

A checklist of algae from Afghanistan

Afganistan alg türleri kontrol listesi

Abuzer Çelekli^{1*} • Mostafa Mohammadi^{1,2}

¹Department of Biology, Faculty of Art and Science, Gaziantep University, 27310, Gaziantep, Türkiye

²Department of Biology, Science Faculty, Herat University, Herat, Afghanistan

*Corresponding author: celekli.a@gmail.com

Received date: 04.04.2024

Accepted date: 24.05.2024

How to cite this paper:

Çelekli, A. & Mohammadi, M. (2024). A checklist of algae from Afghanistan. *Ege Journal of Fisheries and Aquatic Sciences*, 41(2), 126-141. <https://doi.org/10.12714/egejfas.41.2.06>

Abstract: This first comprehensive checklist of algae from freshwater and soil in Afghanistan is a significant milestone in understanding the country's biodiversity. It is the result of a collaborative effort by researchers from various institutions. It comprises 398 species belonging to 132 genera and five phyla of algae, with samples collected from 19 regions of Afghanistan. The *Nitzschia* and *Navicula* genera have the most significant number of species. The checklist also highlights the sensitivity and threatened status of certain species, such as *Achnanthydium gracillimum* (F. Meister) Lange-Bertalot, *Brachysira seriens* (Brébisson) Round & D.G. Mann, *Diploneis ovalis* (Hilse) Cleve, *Eunotia praerupta* Ehrenberg, *Eucocconeis flexella* (Kützing) F. Meister. The currently accepted name of species, biological condition gradient of species, the status of species in the Red List of Germany, and trophic weight of some diatom species according to two diatom trophic indices were defined in the checklist. This study is a new start for this field of study and intends to provide the groundwork for further research, which will aid in the work of others interested in this topic.

Keywords: Biodiversity, diatoms, biological condition gradient, species

Öz: Afganistan'daki tatlı su ve topraklardan alınan alglerin ilk kapsamlı kontrol listesi, ülkenin biyolojik çeşitliliğini anlamamızda önemli bir dönüm noktasıdır. Çeşitli kurumlardan araştırmacıların verileri ile oluşturulan bu çalışma, Afganistan'ın 19 bölgesinden toplanan örneklerle 132 cinse ve beş bölüme ait 398 türü kapsamaktadır. *Nitzschia* ve *Navicula* cinsleri en fazla türe sahip olan cinslerdir. Liste ayrıca, *Achnanthydium gracillimum* (F. Meister) Lange-Bertalot, *Brachysira seriens* (Brébisson) Round & D.G. Mann, *Diploneis ovalis* (Hilse) Cleve, *Eunotia praerupta* Ehrenberg, *Eucocconeis flexella* (Kützing) F. Meister gibi bazı türlerin hassasiyetini ve tehdit durumunu vurgulamaktadır. Kontrol listesinde türlerin güncel kabul edilen isimleri, biyolojik durum gradyanları, Almanya'nın Kırmızı Listesi'ndeki durumları ve iki diyatome trofik indeksine göre bazı diyatome türlerinin trofik ağırlıkları tanımlanmıştır. Bu çalışma, bu alandaki araştırmalar için yeni bir başlangıç olup, bu konuyla ilgilenen diğer araştırmacıların çalışmalarına temel sağlamayı amaçlamaktadır.

Anahtar kelimeler: Biyoçeşitlilik, diyatome, biyolojik durum derecesi, türler

INTRODUCTION

Algae are the most important primary producers in both freshwater and marine habitats. They play a significant role in regulating the ocean's silicon cycle and are known as the fastest-growing organisms; algae are crucial organisms that play important roles, ranging from freshwater to oceans, and are involved in various significant fields, from biocatalysts in space research and water quality assessments to sustainable development efforts. (Çelekli and Zariç, 2024a, 2024b; Yool and Tyrrell, 2003; Zariç and Çelekli, 2024). Environmental monitoring has become increasingly important under changing environmental conditions (Çelekli and Zariç, 2023a). Algae are valuable for taxonomists and ecologists in monitoring archaeological and present environmental conditions (Çelekli et al., 2023; Zariç et al., 2024). They are often utilized in water quality investigations because they are sensitive to environmental factors such as water acidification, eutrophication, and climate change; among algae, diatoms have also been utilized as helpful indicators to assess water quality (Çelekli and Zariç, 2023b; Van Dam et al., 1994) Smol and Stoermer, 2010; Schlüter et al., 2012; Çelekli et al., 2023). Diatom communities help evaluate how ecological conditions vary over time and between sites. These species are widely distributed throughout habitats on the Earth; they are trusted

biological indicators that are used to analyze extensive environmental data (Rott et al., 1999; Della Bella et al., 2012; Delgado and Pardo, 2015; Çelekli et al., 2019).

