Bulletin of Regional Natural History

Formerly Bollettino della Società dei Naturalisti in Napoli

Contribution to the knowledge of two species of psilocybin mushrooms with high therapeutic potential found along the Central-Southern Apennines (Italy): *Psilocybe serbica* M.M. Moser & E. Horak and *Psilocybe semilanceata* (Fr.) P. Kumm. Chorological observations

Fabio Mao Valletta

DOI https://doi.org/10.6093/2724-4393/10411

*Correspondence: maovalletta@gmail.com https://orcid.org/ 0009-0003-0976-5464

Affiliation: Via Cappuccini 12 A Capua CE, Italy, 81043

Conflict of Interest: The author declares that he has no conflict of interest.

Financial Disclosure

Statement: The naturalistic research is being developed by means of private, selfsupported studies by the author, as well by the contributions of the "PsiloSoma Project" collaborators and private donations to the Fabio Valletta

Submitted: 13 Jun. 2023 Revised: 27 Aug. 2023 Accepted: 29 Aug. 2023 Published: 30 oct. 2023 Associate Editor: Antonino Pollio

This work is licensed under a <u>Creative Commons</u> Attribution 4.0 International License

Abstract

The research on *Psylocybe* species distribution along the Mediterranean region, has led to new observations regarding two species of psilocybin mushrooms, with high medicinal potential, found along the Apennine mountains of central and southern Italy: *Psilocybe serbica* Moser & Horak and *Psilocybe semilanceata* (Fr.) P. Kumm. New specimen collections, with ecological observations, from Italy as well as from Spain, France, Albania, and Macedonia are reported here, extending the geographical distribution limits of these specie along the Mediterranean.

Keywords: *Psilocybe*, psychotropic mushrooms, chorology, ecology, Mediterranean

Riassunto

La ricerca sulla distribuzione delle specie di *Psylocybe* lungo la regione mediterranea ha portato a nuove osservazioni su due specie di funghi psilocibinici, ad alto potenziale medicinale, presenti lungo le montagne appenniniche dell'Italia centrale e meridionale: *Psilocybe serbica* Moser & Horak e *Psilocybe semilanceata* (Fr.) P. Kumm. Vengono qui riportate nuove raccolte di esemplari, con osservazioni ecologiche, provenienti dall'Italia, dalla Spagna, dalla Francia, dall'Albania e dalla Macedonia, estendendo i limiti geografici di distribuzione di queste specie lungo il Mediterraneo.

Parole chiave: Psilocybe, funghi psicotropi, corologia, ecologia, Mediterraneo

How to cite

F.M. Valletta (2023). Contribution to the knowledge of two species of psilocybin mushrooms with high therapeutic potential found along the Central-Southern Apennines (Italy): *Psilocybe serbica* M.M. Moser & E. Horak and *Psilocybe semilanceata* (Fr.) P. Kumm. Chorological observations. Bulletin of Regional Natural History (BORNH), Bollettino della Società dei Naturalisti in Napoli. Vol. 3, n. 2, pp. 27 - 42 ISSN: 2724-4393.

Introduction

Wild and grown mushrooms can represent an abundant, free, and natural renewable source of beneficial compounds. During the last years, a growing number of studies reports that, in addition to edible and medicinal mushrooms, also entheogenic fungi can contain useful compounds with potential applications in wellbeing, medicine, mycorestoration and agroforestry. Still little is known about psilocybin fungi ecological interactions and potential uses; indeed, notwithstanding the already available large body of literature on this subject, a lot needs to be verified, supported, and upgraded. Psilocybin mushrooms have been cultivated in patches around the world for more than 20 years and their use is raising interest among people all around. Moreover, some species are also potentially associated with some anthropogenic distribution or disturbance, as it can be found in artificial coniferous plantations, cemeteries, gardens, urban parks (Stamets 1996). Despite this, little is known about the actual distribution of the genus *Psilocybe* around the world. This study represents the first step to an ethnobotanical and mycological approach dealing with the occurrence and distribution of Psylocybe species around the Mediterranean region, contributing to the knowledge of chorology of two psilocybin species, P. serbica M.M.

Moser & E. Horak (Moser & Horak, 1968) and *P. semilanceata* (Fr.) P. Kumm., along the central and southern Apennines, Italy. A part of this research consists in sampling of specimens for herbarium collections as well in naturalistic and ethnomycological observations. This publication adds new biogeographical reports, with ecological observations, relating to the area under investigation in Italy, and also to France, Spain, Albania and North Macedonia, extending the geographical distribution limits of these taxa along the Mediterranean region.

Materials and Methods

The study on *Psylocybe* distribution in the three continents around the Mediterranean region dates back to 2005; it is very extensive and will take some time to be completed. The present research is being conducted by carrying out the following steps:

a) collecting bibliographic, taxonomic and chorological studies, including documents, publications, monographs and biodiversity catalogs or inventories, about the genus *Psilocybe* and others psychotropic fungi in Italy, Europe and around the Mediterranean area;

b) gathering and mapping the traced observations into collection herbariums and

virtual resources on internet Dataset related to the topic, as the Global Biodiversity Information Facility, Global Soil biodiversity, MycoBank, Index Fungorum, www.speciesfungorum.org, www.lnaturalist.org. In Italy, I contacted the mycological groups and online communities such as the ones of AGMT, MCVE, "Saccardo", "G. Bresadola", as well as some universities known to historically study mycology as the Department of Life Sciences and Systems Biology (Turin) and the Department of Agriculture in Naples;

