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CURRENT LIVING ALGAL CULTURE COLLECTIONS

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Abstract. The paper provides a summary on 72 living algal collections, most of which are registered in the World Federation of Culture Collections (WFCC), the European Culture Collection Organisation (ECCO), or in the World Data Centre for Microorganisms (WDCM). The Collections are briefly described and represented in alphabetical order according to their distribution in Asia (17), Australia (2), Europe (41), North (11) and South America (5).

Keywords: algae, biodiversity, bioresources, culture collections, list of collections, survey,

INTRODUCTION

Living algal collections represent a reservoir of different algal species and strains kept in small amounts in liquid cultures or on agar media. Their purpose is to preserve biodiversity by keeping algae in controlled centers, away from environmental changes. In this way, in case of environmental changes that threaten the certain species, collections can be used to restore the biodiversity. Another main purpose of collections is to ensure scientific research, educational, industrial and other purposes with the species deposited in them because the great biotechnological potential of algae and their use in human life have been shown during the last decades

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(Friedl et al. 2004). The future of the collections is focused on increasing their number worldwide and finding longer-term ways to preserve pure algal cultures. One such method is freezing with liquid nitrogen, a method that is currently mainly used for the storage of cell and tissue cultures but is increasingly used for plants and algae. Such collections are significant for biodiversity conservation, but also for development of scientific research and industry (Friedl et al. 2004). However, they are rarely covered in publications (Yuorieva et al. 2023).

Up to date a unified register for culture collections worldwide does not exist. Therefore, they are registered in different organizations like WFCC – World Fed eration of Culture Collections, ECCO – European Culture Collection Organisation and WDCM – World Data Centre for Microorganisms. The present paper provides summarized available data on living algal collections in the world.

Collections are represented in an alphabetical order according to their distribu tion in Asia, Australia, Europe, North and South America (**Figure 1**).

Fig. 1. The location of the living algal collections (dots) in the world.

Culture collections located in Asia:

1. **ALEC** - Algal Excellent Center (https://alec-tech.com/)

This is a repositorium of an agency in Thailand with more than 25 years of experience in research, development, technology transfer and services related to freshwater microalgae in the industrial sector according to the recognized potential of microalgae, which have an increasingly important role in various aspects.

ALEC contains more than 1000 strains collected from different places all over Thailand. The center aims to conserve and sustainably use aquatic resources, but also to

research, develop and take things to the private sector. The center offers various services, provision of algal strains, species classification, microcystin assays, cultivation, consultation and more. ALEC is registered in WDCM with number 1218.

2. **CCCBMA-BT/WUSL** - Culture Collection of Cyanobacteria and Microalgae Department of Biotechnology Wayamba University of Sri Lanka The collection is positioned in the Department of Biotechnology, Faculty of Agriculture & Plantation Management at Wayamba University of Sri Lanka in Makandura, Sri Lanka. It has more than 20 strains of the phyla: Cyanoprokaryota, Chlorophyta and Ochrophyta (Bacillariophyceae) isolated from numerous aquatic and terrestrial habitats in seven districts of Sri Lanka (Balsooriya 2019). The collection is registered at WFCC with number 1277.

3. **Collection of Marine Microalgae at the A. V. Zhirmunsky Institute of Marine Biology**

The collection is at A. V. Zhirmunsky Institute of Marine Biology of Russian Academy of Sciencen (NSCMB), based in Vladivostok, Russian Federation, under the Far Eastern Branch of Russian Academy of Sciences. The collection was opened in 1985 and became the first collection of marine microalgae in Russia. It started with 5 species. Over the years, throughout exchanging strains with other collections and isolations from the marine samples the number of species increased 23, from different systematic groups (Aizdaicher 2008).

4. **DBUP** – Algal Culture Collection of the University of Philippines (https://mnh.uplb.edu.ph/microbial-algal-culture-collection/)

This collection is positioned in the Museum of the Natural History of the University of Philippines Los Banos (UPLB) in Laguna, Philippines. The work on it began in the 1980s and for now has 50 strains of microalgae. The collection is registered in WFCC with number 444.

5. **EGE-MACC** – Ege University Microalgae Culture Collection (https://ege macc.ege.edu.tr/)

The collection is at Ege University, Turkey. It was created in 2004. Currently, it has about 100 strains of algae derived from different regions of Turkey (Atıcı 2020). The role of the collection is to preserve the algal resources of the country.

6. **FACHB - Freshwater Algae Culture Collection Chinese Academy of Sciences**
(http://english.ihb.cas.cn/research/platforms/npmp/202012/t20201202_255451.html)
FACHB is the main algal collection in China (Song et al. 2014) and is located at the Institute of Hydrobiology of the Chinese Academy of Sciences in Wuhan,

Hubei, China. The collection was established in the 1960s. It contains more than 2,000 strains belonging to 120 genera and 8 divisions, most of which are isolated from numerous freshwaters and less are marine and brackish species, or soil algae (Song et al. 1999). Some of the strains are obtained through exchange with Algal Culture Collection of University of Texas (UTEX). FACHB is registered in WDCM with number 873.

7. **GAZI-MACC** - Gazi University Microalgae Culture Collection (https://gazi.edu.tr)
This collection is positioned in Gazi University in Ankara, Turkey. It provides biological resources for academic studies and research at biotechnology. At the same time it serves a role as a genetic conservation centre of the national algal species (Atıcı 2020).

8. **IBRC** – Iranian Biological Resources Center (https://www.acm-mrc.asia/index.html)
IBRC was opened in 2008 in Tehran, Iran under the direction of Academic Center for Education, Culture and Research. It has the role of a center at national and international level in areas such as collection, identification, quality control, classification, preservation, cultivation and distribution of various biological species, not only algae. The collection is registered in WDCM with number 950.

9. **IRK–A** – Algae Culture Collection of SIPPB SB RAS
(http://www.sifibr.irk.ru/ en/)
The collection is part of the Siberian Institute of Plant Physiology and Biochemistry of the Siberian Branch of the Russian Academy of Sciences (SIPPB SB RAS) in Irkutsk, Russia. It started working in 2003 to study the algae in the terrestrial ecosystems. For now, the collection has 165 strains: Cyanoprokaryota – 13, Chlorophyta – 130, Streptophyta – 9, and Ochrophyta – 13. The strains are isolated from different parts of the country.

10. **KCTC** - Korean Collection for Type Cultures (https://kctc.kribb.re.kr/en)
This collection is positioned in the Research Institute of Bioscience and

Biotechnology in Jeonbuk, South Korea. It has start working in 1985 and has more than 200 strains. The collection provides live resources for scientific, academic and industrial studies. KCTC is registered in WFCC with number 597.

11. **KMMCC** – Korea Marine Microalgae Culture Center
The collection is located at Pukyung National University in Busan, South Korea. It was established in 1995. Currently the collection has more than 2200 strains of about 700 species from 233 genera. About 80% of the strains are marine, 16% are freshwater and 4% are brackish. Many of the strains are cryopreserved (Hur

2008, Hur et al. 2015).