A checklist can deliver a great deal of knowledge with little work. Until a specific date, checklists represent taxonomic knowledge found in the literature. The list of species names may not be based on accurate taxonomic information for species without recent taxonomic revisions, and downstream conclusions may be inaccurate. The only precise method to handle each species' nomenclature status is through taxonomic revisions (Dayrat, 2011). It is necessary to make a collective vision for taxonomy, systematics, and biodiversity to realize it by utilizing existing and upcoming resources. The connection between floras, checklists, and biodiversity studies is crucial for accessing up-to-date information. Collaborating with taxonomy societies can help establish a unified network of flora and fauna sites. Taxonomists should actively engage in global initiatives to interconnect and share data (Funk, 2006). Checklists play a vital role as they provide a systematic compilation of species from specific regions, offering valuable insights for biodiversity conservation, ecological research, and environmental assessment and monitoring. For these reasons,

numerous checklists (Singh et al., 2023; Bacci et al., 2024; Álvarez et al., 2023; Daniel et al., 2023) have been reported from various ecoregions.

There are several checklists available for Afghanistan's flora and fauna. For example, a thorough inventory of the plant species in the area is provided by the checklist of vascular plants (Breckle et al., 2013). Wagner et al. (2016) reported that a checklist of reptiles and amphibians records the diversity of these particular species. Additionally, research and inventory of big animals from Afghanistan's eastern woodlands provide light on the existence and range of critical mammalian species (Stevens et al., 2011). These checklists help study and preserve Afghanistan's biodiversity and are essential tools for academics and conservationists.

The first publication about the algae of Afghanistan was published in 19. century (Schaarschmidt, 1884). A taxonomic study of diatoms was published (Foged, 1959). Unfortunately, no significant research and articles on this subject have been published since then. As per the available data, algae are employed extensively in scientific research to examine the condition of several aquatic habitats. Unfortunately, Afghanistan has had several difficulties that have prevented published checklists for algae from reaching the nation for many years. This lack of data creates a big hole in the field. As a result, attempts are underway to create an exhaustive catalog of algae unique to Afghanistan. The primary aim of this

investigation was to compile data on the algal species that have been documented in Afghanistan. Additionally, new taxonomies were created, and significant traits were identified. This study is a new start for this field of study and intends to provide the groundwork for further research, which will aid in the work of others interested in this topic. Through further study within the borders of Afghanistan, we are dedicated to adding to this checklist.

MATERIALS AND METHODS

Study of area

According to hydrological characteristics, Afghanistan has five major river basins, including the Kabul (Indus) River Basin, Amu-Darya River Basin, Northern River Basin, Hari Rud-Murghab River Basin, and Helmand River Basin (Hayat and Tayfur, 2023). Numerous algae species collected in the current checklist were obtained from stations in these river basins. Most species documented in the checklist have been reported from 19 locations in Afghanistan (Figure 1). Due to the lack of data on the coordinates of the sampling stations in the sources, it was not easy to define the exact location of the sampling stations. For this reason, the sampling stations are shown as approximate in Figure 1 from S1 to S19 (Table 1). There were several species whose sampling location was not clearly explained or named by the researcher, so a separate column was created in the checklist table to identify them.