c) preliminary assessment and feasibility study of habitat survey missions, explorations and sampling campaigns set up. In order to locate areas of interest for expeditions, the evaluation of pluviometry, geological and satellite maps, biodiversity dataset, phytosociological correspondences and anthropogenic disturbance studies have been considered necessary during the preliminary phases. Before most field surveys, it was a set of suitable materials and consumables for short and long-term safe mission accomplishment. Contact was tried to establish with local bureaucratic entities, mycological groups as well the natural parks, in which the explorations were developed, to obtain the relevant permits, facilities as well check about previous local reports;

d) realization of contacts and interview, during the field explorations and consultations into web pages, addressed to specialist mycologists and mycophiles, enthusiasts of biodiversity and ethnomycology, psychonauts, mushrooms collectors and growers, forums (online) and discussion groups focused on the topic as w w w.mushroomobserver.org, www.mycoportal.org, www.shroomery.org, w w w.ultimate-mushroom.com, www.mycotaxon.com/resources, www.funghiitaliani.it. When possible was started a discussion of data and suggestions about distribution, phenology and potential areas for the development of related studies based on the author's own observations. As a rule, it has been considered appropriate not to disclose the names of the interviewees in the respect of the legal framework of the law on data;

e) sampling, many observed collections were identified in the field, habitat features as the macro characters are recorded, when possible, with support of digital material shared online into the social network "Inaturalist" within the project named "Psilosoma Project (mediterranean area)". During this research fresh samples were collected and studied from more than one hundred localities around the Mediterranean. Most of the samples were photographed with an Iphone "6s" digital camera. Of some samples it was possible to take the spore print while most of the fresh samples were dried trying to not rich temperatures upper of 50 C°, and conserved in an isolated environment with glass jars or zip-lock plastic bags;

f) microscopic observations, with the support of digital photographs, DNA sequencing for unambiguous identification and chemical analyses are carried out whenever possible and of interest to the author and other scholars.

The samples collected, supported by digital material, are preserved in the naturalist's private collection and visible on line at https://www.inaturalist.org/projects/psilosoma-project-mediterranean-area-759e2919-6e44-46f9-a22b-834a341c7d08.

Some of the donated collection samples from the author and the "PsiloSoma Project" were deposited in the Herbarium of "Società dei Naturalisti in Napoli" (Naples, Italy).

Results

Description of the sampling sites

The Apennines Mountain ranges from the Tuscan-Emilian Apennines to Aspermont, the majority of geologic units are made up of marine sedimentary rocks that were deposited over the southern margin of the Tethys Sea, the large ocean that spread out between the Paleo-European and the Paleo-African plates during their separation in the Mesozoic Era (about 250 to 65 million years ago). Along central-southern Apennines there are large calcareous rock outcrops and limestones, separated by lowland areas of shale and sandstone. The macro-climate is Mediterranean but locally, the sharp altitudinal gradient affects this, from the warm and sub-humid lower elevations to the cold and per-humid higher elevations. The climate of the highest section of the Apennines is continental (as found in the interior of Europe) but ameliorated by Mediterranean influences; snowfalls are frequent, with cold winters and hot summers (average July temperature 24°-35° C). Average rainfall at between 1,000 and 2,000 milliliters per year is higher on the Tyrrhenian slopes than on the eastern, or Adriatic, side of the Apennines. Northern facing slopes experience frequent dense fog due to their exposure to high atmospheric humidity coming from the Tyrrhenian Sea. At medium elevations (up to 1,100 m), it extends the Habitat of Sub-Mediterranean calcicolous beech forests dominated by Fagus sylvatica (Anemono-Fagetum, Aceri lobelii-Fagetum,

Ranunculo brutii-Fagetum) while at higher altitude can appear mixed beech and silver fir forests with a rather fragmented distribution. Especially into the southern Apennines are distributed the endemic silver fir, the subspecies Abies alba subsp. apennina over an altitudinal range which goes from the 650m a.s.l. of Serra S. Bruno (Calabria) to over 1800 m a.s.l. of the Pollino National Park involving both Quercetalia pubescenti petraeae and Fagetalia woodlands. The serial contacts that these habitats make are highly diversified in relation to the specificity of the beech forest dynamic series, which are also the result of past silvicultural use.

Recent artificial spruce plantations have been established in mountainous areas throughout the Apennines, while palynological studies (Bertolani Marchetti 1986) carried out on the sediments of lake areas and peat bogs in the Apennines have shown that white spruce was more widespread in the past and that the recent range contraction is probably also attributable to the impact of human activities on the forest vegetation. In relation to the time of the silvicultural cycle, situations of codominance or dominance of one of the two species over the other will therefore be observed (Mercurio & Spampinato 2006), which, considering the shifts in utilization, can extend for as long as 80 to 120 years. The clear-cutting of the beech forest, practiced in the past mainly for charcoal production, creates bright environments where the Apennine silver fir is more easily renewed due to its temperament as a more heliophilous species (Di Pietro & Fascetti, 2005). In the predominantly fir forest, the purely sciaphilous conditions favor the renewal of beech, which forms a more or less