12. **KU-MACC** – Kobe University Macroalgal Culture Collection (https://ku macc.nbrp.jp/)
This collection is at Kobe University, Hyogo, Japan. It has been established in 2003 and holds more than 1100 strains of more than 300 species of macroalgae (Rhodophyta, Ulvophyceae, Charophyceae, Schizocladiophyceae, Phaeophyceae). The strains are kept as vegetative thalli and as preserved by means of cryopreservation (Kawai et al. 2020).

13. **NAIMCC** - National Agriculturally Important Microbial Culture Collection (https://nbaim.icar.gov.in/)
NAIMCC, established in 2004, is a part of the ICAR - Indian Institute of Seed Science and Technology, Mau, India. It is focused on microorganisms that are important for agricultural crops throughout the country. More than 7,000 strains of fungi, bacteria, actinomycetes and cyanobacteria (known also as blue-green algae, or cyanoprokaryotes), are deposited in it. The aim of the collection is to maintain, conserve and characterize various species collected from all over the country from different habitats and to use them in different research programs to establish the relationships between different species, which will affect agricultural communities. NAIMCC also provides strains for different genomic studies and bioinformatics. The collection is registered in WDCM with number 1060.

14. **NIES** - Microbial Culture Collection at the National Institute for Environmental Studies (https://mcc.nies.go.jp/index_en.html)
NIES is located in the National Institute for Environmental Studies in Tsukuba, Japan. It was founded in 1983 with a focus on organisms that cause environmental problems, such as the eutrophication of water bodies. Currently, there are more than 2000 strains, out of which about 300 are from endangered algae (Charales and red freshwater algae). The collection contains strains of cyanobacteria and eukaryotic algae. They are all maintained and available for educational and

research purposes (Kasai et al. 2009). The collection accepts all strains of rare species, but also strains of common species and of species with proved application. NIES is registered in WDCM with number 591.

15. **NRMC** - National Repository for Microalgae and Cyanobacteria (https://www. bdu.ac.in/centers/NRMC-F/index.php)
NRMC was established in 2015 in Bharathidasan University suited in Tiruchirappalli, India. It aims to conduct an extensive survey of freshwater basins in southern India in order to reveal the spatial and temporal diversity of microalgae and cyanobacteria, as well as to clarify the ecological factors that influence them. Along with this, NRMC is focused on the biotechnological application of the cultivated algae, such

as biofuel production, extraction of proteins, pigments and production of various biologically active substances. The idea of the collection is to become a world center for different algal strains and to be offered to different organizations for educational, research and industrial purposes. NRMC is registered in WDCM with number 976.

16. **TISTR Culture Collection** - Thailand Institute of Scientific and Technological Research Culture Collection (https://www.tistr.or.th/tistr_culture/index.php) The TISTR Culture Collection known also as Bangkok MIRCEN (World Network of Microbiological Resources Centres) is located in Klong Luang, Pathum Thani, Thailand. It was created in 1976. This collection has more than 5000 strains of bacteria, fungi, yeasts and about 430 strains of microalgae. It is oriented mainly to the biotechnology potential of the cultures and provides safe deposits, identification, isolation, preservation and documentation of the strains, but also training services.

17. **UMACC** – University of Malaya Algae Culture Collection UMACC is located in The University of Malaya, Malaysia. It has been created in 1987 and has more than 200 strains derived from different habitats (marine, brackish, freshwater and aero-terrestrial) from Malaysia and from the polar region (Phang et al. 2004). The strains are used to study antiviral and anti-inflammatory effects. The collection is registered in WFCC with number 1059.

Culture collections located in Australia:

1. **ANACC** - Australian National Algae Culture Collection (https://www.csiro.au/en/about/facilities-collections/Collections/ANACC)
The Australian National Algae Culture Collection, housed at Hobart, Tasmania,

holds more than 1000 strains of more than 300 microalgal marine and freshwater species. Although majority of them are isolated from Australian waters, there are also strains been sourced from tropical Australia to Antarctica. The collection is focused on the preservation of Australian biodiversity, but also to provide high quality starter algal cultures to industry, educational institutions and research centers.

2. **CICCM** - The Cawthron Institute Culture Collection of Micro-Algae (https://www.cawthron.org.nz/ciccm/)
This collection is a part of Cawthron Institute in Nelson, New Zealand. It has more than 300 strains from 14 classes of freshwater and marine microalgae, some of which are toxic and unique for New Zealand. Big part of the strains are cryopreserved. The goal of the CICCM is to support research worldwide and to ensure the safety of the countries seafood.

Culture collections located in Europe:

1. **ACOI** - Coimbra Collection of Algae (http://acoi.ci.uc.pt/)
ACOI is located at the Department of Life Sciences, University of Coimbra, Portugal and contains about 3000 cultures assigned to species and about 1000 cultures assigned to a genus level, which are not yet added to the database. A gallery with images of algal species has also been created. Collection aims to start cryopreserving the algal strains for safer storage in long term plan (Santos & Santos 2004). ACOI is registered in the WFCC under number 906.

2. **ACKU** – Algal Culture Collection of Kyiv University (https://biomed.knu.ua/)
This collection is created in the early 1970s in the department of Lower Plants at the Kyiv National Taras Shevchenko University, Ukraine. The strains are isolated from soils from different part of the country and from some other countries like Luxemburg, Belgium, Russia, Check Republic and even from Antarctica. The collection is registered in WDCM with number 994.

3. **ACSSI** – Algal Collection of Soil Science Institute
This collection is situated at the Institute of Physical Chemical and Biological Problems in Soil Science of the Russian Academy of Sciences, in Pushkino, Moscow Region, Russia. It has more than 400 strains of soil algae, isolated from different soil types of the Russian territory. The goal of the collection is not only to maintain the algal strains and to be an important biological resource but also to study their biotechnological potential (Temraleeva 2016). The collection is registered in WFCC with number 1132.

4. **ACUF** – Algal collection at the University "Federico II" (https://www.acuf.net/) This collection is located at the Department of Biology of the University "Federico I" of Naples, Italy. It has more than 600 strains of microalgae from the phyla Cy anoprokaryota, Rhodophyta, Chlorophyta and Ochrophyta (Bacillariophyceae), out of which over 250 strains are extremophilic algae.

5. **ACUS** - Algal Collection of Sofia University
ACUS is situated in the Faculty of Biology of Sofia University, Bulgaria. It was established in 2006 (Uzunov et al. 2012). Aero-terrestrial algal monocultures, as well as species from thermal springs and freshwater habitats have been deposited in it (Stoyneva 2012). They are represented by 197 strains of algae collected from different parts of the country kept on agar (Uzunov et al. 2012). Recently, in the framework of the project SUMMIT (Sofia University Marking Momentum for Innovation and Technological Transfer) 70-123-11/27.02.2023 the collection has been equipped additionally with three growth chambers and with a large photobio reactor for algal cultivation. ACUS is registered in the GSIM, WDCM and WFCC

under number 965.

6. **Algal collection of the Laboratory of Experimental Algology of the Bulgari an Academy of Sciences** (http://www.bio21.bas.bg/ippg/en/?page_id=218) This collection is situated in Sofia in the Institute of Plant Physiology and Genetics (IPPG) of the Bulgarian Academy of Sciences (BAS) (Ivanova et al. 2020). Its main objectives are isolation, characterization of the physiology and biochemistry of the algal strains and their application in pharmaceutical and agricultural indus tries.

