

# The Italian lichens dataset from the TSB herbarium (University of Trieste)

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## Abstract

### Background

The "Herbarium Universitatis Tergestinae" (TSB), with a total of ca. 50,000 specimens, includes the largest modern collection of lichens in Italy, with 25,796 samples collected from all over the country since 1984, representing 74% of all taxa known to occur in Italy. Almost all specimens have been georeferenced "a posteriori". The dataset is available through GBIF, as well as in ITALIC, the Information System of Italian Lichens.

### New information

The TSB Herbarium hosts the largest modern lichen collection in Italy, with a total of ca. 50,000 specimens. This dataset contains all of the 25,796 specimens collected within the administrative borders of Italy. Amongst them, 98% are georeferenced and 87% have the date of collection. The dataset includes several type specimens (isotypes and holotypes) and exsiccata.

### Keywords

collection, diversity, georeference, occurrence, specimens

### Introduction

Herbaria are an important source of falsifiable biodiversity data; stored specimens can be used to validate observations (Willis et al. 2017), to provide data for the assessment of Red Lists (Callmänder et al. 2005, Nascimbene et al. 2012), to obtain DNA for answering questions of evolution, genetic diversity etc. (Taylor and Swann 1994) and to depict the presence of a taxon in a specific space and time. Geo-referenced data obtained

from specimens can be used in distribution modelling and biogeographic studies to assess the past extent of a taxon (Marsico et al. 2020, Albani Rocchetti et al. 2021), to depict its current distribution and to predict potential range shifts in a global changes scenario (Loiselle et al. 2008, Attorre et al. 2018, Meineke et al. 2018, Lang et al. 2019).

The TSB Herbarium hosts the largest modern lichen collection in Italy, with a total of ca. 50,000 specimens. It was the first lichen collection in Italy digitised in a database (Nimis 1990) using the software described by Lagonegro et al. (1982). The Italian collection, started in 1984, contains 25,796 specimens from all parts of the country, mainly resulting from large field surveys, such as those in Sardinia (Nimis and Poelt 1987), eastern Peninsular Italy (Nimis and Tretiach 1999), western Peninsular Italy (Nimis and Tretiach 2004) and in several small islands and protected areas (e.g. Nimis (1985), Nimis et al. (1990), Nimis et al. (1994), Nimis et al. (1996)). The Italian collection hosts also several exsiccata: "Erbario Crittogamico Italiano" (Società Crittogamologica Italiana) (415 specimens), A. Vězda "Lichenes Selecti Exsiccati" (75), A. Vězda "Lichenes Rariores Exsiccati" (54), "Lichenes Italici Exsiccati" (Società Lichenologica Italiana) (35) "Plantae Graecenses" (Karl-Franzens-Universität Graz) (8) etc. and duplicates from other herbaria: Herbarium CLU (427), Herbarium PA (29), Herbarium Museum Caffi (25), Herbarium MOD (15), Herbarium Zirnich (8) etc.

Before the publication of the TSB Herbarium dataset, querying the GBIF (2022) for lichen occurrences in Italy returned about 12,000 records, none of which came from an Italian herbarium, a number which is quite small if compared to those of several others European countries, for example, up to 2 million records for the UK.

In the framework of project "Dryades" (Nimis et al. 2003), an effort to aggregate data from Italian lichen collections is being carried out, aiming at making data available online on ITALIC, the information system on Italian lichens (Nimis 2022). At the same time, records will be encoded in the Darwin Core standard (Wieczorek et al. 2012) and will be shared in the GBIF. In Italy, there are several important historical collections, mostly dating back to the "Golden Period" of Italian Lichenology in the second half of the 19<sup>th</sup> century (Nimis 2018), such as the herbaria of A.B. Massalongo (VER), F. Baglietto (MOD), M. Anzi (TO) and A. Jatta (NAP) (Tretiach and Valcuvia Passadore 1990). While efforts for their digitisation are foreseen, they will provide serious challenges, both as far as nomenclature and the georeferencing of localities are concerned. The latter is an especially challenging task, since localities are reported with obsolete toponyms or not reported at all. Thus, we prioritised 13 modern herbaria (with specimens collected after 1950): CLU, FI, GDOR, GE, HLUC, ORO, SI, TO, TSB and the private herbaria of G. Gheza, J. Nascimbene, S. Ravera and W. von Brackel. The digitisation and publication of the TSB lichen collection is, thus, the first step towards making all the data from Italian lichen collections publicly available.