dense shrub layer, with the silvicultural utilization of the silver fir, the beech juveniles reconstitute the forest in a condition of clear dominance. Interspersed between the mixed forests, generally located up to 800-1000 m above the sea level, are patches of meadows related to the stationing grounds of mountain pasture with cows and horses. At higher altitude, these patches become hyper-humid grasslands that in some places have very rich and aerated soils with carbonatic terrains covered with a top layer of decomposed dung and fibers. Related to the observations reported from this study are the administrative areas of Monti Simbruini Regional Natural Park, Latium; Gran Sasso and Monti della Laga National Park, Abruzzo, Lazio and Molise National Park; Matese Regional Park, Cilento, Vallo di Diano and Alburni National Park, Campania; Gargano National Park, Apulia; Pollino National Park, Sila National Park, Calabria. Even though these habitat types fall within areas with some kind of environmental management, such as nature parks and reserves, forestry management systems are still often inadequate and usage is overly intense, mismanagement of pastures and grazing has also considerably given the study area both a high naturalistic value and a high anthropic disturbance. In addition to the species reported in this study, along the centralsouthern Apennines, are reported other psilocybin mushrooms as P. liniformans var. liniformans (Guzmán & Bas 1977) in Latium, RO (Guzmán et al. 2006), P. fimetaria (P.D. Orton) Watling in Campania, CE (Picillo 2018) and in Abruzzo, TE (Herbarium AGMT N°4237), P. Cyanescens Wakef. in Calabria, RC (Grilli 1990; Herbarium AGMT N°1392).

Psilocybe serbica

Description. The pileus can be up to 2.5 cm in diameter and obtusely conical in young stages, later expanding to campanulate, plane or broadly convex in age. It has often a slight central depression or a hint of obtuse umbo, glabrous, hygrophanous, and slightly translucent-striate when moist but not viscid and without a separable gelatinous pellicle, with striated margin due to transparency, yellow-ochre, grey-brown, stains blue-green when touched or even spontaneously. The cap is buff-brown to dingy orangish-brown and pale ochraceous when dry (Fig. 1).

Hymenophore. The gills are adnate to adnexed, often distinctly subdecurrent, they are moderately spaced, sinuous, ventricose, when young greyish then light brown, finally dark brown-purple when ripe, interspersed with several orders of lamellulae the edges remaining paler with white thread.

The stipe is cylindrical, flexuous, twisted, 35-75 mm- long, and 1-3 mm thick. It has an equal structure, slightly enlarging at the base. It is pale brown, whitish and glabrous with a silky gloss, it soon stains blue-green, it can have some whitish remnants of the fibrillose veil and whitish rhizomorphs. The flesh is whitish to cream-colored, bruise blue, has no specific smell (somewhat radish, but never farinaceous), taste is usually bitterish.

It is a highly variable species characterized by various robustness, shape and coloration of fruit bodies, microscopically has a large range of spore size and varies in abundance and shape of pleuro and cheilocystidia. Its variability has led to the description of several species within it, at present, the distinction of varieties and forms on the basis of morphological and microscopic characters is still debated, apparently, they



Figure 1: Psilocybe serbica. Photo by Fabio Mao Valletta.

represent morphological and ecological varieties of *P. serbica* s.s with the suggested type form P. serbica f. sternberkiana (Borovička et al. 2011). Microscopically it is described with frequent to abundant lageniform pleurocystidia; cheilocystidia are fusiform to lageniform, hyaline, abundant with often a distinctly, straight or flexuous, elongated neck [10-20(- 25) µm long], very narrowly cylindrical, unperforated, but also with mucronate apex. Spores are purplebrown, ellipsoid, slightly flattened, and thickwalled; they are mono or pluriguctulated with evident germinative pore. Basidia are claviform and tetrasporic with basal clamp joints. Lamellar texture regular with cylindrical hyaline hyphae. Pileipellis consists of an ixocutis with cylindrical, slightly intertwined hyphae, with yellowish intracellular pigment and a subcutis with hyphae. Stipitipellis formed by an axis of cylindrical, hyaline, parallel hyphae. Clamp joints present everywhere.

Habitat. P. serbica is saprotrophic, terricolous, it grows gregarious on rotting wood and soils rich in plant material, broadleaves and decaying wood frustules, usually in moist places along creeks, in forest path and roadside verges. Some time was possible to observe more than one hundred fruit bodies popping up from the shadowed edges of a single fallen tree trunk. The species grows in sub-mountainous -mixed forest with Quercus, Fagus, Acer, Abies and other coniferous. Its type habitats, in the Czech Republic, are the calcicolous forests (Cephalanthero- Fagenion suballiance) that includes beech Melitti-Fagetum hungaricum with hornbeam as a thread, Pinus resinosa (red pine) and Pinus sylvestris (Scots pine). The central-southern Apennines form together with the Balkans, a single Biogeographical Province (Rivas-Martinez 2001); in their southern portion the Balkans (Macedonia, Greece, Albania), Fagus sylvatica woodlands are very similar to those of southern Apennine, with which, in

addition to the flora, they share surprising coenological and nomenclatural affinities (Doronico orientalis Fagenion, Doronico columnae-Fagenion, Campanulo tricocalycinae- Fagetum). Along the Apennines, I observed this taxon growing copiously into reforested coniferous areas, where logging and other human activities release, on the ground, a lot of wood residues, twigs, and cones, mostly of Pinus nigra ssp. laricio, Abies alba and Pseudotsuga menziesii. In most xerophytic areas like in Sicily (Italy) and Morocco it looks like this taxon is associated with conifers as Pinus sylvestris, Pinus pinaster, Abies nebrodensis, Abies pinsapo var. marocana. It is likely that P. serbica is fluctuating, around the Mediterranean area range, with the beech forest dynamic series depending on the silvicultural cycle of the area. A special habitat, where I observed it growing in groups, is related to rotting fern stalks; it can be in open grasslands with abandoned mountain pastures, where non-intensive grazing has allowed Pteridium aquilinum ferns to grow for a few years and accumulate slowly decomposing plant material on the soil. In some cases, I observed specimens growing on Hedera spp. rotting woods on the forest mossy floor. The larger specimens were often observed growing nearby nitrophilous plants as Urtica spp., Fragaria spp., Rosa canina or Rubus spp. Additionally, I had the opportunity to observe fructifications growing on human made, plant residues, compost and woodchips, indicating a preference to nitrogenous and a little more acid soil topping the calcareous soils; furthermore, I can suggest that, even if this species is not reported to be synanthropic, is somehow easier to find it where there is anthropic disturbance. I am

currently trying to collect samples to study the ecological relationship with certain midges that degrade the fungus and potentially have a role to disperse its spores; the identification of this insect species and its habits could help to clarify some distribution factors.