7. **Algobank Caen** (https://algobank.unicaen.fr/en/accueil/)
This is the microalgal culture collection of the Caen Basse-Normandie University in France. The collection provides long-term preservation of more than 300 brack ish, freshwater and marine strains. Those biological resources can be provided to different institutions for education and industrial research.

8. **BACA** - Bank of Algae and Cyanobacteria of the Azores (https://baca.uac.pt)
BACA, established in 2018, is located at the University of the Azores in Ponta Delgada, Portugal. It contains strains of microalgae and cyanobacteria that were isolated earlier, in 2013, from freshwater, marine, brackish, thermal and terrestrial habitats from the nine islands of the Azores archipelago. Several strains of blue green algae, kept in BACA, have unique phylogenetic features, thus contributing to the biodiversity the collection possesses and enhancing its biotechnological

poten tial (Luz et al. 2019). The collection is registered in WDCM with number 1242.

9. **BCAC** - Bashkortostan Collection of Algae and Cyanobacteria (https://ufacity.info/press/news/128615.html)
BCAC, created in 1978, is located at the Bashkir State Pedagogical University named after M. Akmulla (M. Akmulla BGPU) in Ufa, Bashkortostan republic, western Russia. By far it is the largest in Russia with more than 1,200 strains of eu karyotic and blue-green algae isolated from the territory of Russia, Ukraine, USA, France, Germany and Antarctica, each strain being unique and can be used for both fundamental and applied research. Research is currently focused on molecular studies and taxonomy of terrestrial algae and cyanoprokaryotes, their biology and ecology, algal physiology and biochemistry and their identification.

10. **BCCM/DCG** - Diatom Collection Ghent https://bccm.belspo.be/about-DCG
BCCM - Belgian Co-Ordinated Collections of Micro-Organisms houses DCG (Di atom Collection Ghent), at Ghent University in Belgium. Currently the collection has more than 200 stains of diatoms, but it houses also some other microalgae that are interesting from a scientific point of view or that have the prospect of being in tegrated into production (Vanormelingen et al. 2012). The collection is oriented

towards taxonomy, and strains are characterised by morphological and DNA anal yses, with additional studies on the evolution, ecology and life cycle of diatoms. For preservation, cryogenic methods are also used. Deposited strains are available for scientific and research purposes, but also for private companies with applied purposes. This colllection is registered in WDCM with number 1039.

11. **BCCM/ULC** - Culture Collection of (sub)polar cyanobacteria (https://bccm.belspo.be/about-ULC)
BCCM/ULC is located at the University of Liège in Belgium since 2011 and is one of the largest repositories of polar and subpolar blue-green algae, addressing their phenotypic and genotypic diversity, evolution, biogeography and ecophysi ology, toxicity and physiological response to stressors. In addition to strains from polar zones, there are also strains from Belgian lakes that cause blooms and release toxins. Molecular approaches are used in species identification. The collection has a polar focus but seeks to deposit terrestrial, freshwater and marine strains from temperate, tropical and subtropical regions as well. To date more than 500 strains have been deposited in BCCM/ULC. This collection is registered in WDCM with number 982.

12. **BEA** – Banco Español de Algas (Spanish Bank of Algae) (https://marinebio

technology.org/en/)
BEA is part of the University of Las Palmas de Gran Canaria, Spain. It has more than 1900 clonal strains, some of them are from tropical and subtropical regions. The collection provides isolation, characterization, conservation, development of cultivation techniques and supply, also it offers a great potential for development and application of algae and cyanobacteria from a technological and scientific point of view. BEA is part of ECCO and WFCC with number 837.

13. **BMCC** – Basque Microalgae Culture Collection (https://www.ehu.eus/en/web/ bmcc/collection)
The collection is positioned in the Department of Plant Biology and Ecology, Fac ulty of Science and Technology of the University of the Basque Country, Leioa, Spain. The collection has more than 600 strains of phytoplankton algae from the following phyla: Cyanoprokaryota, Chlorophyta, Pyrrhophyta, Haptophyta and Ochrophyta. The collection is part of the REDESMI – the Spanish Network of Microorganisms, ECCO and is registered in 2020 in the WFCC with number 1232.

14. **CALU** - Collection of Algae of Leningrad University (https://researchpark. spbu.ru/en/home-eng-3)
This collection, maintained at the Saint-Petersburg State University, is one of the largest in Russia. The collection is not dedicated to algae alone but consists of bac teria strains as well (Pinevich et al 2004). About 1,000 strains are kept in liquid or

solid media and are used for research and educational purposes. CALU is registered in WDCM with number 461.

15. **CAUP** - Culture Collection of Algae of Charles University in Prague (https:// botany.natur.cuni.cz/algo/caup.html)
CAUP was founded in 1961 and is located at Charles University in Prague, Czech Republik. This collection contains 246 strains of algae and cyanobacteria. The pur pose of the collection is to maintain a small set of organisms, and to serve as a platform for education and taxonomic research in the university department (Pun cocharova 1990). The planned development of the collection is its digitization. Since 1981, it is a member of the WFCC and is also a member of the FCCM (The Federation of Czech and Slovak Culture Collections of Microorganisms). CAUP is registered also in the WDCM with number 486.

16. **CCAC** - Central Collection of Algal Cultures (https://www.uni-due.de/biology/ ccac/)
CCAC, founded in 2001, is located at the University of Duisburg-Essen (UDE),

Germany and is one of the largest in the world. It was based on the Culture Collec tion of Algae at the University of Cologn with more than 7,500 algal strains from all over the world have been deposited in it (Surek & Melkonian 2004). Most strains are from freshwater and terrestrial habitats (85%), the remaining 15% are from marine and brackish habitats. Algal strains are stored in growth chambers. The collection accepts strains from all over the world. The collection is registered in WDCM and WFCC under number 807 and is registered also in ECCO.

17. **CCALA** - Culture Collection of Autotrophic Organisms (https://ccala.butbn.cas.cz/)
CCALA is one of the oldest algal collections, having started work as early as 1913 at the Karlov University in Prague, Czech Republik. In 1961, an algal collection in the city of Trebon, Czech Republic, was founded. In 1979, both collections were united and formed the current CCALA collection located in the Institute of Botany of the Czech Academy of Sciences. It aims to collect algal cultures from different habitats (polar regions, hot springs, soils, etc.). It supports algal strains from more than 50 countries, including cultures from the Arctic and Antarctica. Deposited cultures are available for teaching, research and commercial purposes. CCALA is registered in the WFCC with number 905.

18. **CCAM** – Culture Collection of Algae Marburg
(https://www.uni-marburg.de/de/sammlungen/gesamtuebersicht/naturwiss-sammlungen/algenkultursammlung)
CCAM is located at the Department of Biology in Philipps University Marburg, Germany. The collection maintains algal strains from 75 taxa, most of which are diatoms. The strains are used for different research and educational purposes.