## Sampling methods

**Description:** The Italian collection of the TSB lichen herbarium hosts specimens collected from all the 20 administrative regions of Italy.

**Sampling description:** Specimens were mostly gathered in the course of field surveys devoted to the exploration of different areas of the country, where both common and rare species were collected. All specimens are stored in 15 cm x 10 cm paper envelopes. Label data were digitalised and stored in a MySQL database, which has been made publicly available on ITALIC, the information system on Italian lichens (Nimis 2022) and on GBIF (Martellos et al. 2022).

**Quality control:** Specimens were collected and identified by experienced lichenologists (mostly by Nimis PL, Tretiach M and Muggia L), and sometimes revised by foreign specialists. Scientific names have been automatically aligned to the latest checklist of Italian lichens (Nimis 2016) by means of a customised version of the FlorItaly name matching tool (Conti et al. 2021). The verbatim scientific name, i.e. the name originally written on the label, has been retained together with the currently accepted name. Since for almost all specimens geographical coordinates of the collection locality were missing, all specimens were georeferenced a posteriori using Google Maps, Google Earth and regional GIS maps. The georeferencing process followed the best practices by Chapman and Wieczorek (2020).

## Geographic coverage

**Description:** The dataset contains specimens collected in all the 20 administrative regions of Italy: Abruzzo (1451), Basilicata (830), Calabria (1503), Campania (888), Emilia Romagna (842), Friuli Venezia Giulia (6235), Lazio (998), Liguria (567), Lombardia (193), Marche (1098), Molise (598), Piemonte (1904), Puglia (1415), Sardegna (2631), Sicilia (1595), Toscana (1930), Trentino Alto Adige (314), Umbria (97), Valle d'Aosta (148), and Veneto (532). Only for 27 specimens the locality of collection was not reported in the database. The distribution of specimens in the Italian territory is shown in Fig. 1.

**Coordinates:** 35.317 and 49.668 Latitude; 6.284 and 18.809 Longitude.

## Taxonomic coverage

**Description:** The specimens included in the dataset, according to the GBIF Taxonomic Backbone, belong to 44 orders, 118 families and 459 genera.

The following families are represented: Abrothallaceae, Acarosporaceae, Adelococcaceae, Aphanopsidaceae, Arctomiaceae, Arthoniaceae, Arthopyreniaceae, Arthrorhaphidaceae, Baeomycetaceae, Biatorellaceae, Bionectriaceae, Caliciaceae, Candelariaceae,