Chorology. P. serbica has been observed, abundant but localized in its growth stations, mainly in some Central European countries, such as Germany, Czech Republic, Austria, Slovakia, Serbia and Romania. During recent years, its presence has been reported in a much wider range around the Mediterranean as in Italy, Corsica (France) and Morocco where this species has been sometimes misinterpreted by various observers and authors in some mycological publications, books and on-line data as P. mairei (on-line https:// mushroomobserver.org/344663), as P. cyanescens (Grilli 1990; Cetto 1995; Galli 2003), on-line (http://www.ambmuggia.it/ forum/topic/3658-psilocybe-cyanescens wakef-emend-krieglsteiner/, http:// www.salvatoresaitta.it/pages/fungi/ psilocybe_cyanescens.htm) and as P. tenax (Cetto 1995). Its presence is reported in the mycological herbarium MCVE of the Museum of Natural history in Venice (Herb. N° 9556) and of Tuscan Mycological Groups Association (AGMT Herb. N° 2490, 4100, 4101, 4102, 4159, 4186, 4319, 11119) as well.

A summary of previous reports from northern to southern Italian latitude is listed below:

 Emilia-Romagna. (Galli 2003) Province of Forlì-Cesena, municipality Verghereto, locality Monte Fumaiolo found at the edge of a stream on beech woody residues.

- Tuscany. (AGMT Herb. N° 2490; 03/11/2018, A. Pierotti & A. Matteini) Prov. Lucca, municipality Villa Basilica, loc. Pizzorne at 800 m under alder; mentioned as *P. serbica var. serbica* voucher, ser. II n. 398 with small subunit ribosomal RNA gene, partial sequence, internal transcribed spacer 1 and 5.8S ribosomal RNA gene, complete sequence and internal transcribed spacer 2, partial seq.; (AGMT Herb. N° 4159; 14/10/2016) province of Grosseto, municipality of Santa Fiora, loc. Bagnoli, Quattro strade, at 1000m under Beech, Spruce trees.
- Sardegna. (MCVE Herb. N° 9556, 12/11/1995) province of Nuoro, municipality of Villanova Strisaili, loc. Bosco S. Barbara.
- Abruzzo. (exsiccatum in the personal herbarium of Mario lannotti: MI20181006-02) 6/10/2018, province of L' Aquila, municipality Palena, in a mixed wood of *Abies*, *Picea* and various broadleaves including *Fagus*, *Quercus* and *Acer*, on woody debris and decaying plant material. (on-line https:// www.funghiitaliani.it/topic/96936psilocybe-serbica mm-moser-ehorak-1969/).
- Campania. (Picillo 2012) 16-10- 2009, province of Caserta, municipality of San Gregorio Matese, loc. Difesa 1020 m, Matese Regional Park, in a mixed wood of *Fagus sylvatica* and *Abies alba*, on calcareous soil.
- Basilicata, province of Potenza, municipality Grumento nova, loc. Lucano Val d'Agri Apennine National Park. Observer Luca Pasquali in 8/10/2014, alt. 580 m. Lat: 40.28025 Long: 15.90275 (http://

mushroomobserver.org/observer/ show_observation/204184).

Calabria (AGMT Herb. N° 4100; 17/10/03)
 Province of Reggio Calabria, municipality
 San Luca, loc. Canovai- Aspromonte, at
 1800 m near Laricio pine;

(AGMT Herb. N° 4101; 22/10/03) province of Cosenza, municipality of Celico, loc. Midilli, at 1180m, *Quercus cerris, Pinus nigra subsp. laricio and subsp. calabrica*; (AGMT Herb. N° 4102; 20/10/04) prov. COSENZA, municipality San Demetrio Corone, at 680m near *Castanea sativa*, mentioned as *P. serbica* var. *arcana*.

Sicily. (Salvatore Saitta 23/10/2008) Province of Messina, loc. Malabotta Forest Special Area of Conservation, alt 1200m, Lat: 37.974199, Long: 15.049651 mentioned as P. cyanescens (http:// www.salvatoresaitta.it/pages/fungi/ psilocybe_cyanescens.htm); (AGMT Herb. N° 4319; 05/12/18 Panchetti M.) province of Messina, municipality of Tortorici, loc. Contrada La Sciabola, at 650 m near pine, chestnut trees mentioned as *P. serbica var*. moravica; (AGMT Herb. N° 11119; 12/01/2021) province of Messina, municipality of Barcellona P.G., loc. Piano Milioso, at 500 m near Pinus pinea trees, mentioned as *P. serbica var. arcana*.