19. **CCAP** - Culture Collection of Algae and Protozoa (https://www.ccap.ac.uk/)
CCAP is in Scotland, United Kingdom, located within Scottish Association for Marine Science (SAMS) campus. It is a biological resource center that provides access to taxonomically defined live cultures of marine and freshwater algae from more than 3,000 strains for research, education and industry purposes (Gachon 2008). This collection is registered in WDCM under number 522.

20. **CCBA** – Culture Collection of Baltic Algae (https://ccba.ug.edu.pl/pages/en/home.php)
The collection is created in the mid-1980s and is a part of the Department of Ocean ography and Geography of the University of Gdańsk, Poland. CCBA has about 300 strains of microalgae and some seaweeds mainly from the Baltic Sea.

21. **CCryo** – Culture Collection of Cryophilic Algae (https://www.izi-bb.fraun

hofer.de/de/Forschung_Entwicklung/extremophilenforschung/sammlung-kryophiler-organismen.html)
CCryo, established in 1999, currently is located in Fraunhofer IZI-BB in Potsdam, Germany. It is focused on cryophilic algae collected during 7 expeditions in Norway and in the Antarctic. It contains 518 strains of 178 species from 101 genera (Leya 2020). About 90% of the strains are cryophilic, collected from various cold habitats (snow, permafrost, etc.) (Leya 2020). These strains are used for taxonomic and phylogenetic studies, as well as for physiological and genomic studies, show ing the possibility of cryophilic algae to produce commercially potential substanc es. The purpose of the collection is to preserve and provide algal strains as need ed to various institutions related to education, industry, private sector and others. CCryo is registered in WDCM with number 940.

22. **CCVIEO** – Culture Collection, focused on harmful algal blooms (HAB) species (https://vgohab.com/en/)
The collection is at Vigo Oceanographic Center of the Spanish Institute of Oceanography. It has about 300 strains from more than 80 species marine microalgae that cause harmful algal blooms. The strains are used to study their toxicity, genetics, pigments, life cycle, etc.

23. **CoSMi** - Collection of Sea Microorganisms (https://www.ogs.it/en/collection-marine-microorganisms-cosmi)
CoSMi is a part of the Italian Microbial Resource Research Infrastructure (MIRRI) and is situated in Milano, Italy. It is a biological resource center with a purpose to isolate, cultivate and identify marine microorganisms by combining morpholog ical and molecular methods. To date, it contains more than 100 strains of living microalgae (diatoms, flagellates from different groups such as dinoflagellates, coc colithophorids, etc.). They are available for research, industrial and educational

purposes. CoSMi is registered with the WFCC under number 1209.

24. **Culture Collection of Cyanobacteria and Microalgae at the French Nation al Museum of Natural History**
The collection is established in the late 1920s at the French National Museum of Natural History (MNHN) in Paris. It consists of more than 1,300 strains isolat ed from freshwater, benthic and terrestrial habitats in France. A lot of blue-green strains are blooming and are an ecological concern. The collection contributes to taxonomy, genetics and biodiversity research (Hamlaoui et al. 2022).

25. **GUMACC** - Göteborg University Marine Culture Collection (https://www.

gu.se/en/marina-vetenskaper/about-us/algal-bank-gumacc)
The collection is located at the Department of Marine Ecology, Göteborg Universi ty, Sweden. It has 81 strains of marine microalgae that are cultivated in house since 1955 and provided mainly to the university staff for education and research. Since 1992 HPLC-analysis has been used to determine the taxonomical affiliation of the algal strains.

26. **HAMBI Culture Collection** (https://www.helsinki.fi/en/infrastructures/bio diversity-collections/infrastructures/microbial-domain-biological-resource-cen tre-hambi)
HAMBI Culture Collection is located at the University of Helsinki in Finland and is part of the Biodiversity Collections Research Infrastructure (HUBCRI) in the Helsinki Institute of Life Science. It is a resource of living microorganisms from various groups, such as archaea, bacteria, cyanobacteria, fungi, phages and yeasts. A large part of them is collected from the country. There are currently about 1,000 strains of blue-green algae. This collection is registered in the WFCC under number 779.

27. **IBASU-A** – The Microalgae Culture Collection of the M.G. Kholodny Institute of Botany, NAS of Ukraine
The collection is in Kyiv, at the Kholodny Institute of Botany at National Academy of Science of Ukraine. It started functioning in the 1950s and consists of more than 400 strains of halophitic and freshwated algae from the Chlorophyta division (Bo risova et al. 2003; Friedl et al. 2004; Borysova et al. 2020). The collection is registered in WFCC with number 1282.

28. **IBSS** – Collections of algae in the Institute of Biology of the Southern Seas of Russian Academy of Sciences (https://ibss-ras.ru/about-ibss/structure-ibss/tsen try-kollektivnogo-polzovaniya/collection-of-hydrobionts-of-world-ocean/collec tions-of-plants/?sphrase_id=3633121)
These are seven collections included in the system of the aquatic plant collections

of the larger collection of marine hydrobints in the A. O. Kovalevsky Institute of Biology of the Southern Seas of Russian Academy of Sciences. The first is the Col lection of anhydrobiotic algal cultures, created in 2005. Currently, it has more than 500 strains from four divisions: Cyanoprokaryota, Rhodophyta, Chlorophyta and Ochrophyta (Bacillariophyceae). This type of storage is making the preservation reliable and is suited for creating genetic banks (Kharchuk 2020). The second is the Collection of living cultures of marine planktonic microalgae, located in the Department of Ecological Physiology of Algae of the Institute of Biology of the Southern Seas and is one of the largest collections in post-Soviet era. It contains

unicellular algae. The third is the Collection of microalgae and cyanobacteria cul tures, which has been created in the year 2000 and with its more than 30 strains supports scientific and biotechnological research of microalgae and cyanobacteria. The fourth collection of the Institute is focused on carotenogenic microalgae and its data are available from the site "https://micro.depo.msu.ru/module/collection public?openparams=%5bopen-id=91967043"https://micro.depo.msu.ru/module/ collectionpublic?openparams=[open-id=91967043. There are also collections of living dinoflagellates and cryptophytes which contain more than 20 species and belong to the Aquaculture and pharmacology section of the Institute.

29. **IPPAS** - Culture collection of microalgae and cyanobacteria of the K. A. Timiryazev Institute of Plant Physiology of the Russian Academy of Sciences (IP PRAS) (https://en.cellreg.org/Collection-IPPAS.php)
Of the 27 Russian algae culture collections, IPPAS, established in 1958, is one of the oldest and the most diverse collection of biotechnologically important and model strains (Yuorieva et al. 2023). The collection is open for collaborations, and aims to provide targeted services and assistance to scientists working on the physiology and biochemistry of photosynthetic microorganisms or biotechnologi cal applications of microalgae and cyanobacteria (Yuorieva et al. 2023). In addi tion to application of in vitro and cryopreservation techniques, there is cultivation of algae in bioreactors in liquid media from laboratory (5–20 L) to semi-industrial (150–630 L) scale. Currently, the collection holds 430 strains, including 243 strains of eukaryotic microalgae from Chlorophyta, Rhodophyta, Ochrophyta, and Eugle nophyta and 187 strains of cyanobacteria belonging to 91 genera and 106 species. Since 1989, IPPAS has been a member of the ECCO and it is registered in WDCM under number 596.

