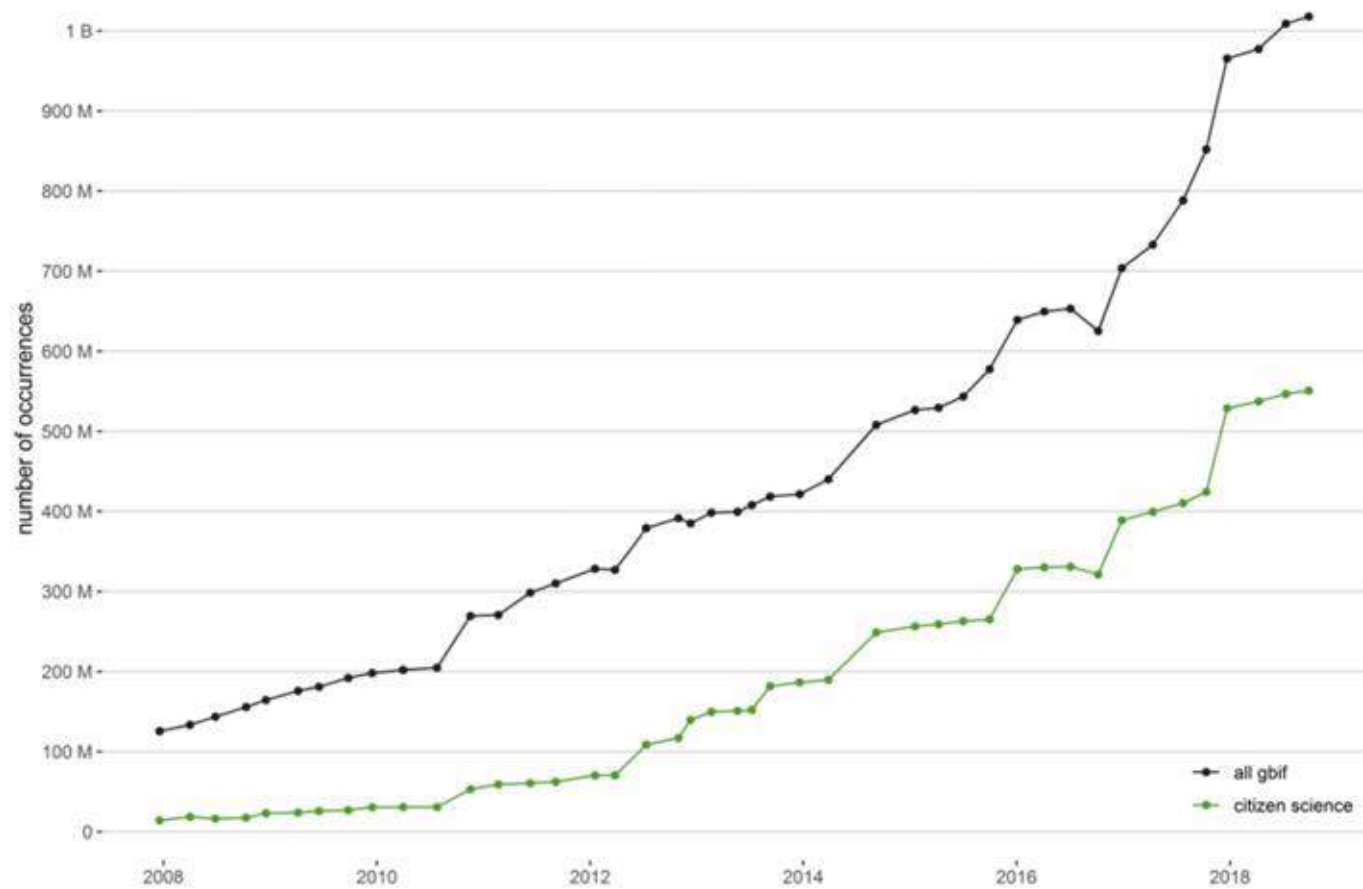
- comparison with “gold standard” datasets
- calibration of ecological thresholds