New records reported in this study

Campania: 21/11/2022, province of Caserta, Matese regional Park, growing on fern stalks alt.1200 m, Lat: 41.397325, Long: 14.37013; 21/11/2022, province of Caserta, San Gregorio Matese, Matese regional Park, growing on fern stalks alt. 1150 m, Lat: 41.407903, Long: 14.365938; 21/11/2022, province of Caserta, Matese regional Park, growing on fern stalks alt. 1100 m, Lat: 41.40773, Long: 14.346347;

19/12/2022, province of Caserta, Matese regional Park, growing on fern stalks alt. 1080 m, Lat: 41.422601, Long: 14.402148; 23/12/2022, province of Salerno, loc. Monte Cervati, Motola e Balze di Teggiano, Cilento, Vallo di Diano and Alburni National Park growing on Pseudotsuga menziesii decayed wood, on twigs and cones, alt. 1180 m, Lat: 40.307317, Long: 15.402927; 27/12/2022, province of Salerno, Monte Gelbison Cilento, Vallo di Diano and Alburni National Park on Pseudotsuga menziesii and Abies alba decayed wood, on twigs and cones alt.1550m, Lat: 40.213878, Long: 15.331642.

- Calabria: 6/10/2019, province of Cosenza, municipality Camigliatello silano, Sila National Park, alt.1700 m, Lat: 39.287168, Long: 16.460698;1/11/2019, province of Cosenza, municipality of Longobucco, nei pressi dell'area pic nic Fossiata alt. 1340 m near rotting Pinus nigra laricio and along Urtica spp., Fragaria spp. or Rubus spp, Lat: 39.397586, Long: 16.589133;11/11/2019, province of Cosenza, municipality of Corigliano Calabro in bosco con pino loricato alt. 580 m, Lat: 39.54029, Long: 16.541805; 19/12/2020, province of Cosenza, municipality of Aprigliano loc. Caporosa, Sila National Park, alt. 1720 m, in clear forest with Pinus nigra laricio, Lat: 39.214729, Long: 16.603796; 9/11/2020 province of Catanzaro, municipality of Magisano, Parco nazionale della Sila, in bosco con pino loricato alt. 1240 m, Lat: 39.047247, Long: 16.652005.
- Apulia: 1/12/2022 province Foggia, loc.
 Foresta Umbra, Parco Nazionale del Gargano, nei pressi del laghetto d'Umbra nella riserva naturale Falascone su rametti, alt. 780 m, Lat: 41.818113, Long:

16.00668. These samples got rotten from insects before it was possible to properly dry and conserve. Future sampling missions cover the gap and hopefully will evaluate which species of insects are eating and possibly interacting with the mushroom spore dispersal.

 North Macedonia: 5/11/2018, proince of Skopje, municipality of Tetovo, locality Šipkovica harvested an altitude between 1900-2100 m, Lat: 42.015438, Long: 20.813506.

According to Global Biodiversity Information Facility (GBIF, observed on-line in data 16/05/2023) and from the evaluation of the above reported data we can resume that in Italy the blooming pick is in octobernovember (Fig. 2) and the southern boundary is in Sicily province of Palermo, loc. Mufara mount, Madonie Park; the minimum altitude (500 m), is reported in province of Messina, while the highest altitude (1800 m) is reported in province of Reggio Calabria. Concerning the Mediterranean region, it is reported as present in Greece (Thessaly in Amárantos and Longá), in France (Corsica in loc.S. Georges), Spain (Navarra in Sierra de Aralar and Quinto Real). In Morocco, province of Marrakesh it is observed on the southern Mediterranean boundary while in North Macedonia prov. Skopje is observed at the highest altitude for this taxon at 2080 m up the sea level.

Psilocybe semilanceata

Description. *P. semilanceata* (Fig. 3) is the type species of the genus and of the division *Semilanceatae* characterized by subellipsoid, thick (1 -2 μ m), more or less thin-walled (0.5 μ m) spores, usually without pleurocystidia. It is the first psychotropic mushroom studied in



Figure 2: Italian distribution map and seasonality of *Psilocybe serbica* (as reported in <u>https://www.inaturalist.org/taxa/518938-Psilocybe-serbica</u>). Hexagonal symbols represent observations made by the author; others symbols represent observations previously reported by other authors. Y- axis indicates the number of individuals.

Europe, its widely distributed species, known and well- studied throughout the world and Mediterranean areas.

This species has extremely variable morphological characteristics depending on the climatic conditions, specific locations and the height of the grass in the meadow where it grows in which it is grown. The pileus is conical-acute with a very pronounced umbo, often darker in the center, it is covered with a thin transparent film and is very viscous and sticky, is very small in size with 5-25 mm in diameter and 6-22 mm in height. Due to the hygrophania, the color varies from ochregrey to chestnut brown: in dry weather the cap is much paler, more like a light brownyellow-white color; with wet weather the gills are visible in transparency giving at the pileus a fine striated appearance with clear olive or olive-green shades, especially in the periphery and towards the margin. The gills are more or less ascending-adnate, fairly dense interspersed with lamellulae, dark purplish-brown with whitish olive-brownish wavy thread margin.

The stem is striate fibrillose, pithy, glabrous, fistulous-midribose, fairly flexible, firm, serpentiform, never straight, but always has a wavy shape; it can be very long 2-15 cm, 1-3 mm in diameter and thickens at the base, it has a from pale ochre to brown color and after harvesting it can turn blue particularly at the base. Sometimes there are traces of a ring due to a fleeting curtain. The Flesh is membranous, odorless or slightly floury, mild earthy taste.