30. **KPABG** – The Collection of Cyanoprokaryotes of the Polar-Alpine Botanic Garden-Institute (https://isling.org/cyano)
The collection is situated at the Polar-Alpine Botanic Garden-Institute named after N. A. Avrorina in Murmansk region of Russia. It has more than 2,000 strains. It's registered in WFCC with number 1281.

31. **MZCH** - Microalgae and Zygnematophyceae Collection Hamburg (https:// www.biologie.uni-hamburg.de/en/einrichtungen/wissenschaftliche-sammlungen/ algensammlung.html)
MZCH is a part of the University of Hamburg, Germany. It houses more than 600 strains of green algae from the class Zygnematophyceae (phylum Streptophyta), and more than 700 strains of green microalgae from the phylum Chlorophyta (Schwartzenberg 2013). The collection serves as a resource center as it allows

experimental work with rare and in many cases endangered species and can pro vide in vitro cultures for educational purposes. MZCH collection is registered in the WFCC without a number.

32. **Nature Research Centre Collection of Pure Cultures of Algae and Cyano bacteria**
The collection is deposited in the Nature Research Centre in Vilnius, Lithuania. It is unique for the country and nowadays has more than 500 strains of 140 spe cies, mainly blue-green (44%) and green (32%) freshwater and brackish algae. The strains are used for educational, biotechnological and research purposes (Ko reivienė et al. 2016).

33. **NORCCA** - The Norwegian Culture Collection of Algae (https://norcca.scrol.net/) NORCCA, located at the University of Oslo, Norway, is the largest in the Scan dinavian peninsula. It was founded in 2016 after the merging of three collections (the NIVA Culture Collection of Algae (NIVA-CCA) (Friedl et al. 2004), the University of Oslo Culture Collection of Algae (UIO-CCA) and the Scandinavian Culture Collection of Algae and Protozoa (SCCAP) at the University of Copenha gen (UoC), Denmark) (Friedl et al. 2004). NORCCA contains more than 2,000 strains of cyanobacteria, micro- and macroalgae isolated from various freshwater, coastal and oceanic habitats of northern Europe. In addition to northern European strain, there are strains from all over the world. Algal representatives are quite diverse, covering 10 divisions. About half of the strains are from freshwater or terrestrial habitats and half are from marine or brackish waters. About 100 strains are macroalgae. The strains are used for research, educational, innovative and com mercial purposes. NORCCA is registered in ECCO.

34. **PACC** - Plovdiv Algal Culture Collection (https://bio.uni-plovdiv.bg/en/bota ny-and-teaching-methods-in-biology/)
The living algae collection of the the Department of Botany of Plovdiv University "St. Paisii Hilendarski" was established in 1963 in. Over the years, the collection grew, and in 1980, it received various algal cultures from 11 foreign collections such as MPI, SAG, CCALA, IBI, CAUP, ALCP and others (Belkinova 2002). It contains 774 strains of 249 species from 103 genera.

35. **PCC** - Pasteur Cultures of Cyanobacteria collection (https://www.pasteur.fr/en/ public-health/crbip/distribution/pcc)
PCC began its development at the University of California in the USA but was moved to France in 1971 to the Institute Pasteur in Paris. It contains more than

750 pure cultures of blue-green algal strains from different habitats. These strains are available for research purposes only.

36. **RCC** - Roscoff Culture Collection (https://roscoff-culture-collection.org/)
RCC is situated in Station Biologique De Roscoff which is run by Sorbonne Uni versity and the CNRS, France. It was created in the late 1970s. Nowadays RCC contains about 6,300 strains of marine planktonic algae, focusing on picocyano bacteria (*Prochlorococcus* and *Synechococcus*), picoeukaryotes (*Bolidomonas*, *Ostreococcus*, *Pelagomonas*), diatoms and Haptophyta (coccolithophorids). The strains are collected from all around the world. The future of the collection is to use molecular methods in order to clarify the classification of the picoplankton species (Vaulot et al. 2004). RCC is registered in WDCM with number 829 and in ECCO.

37. **SAG** - Sammlung von Algenkulturen at University of Göttingen (https://www. uni-goettingen.de/de/184982.html)
SAG is located at the University of Göttingen, Germany and is one of the richest in species and is long considered as important center for living biological resources of microalgae. There are about 2,300 strains in it, represented by almost all divi sions and classes of eukaryotic algae and prokaryotic blue-green algae from more than 500 orders and 1,400 species. The strains were characterized using molecular methods. Pure algal cultures are cryopreserved (Friedl 2012). Collection supports scientific, biotechnological and educational centers worldwide, due to the many services it offers ex situ conservation, isolation and identification of species, provi sion of algal cultures to various institutions for educational, research and industrial purposes. SAG is registered in the WFCC under number 192.

38. **SYKOA** - Strain collection of microalgae and cyanobacteria from northern and arctic regions in the Institute of Biology of Komi Scientific Centre (https://ib.komisc.ru/sykoa/eng/)
SYKOA, situated in the Institute of Biology of Komi Scientific Centre of the Ural Branch of the Russian Academy of Sciences (IB Komi SC UB RAS), started work ing in 2010. To date, it contains more than 400 strains of algae collected from various terrestrial and freshwater habitats in the northeastern part of the European part of Russia. Green and blue-green species form the larger part of the collection, whereas Eustigmatophyceae and Xanthophyceae are represented by five species. Also, the collection contains rare species and strains with unclear systematic af filiation. The main goal of the collection is to preserve the species diversity of

microalgae from the Arctic and northern regions of European Russia and to collect

samples for further use in floristic, systematic, evolutionary, molecular, genetic and ecological studies. SYKOA is registered in WDCM with number 1125.

39. **TAU-MAC** - Thessaloniki Aristotle University Microalgae and Cyanobacteria Collection (https://cyanobacteria.myspecies.info/)
At present, the algal collection of the Thessaloniki Aristotle University, Greece TAU-MAC contains 49 blue-green algal strains, representing 22 taxa, 16 genera and seven families (Chroococcaceae, Microcystaceae, Hapalosiphonaceae, Nos tocaceae, Rivulariaceae, Phormidiaceae, Pseudanabaenaceae, Synechococcaceae), belonging to four orders: Chroococcales (18), Nostocales (15), Oscillatoriales (12) and Synechococcales (4) isolated manly from lakes of Greece, but also from differ ent marine habitats of the country and aims to contribute to the knowledge of their biological diversity. TAU-MAC is registered in WDCM with number 1156.

40. **TCC** – Thonon Culture Collection (https://carrtel-collection.hub.inrae.fr/)
This collection is located at the Parachet Hydrobiology Station in Somme, France. It was created in the late 1950s. Currently, the collection has more than 500 fresh water algal strains. It is a part of The Biological Resource Centre for the Environ ment which is a network of collections whose objective is to improve the visibility of the biological resources maintained in centers from different parts of France (Mougin et al. 2018). The collection is registered in WDCM with number 1030.