Use of digital technologies

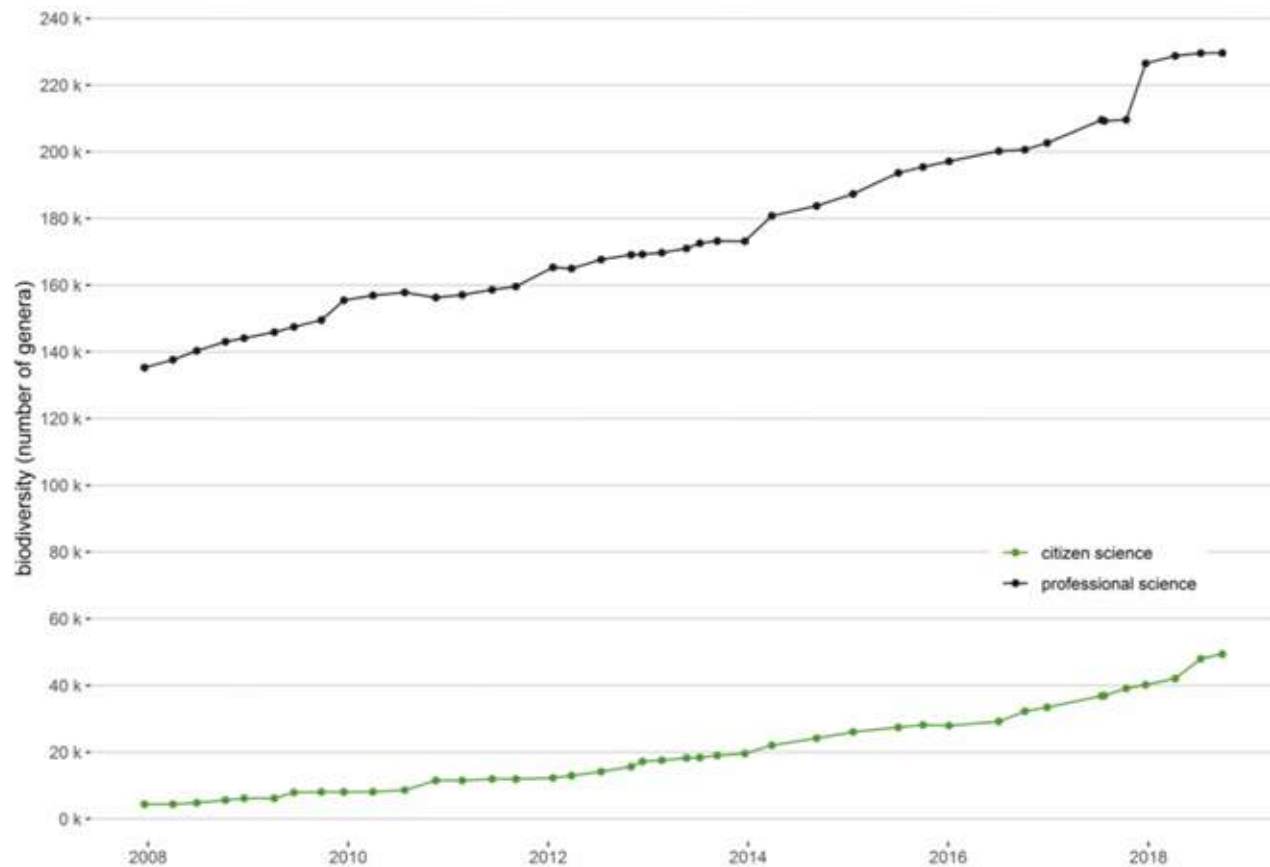
- mobile apps
- collaborative platforms

The elephant in the room:
data quality





However....



There are > 8 000 000 seagull occurrence records



Larus argentatus subsp. *argenteus* by G.Droege via Botanic Garden and Botanical Museum Berlin-Dahlem. Photo licensed under [CC BY-SA 3.0](#)

Top insect is the red admiral butterfly 200k records



Vanessa atalanta by W.-H. Kusber via BoBO - Botanic Garden and Botanical Museum Berlin-Dahlem Observations. Photo licensed under [CC BY-SA 4.0](#)

Top mammal is the roe deer 140k records



Capreolus capreolus by Trine Brevig via the Norwegian Species Observation Service. Photo licensed under [CC BY 4.0](#)

Top plant is the common nettle 100k records



Urtica dioica subsp. *dioica* by Peter de Lange via iNaturalist. No copyright.

But the major issue is that
validation and verification
protocols are often transparent
to the users

iNaturalist will be offline for 6 hours

beginning Wednesday, April 8 at 9 pm Pacific Daylight Time (UTC-7) ([convert to your local time](#)).

[Read more](#) on the iNaturalist Forum.



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Osservazioni Finora

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ESPLORA



Adedotun Ajibade ~ Abyssinian Roller in Oyun River, Kwara, Nigeria

Come Funziona



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Feel free to check out mobile adapted Artportalen! The functionality of Artportalen is gradually being moved to a new environment and is being adapted for field use.