Spores are blackish-brown, elliptically elongated, smooth with a germinative pore. Basidia claviform, often with a slight central constriction, tetrasporic, very rarely bisporic. Cheilocystidia lageniform with more or less enlarged belly and tapering upper portion with apex, interspersed with others with irregularly shaped belly and bifid apex. Sterile lamella filament. Subhimenium composed of a short subisodiametric or inflated cell overlying a layer of filamentous



Figure 3: Psilocybe semilanceata. Photo by Fabio Mao Valletta.

hyphae. Lamellar texture is regular. Pleurocystidia not present. Pileipellis arranged in ixocutis, formed by septate hyphae, smooth or finely encrusted, immersed in a hyaline gel. Subpellis arranged in cutis, consisting of a dense layer of hyphae finely encrusted and pigmented with ochre-yellow. Stipitipellis arranged in cutis, consisting of septate hyphae. Caulocystidia lageniform, with enlarged belly and tapering upper portion with apex. No bifid cheilocystidia and clamp joints abundantly present everywhere. As some other Psilocybe mushrooms may form sclerotia, a dormant form of the fungus, which affords it some protection from wildfires and other natural disasters.

Habitat. It is localized in its growing stations on drained acid and sunny wetlands, where there are very rich aerated terrains, mainly

grassy and moisty pasture areas of medium to high mountain (200 - 2000 m above the sea level). These mushrooms are known to feed on putrescent grassroots, often in association with Deschampsia caespitosa (L), Festuca filiformis, Lolium spp and other raygrasses of the family Poaceae (Keay S.M. & Brown A.E., 1989). Often, I observed these mushrooms fruiting in terrain depressions where water flows during rainfall, on the edges of rivulets or canals at the side of roads and paths. In areas where water is more constant and, in some cases, stagnant, it is much rarer; in these conditions I have only observed that this species rarely grows on sandy soil or in grass stumps raised above the ground.

On Apennines carbonated soils this taxon seems mainly related to the stationing grounds of mountain pasture with cows and horses, generally located up to 800-1000 m; probably, dung decomposition provides an optimal habitat with the top layering, grasses seeds and fibers, nutrients and, not less important, a strip of topsoil that is more acidic than the limestone soil below it. In fields with a lot of dung, I observed in different cases that this species can grow through droppings that probably fell on the decaying grass due to the previously active mycelium, acting as an optional fimiculous. In Latium and Campania, it was possible to observe very rarely this species, prevalently in humid protected places and during rainy days. However, due to the milder climate, the nature of soils and the land uses along Apennine mountains it can grow to higher altitudes and occasionally during winter and spring. The less constant rainfall and the particularly draining soil could be the cause of a lower abundance and size of fruiting bodies and could explain why the presence of the pecies in the areas under study was not previously reported.

Chorology. It is distributed worldwide, and it is considered to be endemic to Europe where it is cited in 17 countries (Watling 2007). Around the Mediterranean it is distributed in Turchia, (Makalesi et al., 2016), Slovenia (Slovenian Forestry Institute), Italy, France and Spain (GBIF consulted on-line on 16/05/2023). In this study its presence is cited for the first time in Albania and North Macedonia.

This taxon has been found along the entire Alpine arc and along most part of the Apennines. It is preserved in the mycological collection MCVE (Herbarium N° 20458, 1987) and the Saccardo Mycological Group (Herbarium N° 7598, 7537, 5472, 3579), as well it is reported in some publications as in province of Trento (Bresadola 1928), Turin (Fiussello & Ceruti Scurti 1972), Brescia, Bergamo, Sondrio (Gitti et al., 1983; Samorini 1988), in the alpine environment of the Tuscan-Emilian Apennine ridge like into the provinces of Modena, Bologna and Florence (Samorini 1989). Then was reported it in the province of Novara (Jamoni 1990) with a more limited presence at altitudes of 200-300 metres, Bolzano and Pistoia, Reggio Emilia (Samorini 1993) and of Udine, Verona, and Lucca (Cacialli et al. 1996; Doveri 2004), Cuneo, Arezzo, Aquila, Frosinone and Potenza (Samorini 2005).

New records reported in this study

- Latium: 18/10/2022, province of Rome, municipality of Livata, Simbruini Mountains Regional Nature Park, on grassland, alt. 1550 m, Lat: 41.948815 Long: 13.164968.
- Abruzzo: 4/10/2020 province of Aquila, municipality of Opi, Abruzzo, Lazio and Molise National Park, in meadow with horse pasture, alt. 1500 m, Lat: 41.78652, Long: 13.811945; 14/10/2020 province of Teramo, municipality of Crognaleto, monte Gorzano, Gran Sasso e Monti della Laga National Park, in meadow alt. 2400 m, Lat: 42.622565, Long: 13.404978.
- Molise: 9/11/2022, province of Campobasso, municipality of Bojano, in a meadow into an area bordering the Matese Regional Park, alt. 1650 m, Lat: 41.444532, Long: 14.424349; 10/11/2022 province of Campobasso, municipality of. Bojano, in a meadow into an area bordering the Matese Regional Park, alt. 1630 m, Lat: 41.44454, Long: 14.383281.
- Campania: 8/11/2022, province of Caserta, municipality of. San Gregorio Matese, in a meadow, alt. 1030 m, Lat: 41.408924, Long: 14.387133; 24/11/2022 province of

Salerno, Monte Cervati, Motola and Balze di Teggiano National Park of Cilento, Vallo di Diano and Alburni, in grassland alt. 1280 m, Lat: 40.307667, Long: 15.473639.