Cantharellaceae, Carbonicolaceae, Catillariaceae, Chrysotrichaceae, Cladoniaceae, Coccocarpiaceae, Coenogoniaceae, Collemataceae, Coniocybaceae, Cystocoleaceae, Dacampiaceae, Dactylosporaceae, Dermateaceae, Fuscideaceae, Gloeoheppiaceae, Gomphillaceae, Graphidaceae, Gyalectaceae, Haematommataceae, Helocarpaceae, Herpotrichiellaceae, Hygrophoraceae, Hymeneliaceae, Hysteriaceae, Icmadophilaceae, Koerberiaceae, Lecanographaceae, Lecanoraceae, Lecideaceae, Leprocaulaceae, Leptosilliacae, Lichenconiaceae, Lichenotheliaceae, Lichinaceae, Lichinodiaceae, Lobariaceae, Lopadiaceae, Massalongiaceae, Megasporaceae, Melaspileaceae, Microcaliciaceae, Monoblastiaceae, Mycocaliciaceae, Mycoporaceae, Mycosphaerellaceae, Mytiliniaceae, Naetrocymbaceae, Nectriaceae, Nephromataceae, Niessliaceae, Nitschkiaceae, Ochrolechiaceae, Opegraphaceae, Ophioparmaceae, Pannariaceae, Parmeliaceae, Patellariaceae, Peltigeraceae, Peltulaceae, Pertusariaceae, Phaeococcomycetaceae, Phlyctidaceae, Physciaceae, Pilocarpaceae, Placynthiaceae, Pleomassariaceae, Pleosporaceae, Polycoccaceae, Porinaceae, Porpidiaceae, Protothelenellaceae, Psilolechiaceae, Psoraceae, Pycnoraceae, Pyrenidiaceae, Pyrenulaceae, Ramalinaceae, Ramboldiaceae, Rhizocarpaceae, Roccellaceae, Roccellographaceae, Sagiolechiaceae, Sarrameanaceae, Schaereriaceae, Scoliosporaceae, Sphaerophoraceae, Sphinctrinaceae, Sporastatiaceae, Stereocaulaceae, Stictidaceae, Strangosporaceae, Strigulaceae, Teloschistaceae, Tephromelataceae, Teratosphaeriaceae, Thelenellaceae, Thelocarpaceae, Trapeliaceae, Trypetheliaceae, Tympanidaceae, Umbilicariaceae, Vahliellaceae, Verrucariaceae, Xanthopyreniaceae and Xylographaceae.

Taxa and specimens numbers for each kingdom, phylum, class, order, family and genus are available in a spreadsheet (Suppl. material 1) and can be graphically visualised as a krona graph (Fig. 2; the interactive file is provided in Suppl. material 2).

## Temporal coverage

**Notes:** Specimens have been collected and recorded from 1810 to 2021. Occurrences per year are shown in Fig. 3. All specimens dated before 1984, the year in which the TSB collection was started, come from exsiccata collections or from exchanges with other Herbaria. The highest number of accessions was between 1987 and 2010, corresponding to the peak of lichenological exploration of Italy by researchers of the University of Trieste.

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## Data resources

**Data package title:** TSB Lichen Herbarium

**Resource link:** <https://www.gbif.org/dataset/859c6946-f762-11e1-a439-00145eb45e9a>

**Alternative identifiers:** <https://doi.org/10.15468/dl.t3kjr9>

**Number of data sets:** 1

**Data set name:** TSB Lichen Herbarium

**Download URL:** [https://www.gbif.org/occurrence/download?dataset\\_key=859c6946-f762-11e1-a439-00145eb45e9a](https://www.gbif.org/occurrence/download?dataset_key=859c6946-f762-11e1-a439-00145eb45e9a)

**Data format:** Darwin Core

**Description:** This is the largest modern lichen collection of specimens collected within the administrative borders of Italy. It was started in 1984 and, to date, it includes ca. 26,000 samples, collected mainly by P.L. Nimis, M. Tretiach and L. Muggia (Martellos et al. 2022).

Column label	Column description
occurrenceID	An identifier for the Occurrence.
institutionID	An identifier for the institution having custody of the object.
institutionCode	The acronym in use by the institution having custody of the object (TSB for all specimens).
basisOfRecord	The specific nature of the data record (PreservedSpecimen for all specimens).
catalogNumber	An identifier for the record within the dataset or collection.
recordedBy	A list of names of people, groups or organisations responsible for recording the original Occurrence.
occurrenceRemarks	Comments or notes about the Occurrence.
eventDate	The date-time or interval during which an Event occurred.
year	The four-digit year in which the Event occurred, according to the Common Era Calendar.
continent	The name of the continent in which the Location occurs (Europe for all specimens).
country	The name of the country or major administrative unit in which the Location occurs (Italy for all specimens).
countryCode	The standard code for the country in which the Location occurs (IT for all specimens).