41. **VKM -** All Russian Collection of Microorganisms
(https://www.vkm.ru/index.htm) VKM operates as a Department of the G. K. Skryabin Institute of Biochemistry and Physiology of Microorganisms at the Pushchino Biological Research Center of the Russian Academy of Science. It is one of the largest Russian collections and con tains more than 23,000 strains of bacteria, archaebacteria, fungi, yeasts and algae (50 strains). The collection offers services related to the procurement of cultures, their deposit and storage, study and determination. VKM is registered in WDCM with number 342.

Culture collections located in North America:

1. **APCC** – Antarctic Protist Culture Collection
(https://www.whoi.edu/science/B/ protists/
The Antarctic culture collection is in the Woods Hole Oceanographic Institution, Massachusetts, USA and consists of about 80 strains of algae from the Antarctic marine water and other protists. The samples were obtained from water, ice and slush in the Ross Sea, Antarctica. The cultures are used in different physiological and molecular experiments that lead to better understanding of the Antarctic micro bial community and its structure and function.

2. **ARC** – Algal Resources Collection (https://www.algalresourcescollection.com/) The collection was created in the Florida Marine Research Institute in 1987 and was focused on toxic dinoflagellates from the region. In 1999, it was transferred to the Center for Marine Science at the University of North Carolina at Wilmington (UNCW), USA. In 2013, ARC was moved to the newly constructed MARBIONC (Marine Biotechnology in North Carolina) building at UNCW's Crest Research Park. Currently, its focus has expanded on the maintenance of toxic algal species from different taxonomic groups. The strains are used for commercial, educational, industrial and pharmaceutical research.

3. **ATCC** – American Type Culture Collection (https://www.atcc.org/) ATCC is established in 1925 and is in Gaithersburg, Maryland, USA. The collec tion offers a great variety of different culture collections like algae, viruses, fungi, yeasts and many others. The algal cultures are represented by more than 150 strains from different habitats. They are used for academic/scientific research in the means of different uses like animal feed, textile pigments, fertilizers, biofuels and many more.

4. **CCCM** – Canadian Center for the Culture of Microorganisms (https://cccm.botany.ubc.ca/)
The CCCM is a part of the Department of Botany at the University of British Columbia, Canada. It contains two other collections Northeast Pacific Culture Collection (NEPCC) which has marine algae and Freshwater Algal Culture Col lection (FWAC). Both collections have approximately 300 strains. About 75% of the strains are local, the other 25 % are from tropical and temperate regions. The maintained strains are used for research, education and commercial.

5. **CCMEE** – Culture Collection of Microorganisms from Extreme Environments CCMEE is at The University of Oregon, USA. It's a unique collection focused on extremophile organisms (Shaw et al 2020). The algal strains are dominated by cyanoprokaryotes and red algae, collected from a range of extreme habitats. The goal of the collection is to stabilize the cultures for general research.

6. **CODIMAR** – Marine Dinoflagellates Collection (https://www.cibnor.gob.mx/investigacion/colecciones-biologicas/codimar)
This collection is suited in Northwest Biological Research Center in La Paz, Mex ico. Its role is to gather dinoflagellates that cause harmful algal blooms and to de velop a taxonomic and a biological bank. Currently the collection has 149 strains from the orders Peridiniales, Gonyaulacales, Gymnodiniales and Prorocentrales of the division Pyrrhophyta and class Raphidophyceae from the division Ochrophyta.

The CODIMAR cultures can be provided to different scientific communities for research and educational purposes.

7. **CPCC** - the Canadian Phycological Culture Collection (https://uwaterloo.ca/canadian-phycological-culture-centre/about/history)
The Canadian Phycological Culture Collection (CPCC) was created in 1987 and was formerly known as University of Toronto Culture Collection of Algae and Cy anobacteria (UTCC) (Friedl et al. 2004 and references therein). It has more than 500 strains and is the the only full-service Canadian collection of cultivated algae. It has provided cultures to institutions in more than 30 countries.

8. **CRC** collection at *Chlamydomonas* Resource Center (https://www.chlamycollection.org/)
CRC, established in 1978 as *Chlamydomonas* Genetics Center at Duke University (Friedl et al. 2004 and references therein), is at the University of Minnesota, USA. There are over 3,900 strains of the genus *Chlamydomonas*. The main goal of the collection is to maintain and distribute strains of *Chlamydomonas* for dif ferent research like flagellar assembly and motility, metabolic pathways, genetics research and many others.

9. **NCMA** collection at Provasoli-Guillard National Center for Marine Algae and Microbiota (https://ncma.bigelow.org/; https://ncma.bigelow.org/who-we-are) The NCMA originated from private culture collections established by Dr. Luigi Provazoli of Yale University and Dr. Robert R. L. Guillard of the Woods Hole Oceanographic Institution and was originally called the Culture Collection of Ma rine Phytoplankton (CCMP). It was founded in 1980 in the Woods Hole Oceano graphic Institution, Massachusetts. Later, moved to Bigelow Laboratory for Ocean Sciences, Maine and in 1985, the name was changed from a "Collection" to a "Center" to reflect its wider services and in October 2011 the CCMP was renamed the Provasoli-Guillard National Center for Marine Algae and Microbiota (NCMA). Currently, it contains about 783 species represented by more than 2000 strains. NCMA is registered in WDCM with number 2.

10. **UTCC/CPCC** – Canadian Phycological Culture Centre (https://uwaterloo.ca/canadian-phycological-culture-centre/)
UTCC/CPCC is housed at the University of Waterloo, Canada. It was opened in 1987. Now, more than 300 algal strains collected from different habitats have been deposited in it. These strains are used for research purposes, oriented towards bi ofuel production, bioremediation, ecotoxicology, physiology and ecology (Acre man 2004). This collection is the only one in the country that offers algal cultures, nutrient media, isolation and organizing seminars for educational purposes.

UTCC/ CPCC is registered in WDCM with number 605.

11. **UTEX** – Culture Collection of Algae (https://utex.org/)
UTEX, located at the University of Texas at Austin, USA, was founded in 1976.

It originally had about 400 algal strains provided by the University of Cambridge, UK (Starr 1993). Currently, it contains more than 3,000 algal strains from more than 1,500 species and 450 genera. The collection is a repository of biological resources and a distribution center for algal cultures. Its mission is to promote and provide algae for scientific research, educational and practical applications. UTEX is registered in WDCM with number 606.

Culture collections located in South America:

1. **BCCUSP** – Brazilian Cyanobacteria Collection of the University of Sao Paulo
This collection belongs to the University of Sao Paulo, Brazil. It has more than 300 strains of blue-green and green algae. The strains are used for research of toxins, genetic analysis, physiology, biotechnological application, etc. (Lourenco et al. 2004). BCCUSP is registered in WFCC with number 844.

2. **CCAPE** - Culture Collection of Cyanobacteria and Algae of Pernambuco (https://collectory.sibbr.gov.br/collectory/public/show/co393)
This collection is located in the Laboratory of Phycology (LABFIC) of the Univer sidade Federal Rural de Pernambuco, Brazil and contains mainly strains of green algae (Chlorophyta). It has 90 strains of species that has commercial and biotech nological interest (Oliviera et al. 2018). The collection is registered in WFCC with number 1311.