Calabria: 19/12/2019, Province of Cosenza, municipality of Longobucco, loc. Cava di melis, la fossa del lupo, Sila National Park, near recreational area alt. 1140 m, Lat: 39.35916, Long: 16.672793; 10/10/2019 province of Cosenza, municipality. Saracena, loc. Piano di Novacco, Pollino National Park, in pastureland, alt. 1300 m, Lat: 39.807856, Long: 16.044617; 2/11/2018 province of Catanzaro, municipality of Taverna, loc. Buturo, present at the edge of woods, alt. 1260 m, Lat: 39.066774, Long: 16.648114.

This study adds the provinces of Rome, Campobasso, Caserta, Salerno, Cosenza and Catanzaro where *P. semilanceata* is mentioned so far. The report of Catanzaro at an altitude of 1520 m signals the most southerly boundary for this species in Italy.

Moreover, I observed the presence of *P*. *semilanceata* in different Mediterranean localities of other countries such as France, Spain, Albania and North Macedonia, as below:

- France, 12/8/2021, municipality of Fontpédrouse, Languedoc-Roussillon, Pyrénées-Orientales, 2150m, Lat: 42.441761, Long: 2.163367.
- Spain: 11/11/2017, Andalucia, province of Granada, municipality of. Trevélez, Parque Nacional de Sierra Nevada alt. 2650 m Lat: 37.041968, Long: -3.287341; 8/12/2021, Galicia, province of A Coruña, municipality of Cedeira, loc. Santo André de Texido, alt 200m Lat: 43.710675, Long: -7.978597.
- Albania, 25/10/2018, province of Dibër, loc. Cerjan Liqeni i Gramës, Mount Korab,

on grassland alt. 1780 m, Lat: 41.756785, Long: 20.494816.

North Macedonia, 2/11/2018, province of Skopje, municipality of Tetovo alt. 2020 m, Lat: 42.019329, Long: 20.825393; 2/11/2018, province of Skopje, municipality of Tetovo alt. 2300 m, Lat: 42.008069, Long: 20.83543; 5/11/2018 province of Skopje, municipality of Tetovo, loc. Shipkovica alt. 2220 m, Lat: 42.019003, Long: 20.860489.

According to Global Biodiversity Information Facility (observed on line in data 16/05/2023) and from the evaluation of the above reported data we can resume that, about Mediterranean countries, *P. semilanceata* carpophores blooming pick is in october-november (Fig. 4) and in Spain are reported the highest altitude and the most southerly boundary reported, about 2650 m in Sierra Nevada Granada, as well the lower altitude, about 190 m in the Atlantic coast of Galicia.

Further chorological exploring missions, that I'm preparing with the "Psilosoma Project", could verify the presence of this taxon also in the rest of Balkan countries as (Croatia, Bosnia Herzegovina, Montenegro), Greece, and North African countries such as Morocco and Algeria, as well Est-Asia.

Conclusions

While *P. semilanceata* is a well-studied psilocybe species, *P. serbica* is very poorly known and further investigation on its morphological variability, distribution and relationship to other similar toxic species is needed. This study suggests a continuum in the distribution of the taxa *P. serbica* from Europe to Africa. Where no psilocybin specimens were still encountered, their



Figure 4: Italian distribution map and seasonality of *Psilocybe semilanceata* (as reported in <u>https://www.inaturalist.org/taxa/518938-Psilocybe-serbica</u>). Spherical symbols represent observations made by the author; quadrangular symbols represent observations previously reported by other authors. Y- axis indicates the number of individuals.

relative presence cannot be ruled out, due to the fluctuations of climatic conditions, along with the difficulty to properly observe and identify these mushrooms.

Psychotropic mushrooms are difficult to find in the field and even more in the central and south Mediterranean region due to the environmental and geological factors that characterize these areas.

Indeed, even though many taxa can be easily identified in the field or using images evidencing key macro characters, often a microscopic study is necessary for unambiguous identification. Thanks to recent reports dealing with herbarium samples and to up-dated internet databases we are discovering that the so called "magic mushrooms" are much more widespread than we knew.

This study confirms the presence of *P. serbica and P. semilaceata* in the Apennines of southern Italy, extending their range of distribution further south and east in the Mediterranean region. Along the central-

southern Apennines are reported other psilocybin species as P. liniformans var. liniformans (Guzmán and Bas, 1977) in Latium, Province of Rome (Guzmán et al. 2006), P. fimetaria (P.D. Orton) Watling in Campania, Province of Caserta (Picillo 2018) and in Abruzzo, Province of Teramo [Herbarium AGMT N°4237], P. cyanescens Wakef. in Calabria, Province of Reggio Calabria (Grilli 1990) [Herbarium AGMT N°1392]. Central and South Apennines deserve further study in the fields of Psilocybe taxonomy, biogeography, ethnomycology, and potential medicinal and bio-remedial applications. It is suggested that samples reported here will be included in the catalogs and dataset of the mycological flora in Italy, Albania, North Macedonia, France and Spain.

Acknowledgements

To the 'PsiloSoma Project' team and its supporters who sustain the investigations with aim to contribute to fill the lack of

Mediterranean Psilocybe Ecology and Chorology

Valletta

knowledge of magic mushroom biodiversity around the world <u>https://</u> <u>www.inaturalist.org/projects/psilosoma-</u> <u>project-mediterranean-</u> <u>area-759e2919-6e44-46f9-</u> <u>a22b-834a341c7d08</u>.

Additional information Correspondence:

Some divulgation works of the "PsiloSoma Project" are available on the YouTube channel "NaturalMao". Requests for copy documents and samples material to study can be addressed to <u>psilosoma.project@gmail.com</u>.