stateProvince	The name of the next smaller administrative region than country (state, province, canton, department, region etc.) in which the Location occurs.
locality	Description of the place where the specimen was taken.
minimumElevationInMeters	The lower limit of the range of elevation in metres.
maximumElevationInMeters	The upper limit of the range of elevation in metres.
decimalLatitude	The latitude in decimal degrees. Locations were georeferenced a posteriori according to the information written on the label.
decimalLongitude	The longitude in decimal degrees. Locations were georeferenced a posteriori according to the information written on the label.
geodeticDatum	The ellipsoid, geodetic datum or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude are based (WGS84 for all specimens).
coordinateUncertaintyInMetres	The horizontal distance from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location.
scientificName	The full scientific name, with authorship. Assigned according to the Italian checklist of lichens.
verbatimIdentification	A string representing the taxonomic identification as it appeared in the original record.
typeStatus	The nomenclatural type applied to the subject.
kingdom	The full scientific name of the kingdom in which the taxon is classified.
phylum	The full scientific name of the phylum or division in which the taxon is classified.
class	The full scientific name of the class in which the taxon is classified.
order	The full scientific name of the order in which the taxon is classified.
family	The full scientific name of the family in which the taxon is classified.
taxonRank	The taxonomic rank of the most specific name in the scientificName.
licence	A legal document giving official permission to do something with the resource.
type	The nature or genre of the resource (PhysicalObject for all specimens).
language	The language of the resource.

## Author contributions

Writing—original draft preparation, M.C., S.M. and P.L.N.; writing—review and editing, P.L.N., S.M., T.M., M.L. and M.A. All authors have read and agreed to the published version of the manuscript.

## References

- Agafonkin V (2022) Leaflet. 1.8. URL: <https://leafletjs.com>
- Albani Rocchetti G, Armstrong CG, Abeli T, Orsenigo S, Jasper C, Joly S, Bruneau A, Zytaruk M, Vamosi J (2021) Reversing extinction trends: new uses of (old) herbarium specimens to accelerate conservation action on threatened species. *New Phytologist* 230 (2): 433-450. <https://doi.org/10.1111/NPH.17133>
- Attorre F, Abeli T, Bacchetta G, Farcomeni A, Fenu G, De Sanctis M, Gargano D, Peruzzi L, Montagnani C, Rossi G, Conti F, Orsenigo S (2018) How to include the impact of climate change in the extinction risk assessment of policy plant species? *Journal for Nature Conservation* 44: 43-49. <https://doi.org/10.1016/J.JNC.2018.06.004>
- Callmender M, Schatz G, Lowry P (2005) IUCN Red List assessment and the Global Strategy for Plant Conservation: taxonomists must act now. *TAXON* 54 (4): 1047-1050. <https://doi.org/10.2307/25065491>
- Chapman AD, Wieczorek JR (2020) Georeferencing Best Practices. GBIF Secretariat <https://doi.org/10.15468/doc-gg7h-s853>
- Conti M, Nimis PL, Martellos S (2021) Match Algorithms for Scientific Names in FlorItaly, the Portal to the Flora of Italy. *Plants* 10 (5): 974. <https://doi.org/10.3390/plants10050974>
- GBIF (2022) <https://www.gbif.org>. Accessed on: 2022-8-26.
- Lagonegro M, Ganis P, Feoli E, Poldini L, Canavese T (1982) Un software per banche dati di flore territoriali, estendibile alla vegetazione. C.N.R., Collana Programma Finalizzato "Promozione della Qualità dell ambiente" 5 (38): 84-85.
- Lang PM, Willems F, Scheepens JF, Burbano H, Bossdorf O (2019) Using herbaria to study global environmental change. *New Phytologist* 221 (1): 110-122. <https://doi.org/10.1111/NPH.15401>
- Loiselle B, Jørgensen P, Consiglio T, Jiménez I, Blake J, Lohmann L, Montiel OM (2008) Predicting species distributions from herbarium collections: Does climate bias in collection sampling influence model outcomes? *Journal of Biogeography* 35 (1): 105-116. <https://doi.org/10.1111/J.1365-2699.2007.01779.X>
- Marsico T, Krimmel E, Carter JR, Gillespie E, Lowe P, McCauley R, Morris A, Nelson G, Smith M, Soteropoulos D, Monfils A (2020) Small herbaria contribute unique biogeographic records to county, locality, and temporal scales. *American Journal of Botany* 107 (11): 1577-1587. <https://doi.org/10.1002/AJB2.1563>
- Martellos S, Nimis PL, Conti M (2022) TSB Lichen Herbarium. Dept. Of Biology, University of Trieste. Occurrence dataset URL: <https://doi.org/10.15468/dl.t3kjr9>
- Meineke E, Davis C, Davies TJ (2018) The unrealized potential of herbaria for global change biology. *Ecological Monographs* 88 (4): 505-525. <https://doi.org/10.1002/ECM.1307>
- Nascimbene J, Nimis PL, Ravera S (2012) Evaluating the conservation status of epiphytic lichens of Italy: A red list. *Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology* 147 (4): 898-904. <https://doi.org/10.1080/11263504.2012.748101>
- Nimis PL (1985) Contributi alle conoscenze floristiche sui licheni d'Italia. III. Flora lichenica delle Isole Tremiti. *Studia Geobotanica* 5: 75-88.