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Articles about species and habitats

Ny nordisk mosslista – över 100 arter i Sverige
NATURISTEN 2024-02-23

Under 2025 publiceras en ny nordisk checklista för mossor, en efterlängad uppdatering som speglar naturen full decenniers forskning. En checklista är i grunden en gemensam referens och då arttaggrepp och släktskap ofta överlappar i takt med nya studier är detta särskilt viktigt.

Läs hela artikeln

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Today's sightings


TODAYS SIGHTINGS

2009 Sightings

Today 228 Species

SPECIES GROUP

All



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Funded by
The Species Observation System is mainly funded by Naturvetenskapliga Forskningsrådet (Environmental Protection Agency)

ARTDATABANKEN

April 7th, 10 a.m.:

159 users online

More than 2k observations

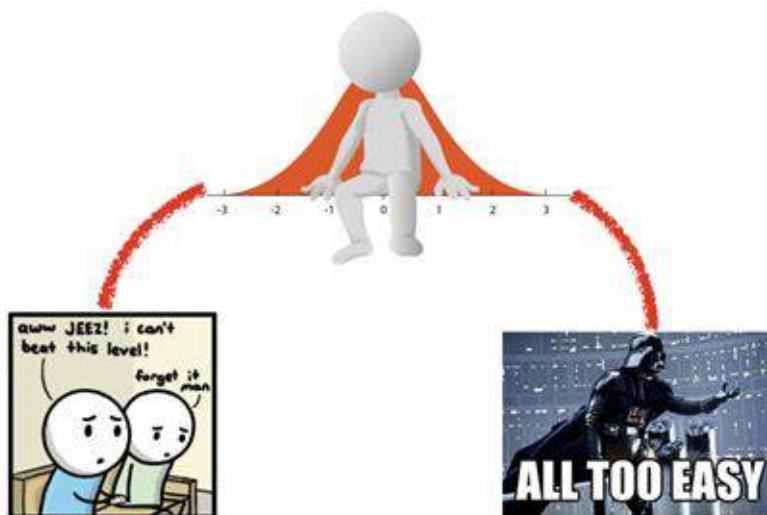
228 species reported

Since January 1st: >1,7 million observations

In total: > 118 million observations

Retention Groups	% of Correct Observations
1	70.53
2-5	74.97
6-10	87.95
11-20	90.14
21-30	92.20
>30	96.70

Retention groups are based on the number of months in which each volunteer contributed to the project. Retention groups are 1 month, 2-5 months, 6-10 months, 11-20 months, 21-30 months, and >30 months.





Levels of Citizen Science

Level 4 'Extreme'

- Collaborative Science – problem definition, data collection and analysis

Level 3 'Participatory science'

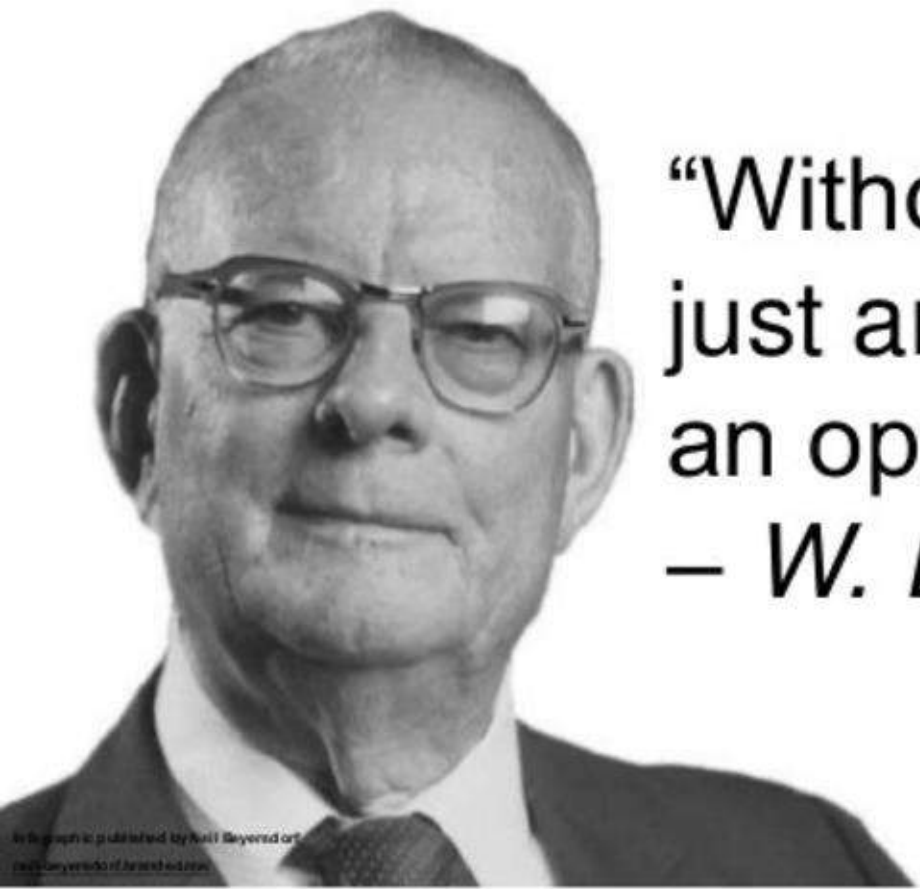
- Participation in problem definition and data collection