References

- Bertolani Marchetti D. (1986). Dall'Appennino Campano alle Serre Calabresi, Cenni palinologici e paleoclimatici. *Lavori della Soc. Ital. Biogeogr.*, n.s. **10** (1984), 67-88.
- Brande E. (1799). On a poisonous species of agaric. *London Med. Phys. J.* **11**, 41-44.
- Borovička J., Noordeloos M.E., Gryndler M., Oborník M. (2011). Molecular phylogeny of *Psilocybe cyanescens* complex in Europe, with reference to the position of the secotioid Weraoa novae-zelandiae. *Mycol Progr.* **10** (2): 149-55.
- Bresadola G. (1928). Iconographia Micologica. vol. XVIII. Edizione digitale a cura del Gruppo Micologico «G. Bresadola» (available from <u>https://</u> <u>www2.muse.it/bresadola</u>).
- Cacialli G., Caroti V., Doveri F. (1996). Contributo allo studio dei funghi fimicoli. XI. Agaricales: *Psilocybe semilanceata* (FRIES) KUMMER e *Pholiotina coprophila* KUHNER SINGER. *Funghi e Ambiente* **72**, 5-16.
- Cetto B. (1995). I funghi dal vero. Vol. 3. Saturnia. Trento 658 pp.

- Di Pietro R., Fascetti S. (2005). A contribution to the knowledge of Abies alba woodlands in the Campania and Basilicata regions, southern Italy. *Fitosociologia* **42**(1): 71-95.
- Doveri F. (2004). Funghi fimicoli italiani. A.M.B - Fondazione Centro Studi Nicologici, pp. 270-300. Vicenza Ed. Associazione MIcologica Bresadola. Trento.
- Fiussello N., Ceruti Scurti J. (1972). Idrossi indol derivati in Basidiomiceti. II. Psilocibina, Psilocina e 5-idrossi-indol derivati in carpofori di Panaeolus e generi affini. *Allionia* **18**, 85 -89.
- Galli R. (2003). *La rivista dei funghi,* pp. 44-53 Bimestrale di micolagia pratica anno II n°7. January-February.
- Gitti S., Samorini G., Belletti C., Molinari C. & Baldelli G. (1983). Contributo alla conoscenza della micoflora psicotropa del territorio bresciano. Natura Bresciana, Ann. Mus. Civ. St. Nat. **20**, 125-130.
- Grilli E., (1990). Appunti sulla micoflora calabra. Raccolte interessanti fatte in Aspromonte. *Riv. Micol.* **33**, 100-122.
- Guzmán G., Bas C. (1977). A new bluing species of psilocybe from Europe. *Persoonia* **9**, 233-238.
- Guzmán G., Granito V.M., Lunghini D., Gandara E., Ramirez-Guillen F. (2006). An emendation of Psilocybe liniformans var liniformans, an uncommon species found in the central appennones (Italy). *Micol. Veget. Medit.* **21**(2), 117-122.
- Jamoni P.G. (1990). Agarici invernali delle colline Bavaresi. *Riv. Micol.* **33**, 77-93.
- Keay S.M., Brown A.E. (1989). Interactions between Psilocybe semilanceata and fungi of its habitat. Mycological Research, Volume 93, Issue 4, 554-556.

- Makalesi A., Topcu Sesli A., Sesli E. (2016). *Psilocybe semilanceata (Fries)* Kumber (Strophariaceae): Türkiye için yeni bir halüsinojen mantar *Bağbahçe Bilim Dergisi* **3** (1): 34-40(*in Turkish*).
- Mercurio R., Spampinato G. (2006). *I tipi* forestali delle serre calabresi. Laruffa, Reggio Calabria, pp. 205.
- Moser M., Horak E. (1968). *Psilocybe serbica* spec.nov., eine neue Psilocybin und Psilocin bildende Art aus Serbien. *Zeitschrift für Pilzkunde* (in German). **34** (3-4): 137-44.
- Picillo B. (2012). Rare agarics from Matese Regional Park. Micol. Veg. Medit., **27(**2), 109-118.
- Picillo B. (2018). *Psilocybe fimetaria* first record from peninsular Italy. *Micol. Veget. Medit.* **33**(1): 17-26.
- Rivas-Martinez S. (2001). Biogeographic map of Europe. Cartographic service, University of Leon, Spain.
- Samorini G. (1988). Sulla presenza di piante e funghi allucinogeni in Valcamonica. *Boll. Centro Camuno Studi Preistorici* **24**, 132-136.
- Samorini G. (1989). Sullo stato attuale della conoscenza dei Basidiomiceti psicotropi italiani. *Ann. Mus. Civ. Rovereto* **5**, 167-184.
- Samorini G. (1993). Funghi allucinogeni italiani. In Atti II Convegno Nazionale Avvelenamenti da Funghi. *Annali Mus. Civ. Rovereto* Suppl. vol. **8**, 125-149.
- Samorini G. (2005). Funghi psicoattivi italiani: aggiornamenti. *Eleusis*, vol. **9**, pp. 71-83.
- Stamets P. (1996). *Psilocybin mushrooms* of the world: An identification guide. Ten Speed, Berkeley, California.
- Watling R. (2007). *Psilocybe semilanceata* a hallucinogenic mushroom native to Europe. En Hancock G, ed.

Supernatural: Meetings with the Ancient Teachers of Mankind. New York, New York: Disinformation Company, 404 pp.

Bulletin of Regional Natural History (BORNH) ISSN 2724-4393.