- Nimis PL, Poelt J (1987) The lichens and lichenicolous fungi of Sardinia (Italy). *Studia Geobotanica* 7: 1-269.
- Nimis PL (1990) L'erbario lichenologico dell'Università di Trieste. Censimento degli erbari lichenologici. *Notiziario della Società Lichenologica Italiana* 3: 11-22.
- Nimis PL, Tretiach M, Marchi A (1990) Contributions to lichen floristics in Italy-V. The lichens of the Island of Capraia Tuscan Archipelago. *Cryptogamie Bryologie et Lichénologie* 11 (1): 1-30.
- Nimis PL, Poelt J, Tretiach M, Ottonello D, Puntillo D, Vězda A (1994) Contributions to lichen floristics in Italy. VII. The Lichens of Marettimo (Egadi Islands, Sicily). *Bulletin de la Société Linnéenne de Provence* 45: 247-262.
- Nimis PL, Poelt J, Tretiach M (1996) Lichens from the Gypsum Park of the northern Apennines (Emilia-Romagna, N Italy). *Cryptogamie Bryologie et Lichenologie* 17: 23-38.
- Nimis PL, Tretiach M (1999) Itinera Adriatica - lichens from the Eastern part of the Italian Peninsula. *Studia Geobotanica* 18: 51-106. URL: <https://www.openstarts.units.it/handle/10077/15315>
- Nimis PL, Martellos S, Moro A (2003) Il progetto Dryades: come identificare una piante, da Gutenberg a Internet. *Biologi Italiani* 7: 9-15.
- Nimis PL, Tretiach M (2004) Delimiting Tyrrhenian Italy: A lichen foray in the SW of the peninsula. *Bibliotheca Lichenologica* 88: 456-478.
- Nimis PL (2016) The lichens of Italy. A second annotated catalogue. EUT Edizioni Università di Trieste [ISBN 8883037545]
- Nimis PL (2018) The "Golden Period" of Italian lichenology and its importance in modern times. In: Blanz P (Ed.) *Biodiversity and Ecology of Fungi, Lichens, and Mosses*. Austrian Academy of Sciences Press, Wien, 716 pp. <https://doi.org/10.1553/0x003892e7>
- Nimis PL (2022) ITALIC - The Information System on Italian Lichens, version 7.0. <https://italic.units.it>. Accessed on: 2022-8-26.
- Ondov B, Bergman N, Phillipy A (2011) Interactive metagenomic visualization in a Web browser. *BMC Bioinformatics* 12 (1): 1-10. <https://doi.org/10.1186/1471-2105-12-385>
- Taylor J, Swann E (1994) DNA from herbarium specimens. *Ancient DNA* 166-181. [https://doi.org/10.1007/978-1-4612-4318-2\\_11](https://doi.org/10.1007/978-1-4612-4318-2_11)
- Tretiach M, Valcuvia Passadore MG (1990) Censimento degli erbari lichenologici Italiani. 3. *Notiziario della Società Lichenologica Italiana*, 144 pp.
- Wieczorek J, Bloom D, Guralnick R, Blum S, Döring M, Giovanni R, Robertson T, Vieglais D (2012) Darwin Core: An evolving community-developed biodiversity data standard. *PLOS One* 7 (1). <https://doi.org/10.1371/JOURNAL.PONE.0029715>
- Willis C, Ellwood E, Primack R, Davis C, Pearson K, Gallinat A, Yost J, Nelson G, Mazer S, Rossington N, Sparks T, Soltis P (2017) Old plants, new tricks: Phenological research using herbarium specimens. *Trends in Ecology & Evolution* 32 (7): 531-546. <https://doi.org/10.1016/J.TREE.2017.03.015>