Level 2 'Distributed Intelligence'

- Citizens as basic interpreters

Level 1 'Crowdsourcing'

- Citizens as sensors



“Without data you’re
just another person with
an opinion.”

– *W. Edwards Deming*

Working Group on Community Science

During the 3rd IABEP meeting in Belgrade many presentations and a great part of the discussion, stimulated by the talk of some invited and regular speakers, highlighted the importance of Community Science within our Association. It was remarked that biomonitoring studies are a crucial means to reconnect people with their environment, allowing them to take care of it based on objective experiments brought about by individuals themselves. This kind of engagement can lead to meaningful changes in both personal and societal behaviors, potentially influencing policy-making processes. In light of these considerations, the IABEP Council has established a **Working Group on Community Science**.

The aim of this working group is to foster the use of community science, both within IABEP members and to society. This working group is expected to define its own work program, which can include:

1. Collect the names of interested members;
2. Select appropriate methodologies based on past experiences and new proposals;
3. Design a community science experiment involving IABEP across multiple countries.

While it would be beneficial to seek public funding, the Council intends to allocate a dedicated budget in 2026 to ensure the work begins as effectively as possible.

The persons who are leading this activity are Stefano Loppi (stefano.loppl@unisi.it) and Stefano Martellos (martelst@units.it)



LICHENS AS SENTINELS OF AIR QUALITY IN URBAN AREAS

A CITIZEN SCIENCE PROJECT

**promoted by the IABEP
International Association for Biomonitoring
of Environmental Pollution**

An air pollution survey by school children

O.L. Gilbert

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[https://doi.org/10.1016/0013-9327\(74\)90055-X](https://doi.org/10.1016/0013-9327(74)90055-X)

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Abstract

A criticism of biological scales for the estimation of air pollution has been that they can only be used by experts. A highly simplified scale has been successfully used by school children (average age 13–14 years) to produce a national picture of air pollution which compares favourably with existing lichen zone maps. Scotland is covered for the first time.

LICHENS AS SENTINELS OF AIR QUALITY IN URBAN AREAS

A CITIZEN SCIENCE PROJECT

THE PROTOCOL

1. Site Selection

1.1 Select ad a representative number of sampling sites throughout the city, possibly based on a randomized or systematic design

***Note:** the availability of trees limits the choice of sites to be sampled (see §2); Google maps or Google street view may be useful tools for planning site selection*

1.2 Sampling sites have roughly a circular shape, with a radius of about 50 m

1.3 The center of two adjoining sampling sites must be at least 200 m apart (i.e. the outer boundaries must be at least 100 m apart

2. Tree selection

2.1 Sites must have a minimum of 3 trees suitable for lichen sampling (see §2.2 and §2.3)

2.2 The trees to be sampled must be chosen in such a way as to ensure that the survey is carried out under **comparable ecological conditions**. The trees must thus comply with the following features:

- isolated position (trees within bushes must not be included, as in these environments the lower amount of light can limit lichen presence)
- straight trunk, with inclination $<10^\circ$ and without large branches or forks in the part to be sampled (1-2 m from ground, see 2.1), where water stagnation or areas of preferential stemflow may influence lichen presence
- trunk circumference at breast height >60 cm
- absence of obvious disturbances (e.g. painting, wounds, diseases, fungicide treatments, etc.)

2.3 Since bark features (especially pH) may greatly influence the lichen vegetation, only trees belonging to the genera *Tilia* and *Quercus* (linden/lime tree and oak) should be sampled; maple (*Acer* spp.), poplar (*Populus* spp.) and elm (*Ulmus* spp.) may be included if necessary. Unsuitable trees: horse chestnut (*Aesculus hippocastanum*), plane tree (*Platanus orientalis*), since their bark is flaking off, black locust (*Robinia pseudacacia*) since its bark is eutrophic and has a very high water-holding capacity. All conifers must be excluded as well, since their bark has a very low pH.