3. **CCMA-UFSCar** – Culture Collection of Freshwater Microalgae This collection is located the Federal University of Sao Carlos, Brazil. CCMA-UFS Car started working in 1977. Currently is the largest algal collection in Brazil, con taining more than 700 strains of freshwater algae mostly of the Sao Paulo region. The strains are cryopreserved and they are used for different research projects (Tes sarolli 2017). The collection is registered in WFCC with number 835.

4. **LAM** – Laboratory of Seaweed (https://lam.ib.usp.br/ingindex.html) The collection is a part of the Institute of Bioscience of University of Sao Paulo, Brazil (Friedl et al. 2004). It startet working in the 1950s with the goal was to study and catalogue the Brazilian macroalgae that form the coastal algal diversity. In the 70s of the 20th century the collection started to maintain living seaweeds and to cultivate them in vitro, and study their physiology, phycocoloids and to proceed different molecular studies.

5. **The Marine Algae Collection of the Coast of Piaui** (https://collectory.sibbr.gov.br/collectory/public/show/co728?lang=en_GB)
This collection is at the State University of Piauí, Brazil (Friedl et al. 2004). It includes algae belonging to the Archaeplastida clade from the divisions Chloro-

phyta, Rhodophyta and Glaucophyta which play a fundamental ecological role in coastal ecosystems, contributing to primary production, habitat formation and the maintenance of marine biodiversity.

In conclusion, according to our best knowledge, there are 76 living algal collec tions (**Figure 1**), most of which are located in Europe and Asia (**Figure 2**).

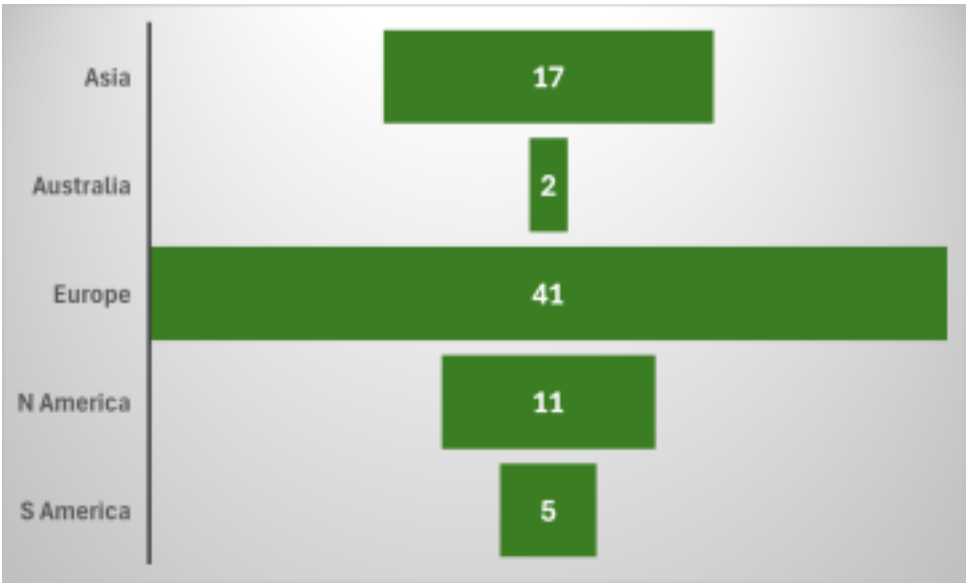

Fig. 2. Number of living algal collections in different geographic regions.

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CONFLICT OF INTERESTS

The author declare that there is no conflict of interests regarding the publication of this article.

References

Acreman C. J. 2004. The University of Toronto Culture Collection of Algae and Cyanobacteria (UTCC): A Canadian phycological resource centre. – Nova Hedwigia 79 (1-2): 135-144.

Aizdaicher N. A. 2008. Collection of marine microalgae at the A. V. Zhirmunsky institute of marine biology. – Russian Journal of Marine Biology 34 (2): 139–142.

Atıcı T. 2020. Production and collection of microalgae isolated from freshwater reserves in Central Anatolia, Turkey. – Türler ve Habitatlar 1 (1): 14–21.

Balasooriya B.L.W.K. 2019. Culture Collection of Cyanobacteria and Microalgae at Department of Biotechnology Wayamba University of Sri Lanka. Nethwin Printers Kandy, Sri Lanka, 60 pp.

Belkinova D., Kirjakov I. & Mladenov R. 2002. Catalogue of the Strains of Plovdiv Algal Culture Collection (PACC). - Travaux Scientifiques Universite de Plovdiv – Biologie, Plantarum 2 (6): 3-78.

Borisova E. & Tsarenko P. 2003. Microalgae culture collection of Ukraine. – Algological Studies 110: 143–150.

Borysova O., Tsarenko P., Konishchuk M. & Burova O. 2020. Microalgae of culture collection of IBASU-A of M. G. Kholodny Institute of Botany NAS of Ukraine. Published by the M. G. Kholodny Institute of Botany NAS of Ukraine, Kyiv, 131 pp.

Friedl T. & Lorenz M. 2012. The Culture Collection of Algae at Göttingen University (SAG): A Biological Resource for Biotechnological and Biodiversity Research. - Procedia Environmental Sciences 15: 110–117.

Friedl T. & Lorenz M. 2012. The Culture Collection of Algae at Göttingen University (SAG): A Biological Resource for Biotechnological and Biodiversity Research. - Procedia Environmental Sciences 15: 110–117.

Friedl T., Day G. D. & Preisig H. R. (Eds) 2004. Culture Collections of Algae: Increasing Assessibility and Exploring Algal Biodiversity. - Nova hedwigia 79 (1-2): 1-327.

Gachon C., Day J., Campbell C., Proschold T., Saxon R. & Kupper F. 2008. The Culture Collection of Algae and Protozoa (CCAP): A Biological Resource for Protistan Genomics. - Gene 406: 51-57.

Hamlaoui S., Yepremian C., Duval C., Marie B., Djediat C., Piquet B., Bernard C. & Duperron S. 2022. The Culture Collection of Cyanobacteria and Microalgae at the French National Museum of Natural History: A Century Old But Still Alive and Kicking! Including in Memoriam: Professor Alain Couté – Cryptogamie, Algologie 43 (3): 41-83.

Hur S. B. 2008. KMCC – Korea Marine Microalgae Culture Center: List of strains. – Algae 23 (3): 1-68.

Hur S. B., J. H. Bae, J.-Y. Youn & M. J. Jo 2015. KMCC – Korea Marine Microalgae Culture Center: List of strains. – Algae 30 (1): 1-188. Ivanova J. G., I. A. Vasileva & L. V. Kabaivanova 2020. Enhancement of Algal Biomass Accumulation Using Undiluted Anaerobic Digestate. - International Journal of Pharma Medicine and Biological Sciences 9 (3): 111-116. Kalaloutskii L. V. 1993. Microbial culture collections in Russia and the former

USSR – the current situation and future prospects. - Trends in Biotechnology 11 (11): 443–450.

Kasai F., Kawachi M., Erata M., Mori F., Yumoto K., Sato M. & Ishimoto M. 2009. NIES-Collection, List of strains 8th edition. – Japanese Journal of Phycolgy 57: 1-350.