Figure 1.  
Distribution map of TSB herbarium specimens in Italy; created with Leaflet (Agafonkin 2022).

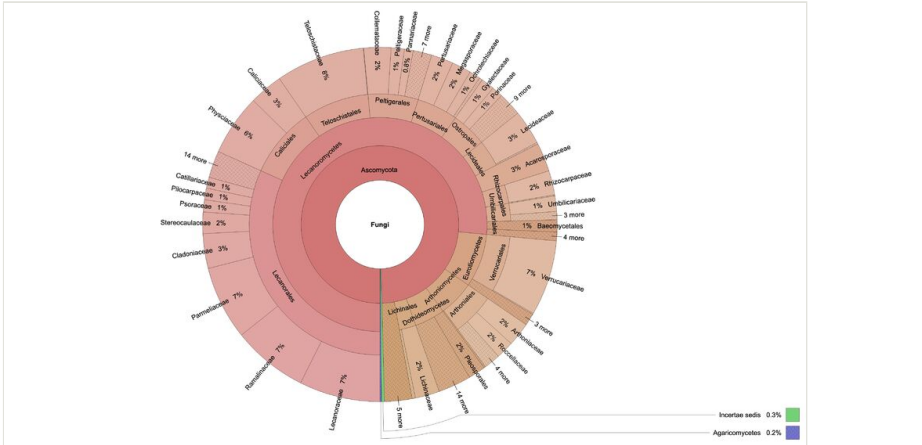


Figure 2. Taxa distribution between classes, orders and families, created using krona graph tool (Ondov et al. 2011).

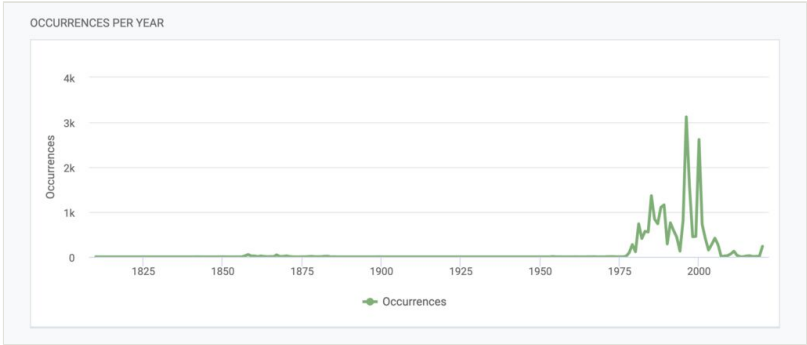


Figure 3.  
Lichens occurrences per year.

## Supplementary materials

### Suppl. material 1: Taxa and specimens table

**Authors:** Matteo Conti

**Data type:** table

**Brief description:** A table showing the total number of taxa and specimens in the dataset.

[Download file](#) (34.46 kb)

### Suppl. material 2: Krona graph taxa and specimens

**Authors:** Matteo Conti

**Data type:** html file

**Brief description:** A Krona graph showing taxa and specimens in the herbarium.

[Download file](#) (277.23 kb)