3. Lichen sampling

3.1 For each of the at least 3 trees selected in each sampling site, the lichens all around the trunk from 1 to 2 m from ground must be observed, and the relative rank noted as follows:

0 – absence of lichens (“lichen desert”)

1 – presence of crustose lichens

2 – presence of narrow-lobed foliose lichens, with orange or grey color (e.g. *Physcia adscendens*, *Hyperphyscia adglutinata*, *Phaeophyscia orbicularis*, *Physconia grisea*, *Xanthoria parietina*)

3 – presence of large-lobed foliose lichens (e.g. *Parmelia sulcata*, *P. tiliacea*, *F. caperata*, *Parmotrema perlatum*, “*melanoparmelia*”, *P. acetabulum*, *Physconia distorta*)

4 – presence of fruticose lichens (e.g. *Evernia prunastri*, *Pseudevernia furfuracea*, *Usnea* sp.)

Under mixed situations, note multiple values

3.2 → SEE NEXT SLIDE

3.3 Additional data: record the coordinates (e.g. from Google maps) of the center of the sampling site and of the individual trees; take photos of the sampled trees; shortly describe the site (e.g. avenue with heavy traffic, urban park, residential area, etc.)

3. Lichen sampling

3.2 For ranks 1-4, also indicate the degree of trunk cover (abundance) for each category, according to the scale:

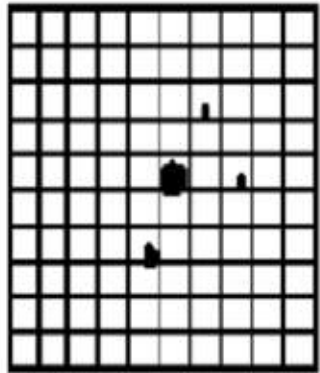
1 = <5%

2 = 5-25%

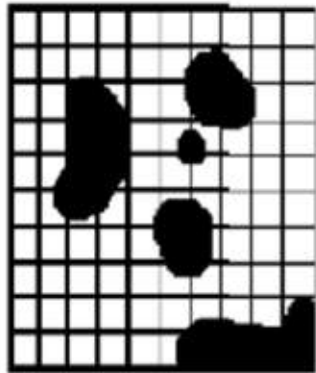
3 = 25-50%

4 = 50-75%

5 = >75%



1



2



3



4



5

crustose lichens



narrow-lobed foliose lichens



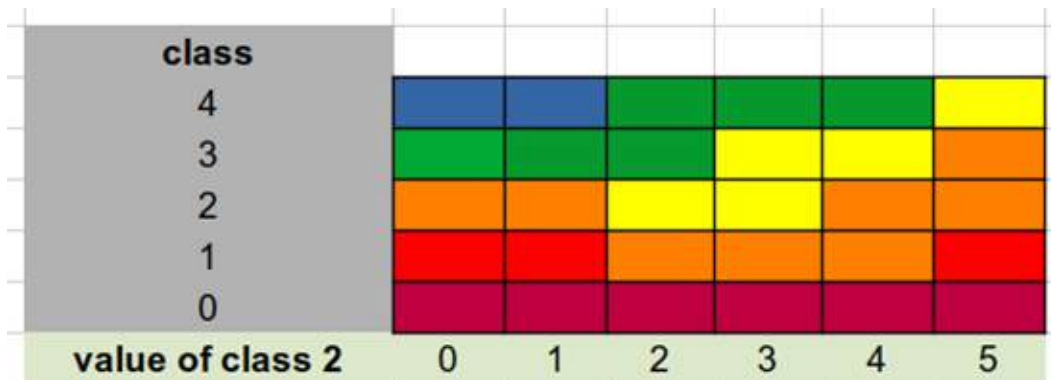
large-lobed foliose lichens



fruticose lichens



INTERPRETATION (still ongoing)



	Air quality	Eutrophication
	very good	0 negligible
	good	1 very low
	moderate	2 low
	low	3 moderate
	very low	4 high
	lichen desert	5 very high

In addition to engaging and recruiting volunteers, the basic idea is to involve schoolchildren, as this will allow to sample a much larger number of cities and sites.

It is expected that each Country will establish his own network to develop the project (e.g. in Italy with the aid of the working group for Citizen Science of the Italian Lichen Society)

It is important to start contacting schools now, so to be ready to launch the project at the beginning of the next school year at the latest

Having on board also very large cities (i.e. >1.000.000 inhabitants), or very famous cities is very important, likely crucial, for the visibility of the project

Countries involved so far

Belgium

Serbia

Canada

Slovakia

Italy

South Africa

Kazakhstan

Spain

Poland

UK

Portugal

USA

Russia