Kawai H., Hanyuda T., Akita S. & Uwai S. 2020. The macroalgal culture collection in Kobe University (KU-MACC) and a comprehensive molecular phylogeny of macroalgae based on the culture strains. – Applied Phycology 3 (1): 159-166.

Kharchuk I. A. 2020. The Storage of Anhydrobiotic Cultures of Microalgae and Cyanobacteria of A. O. Kovalevsky Institute of Biology of the Southern Seas of RAS. – Marine Biological Journal 5 (1): 90–98.

Koreivienė J., Kasperovičienė J., Savadova K., Karosienė J. & Vitonytė I. 2016. Collection of pure cultures of algae and cyanobacteria for research, teaching and biotechnological applications (Nature Research Centre, Lithuania). – Botanica Lithuanica 22 (1): 87–92.

Leya, T. 2020. The CCCryo Culture Collection of Cryophilic Algae as a valuable bioresource for algal biodiversity and for novel, industrially marketable metabolites. - Applied Phycology 3(1): 167–188.

Lourenço S. & Vieira A. 2004. Culture collections of microalgae in Brazil: progress and constraints. – Nova Hedwigia 79 (1-2): 149—173. Luz R., Cordeiro R. I., Vilaverde J., Neto A. I., Fonseca A. & Goncalves V. 2019. Bank of Algae and Cyanobacteria of Azores (BACA) a culture collection for biotechnological and pharmaceutical research. – In: Vasconcelos V. et al (Eds), Book of abstracts, 2nd Ibero-American Cyanotoxin and the 6th Iberian Congress CIS-2019, Murcia, Spain, 3-5 Jully 2019, p. 27.

Mougin C., Artige E., Marchand F., Mondy S., Ratié C., Sellier N., Castagnone-Sereno P., D'Acier A., Esmenjaud D., Faivre-Primot C., Granjon L., Hamelet V., Lange F., Pagès S., Rimet F., Ris N. & Sallé G. 2018. BRC4Env, a network of Biological Resource Centres for research in environmental and agricultural sciences. – Environmental Science and Pollution Research 25: 33849–33857.

Olieveira C., Almeida A., Silva M., Santos I. & Dantas D. 2018. Prospecting the First Culture Collection of Algae From the Pernambuco Semiarid, Brazil. – Revista Brasileira de Engenharia de Pesca 11 (2): 27-34.

Phang S. M. & Chu W. L. 2004. The University of Malaya Algae Culture Collection (UMACC) and potential applications of a unique Chlorella from the collection. – Japanese Journal of Phycology 52: 221-224.

Pinevich A. V., Mamkaeva K. A., Titova N. N., Gavrilova O. V., Ermilova E. V. Kvitko K. V., Pljusch A. V., Voloshko L. N. & Averina S. G. 2004. St. Petersburg Culture Collection (CALU): Four devades of storage and research with microscopic algae,cyanobacteria and other microorganisms. – Hova

Hedwigia 79: 115-126.

Puncocharova M. 1990. Culture Collection of Algae at the Department of Botany, Faculty of Natural Science, Charles University in Prague (CAUP). - Archiv für Protistenkunde 138: 143-158.

Santos L. & Santos F. 2004. The Coimbra Culture Collection of Algae (ACOI). - Nova Hedwigia 79: 39-47.

Schwartzenberg K., Born□leth S., Linder A. & Dieter H. 2013. The Microalgae and Zygnematophyceae Collection Hamburg (MZCH) – Living Cultures for Research on Rare Streptophytic Algae. - Algological Studies 142: 77-107.

Shaw C., Brooke C., Hawley E., Connolly M. P., Garcia J. A., Harmon-Smith M., Shapiro N., Barton M., Tringe S. G., Glavina del Rio T., Culley D. E., Castenholz R. & Hess M. 2020. Phototrophic Co-cultures From Extreme Environments: Community Structure and Potential Value for Fundamental and Applied Research. – Frontiers in Microbiology 11. https://doi.org/10.3389/ fmicb.2020.572131

Song L., Liu Y., Gan X., Zhu Y. & Yu M. 1999. Fachb – Collection: General Introduction and the Strain List. - Acta Hydrobiologica Sinica 23 (5): 537-546.

Song L., Zhang Q., Zheng L., Liu G., Zhang X. & Zhao J. 2014. The Freshwater Algae Culture Collection at the Institute of Hydrobiology (FACHB): Algal Resources for Fundamental and Applied Research. - Algological Studies 145-146: 5–14.

Starr R. C. & Zeikus J. A. 1993. UTEX - The Culture Collection of Algae at the University of Texas at Austin 1993 LIST OF CULTURES. - Journal of Phycology 29 (2): 1– 106.

Stoyneva M. 2012. Department of Botany at the faculty of Biology of Sofia University "st. Klimnet Ohridski" during the last 30 years. - In: Petrova A. (Ed), Proceedings of the VII National Conference in Botany; 2011 29-30 September; Sofia. Sofia, Bulgarian Botanical Society, ISBN 978-954-93808-2-1, 33-42. (In Bulgarian).

Surek B. & Melkonian M. 2004. CCAC – Culture Collection of Algae at the

University of Cologne: A New Collection of Axenic Algae With Emphasis on Flagellates. - Nova Hedwigia 79: 77-92.

Temraleeva A. 2016. Cyanobacteria of Algal Collection of Soil Science Institute (ACSSI). Retrieved from https://www.gbif.org/dataset/d27fe7f2-0f22-41cb 95d0-1c0acc58887e on 28.10.2024.

Tessarolli L., Day J. & Vieira A. 2017. Establishment of a cryopreserved biobank for the Culture Collection of Freshwater Microalgae (CCMA-UFSCar), São Paulo, Brazil. – Biota Neotropica 17 (2): 1-9.

Uzunov B, Stoyneva M, Mancheva A & Gärtner G. 2012. ACUS – the new collection of living aeroterrestrial algae of Sofia University "St. Kliment Ohridski". - In: Petrova A. (Ed), Proceedings of the VII National Conference in Botany; 2011 29-30 September; Sofia. Sofia, Bulgarian Botanical Society,

ISBN 978-954-93808-2-1, 271-274 (In Bulgarian, English summ.).

Vanormelingen P., Detongre O., Chepurnova O. & Vyverman W. 2012. BCCM/DCG, a New and Dedicated Diatom Culture Collection Integrated in the Belgian Coodinated Collections of Micro-organisms. - In Sabbe K. et al. (Eds) Book of Abstracts, XXII International Diatom Symposium, Ghent, Belgium, 26-31 August 2012, p. 239.

Vaulot D., Le Gall F., Marie D., Guillou L. & Partensky F. 2004. The Roscoff Culture Collection (RCC): A Collection Dedicated to Marine Picoplankton. - Nova Hedwigia 79: 49-70.

Yuorieva N, Sinetova M, Messineva E, Kulichenko I, Fomenkov A, Vysotskaya O, Osipova E, Baikalova A, Prudnikova O, Titova M, Nosov A. V & Popova E. 2023. Plants, Cells, Algae, and Cyanobacteria In Vitro and Cryobank Collections at the Institute of Plant Physiology, Russian Academy of Sciences - A Platform for Research and Production Center. - Biology 12 (6): 838.

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