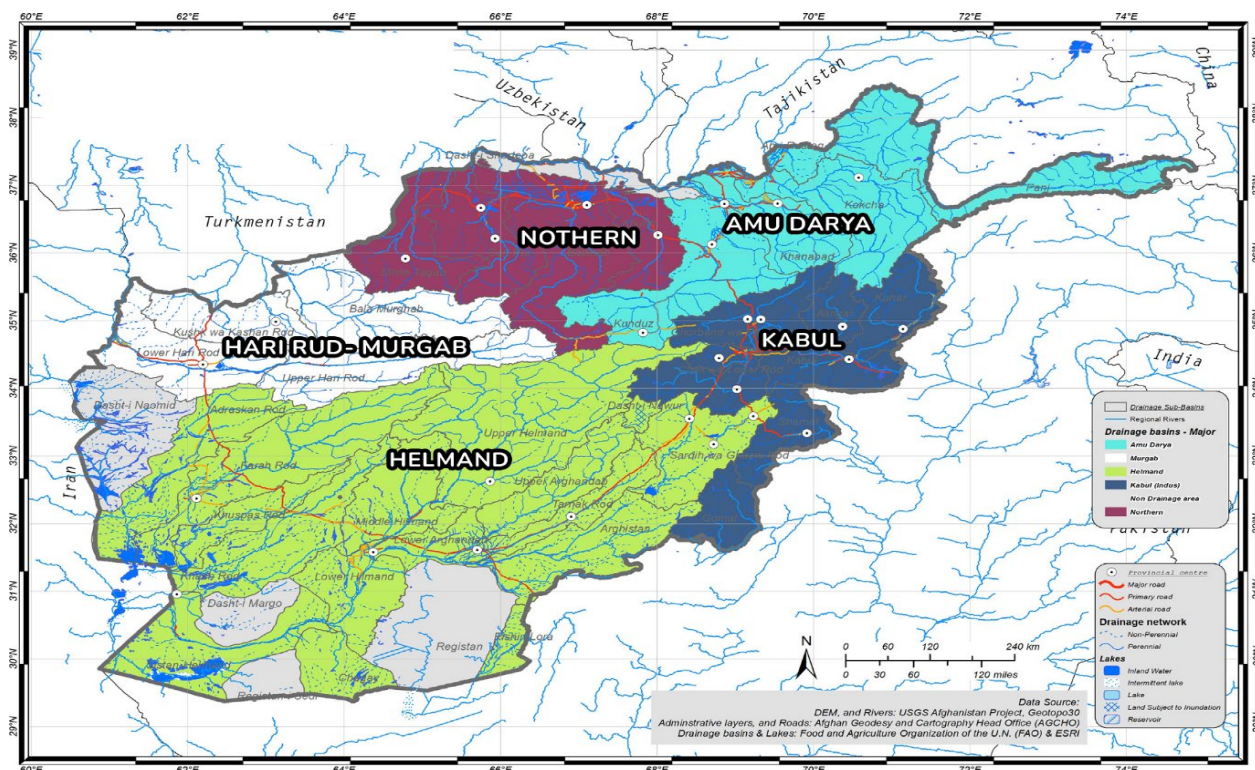


Figure 1. Map of Afghanistan River Basins: Hari-Rud River Basin, Helmand River Basin, Northern River Basin, Amu Darya River Basin, Kabul River Basin. The species documented in the checklist from different water bodies in Afghanistan (Ahlers et al., 2014)

Table 1. The full names of the sampling stations are shown in Figure 1, which are called S1 to S19

Code	Name of locations	Code	Name of locations
S1	Murghab-Maimana River	S11	Panjao small River
S2	Qala Nau-Murghab River	S12	Band-i Amir (Lake)
S3	Upper Hari Rud River Basin1	S13	Upper Helmand (Farakulum) River2
S4	Upper Hari Rud River Basin2	S14	Upper Helmand (Hauz-i-Mahiha) River3
S5	Shin Dand (Sabzwar) River	S15	Sar-i Chasma Stream1
S6	Dilaram (Khash Rud) River	S16	Sar-i Chasma Stream2
S7	Upper Helmand River1	S17	Andarab River
S8	Girishk River	S18	Panjshir River
S9	Lal-i-Sarjangel River	S19	Nuristan Stream
S10	Mokur Canal		

Extensive efforts were made to gather pertinent papers and information from many reliable sources to create a checklist of algae that have been identified and studied in Afghanistan up to this point. The most recent and correct information on the recognized names of species was checked according to the currently accepted taxonomic names in the [Algaebase \(2024\)](#). Furthermore, the [Diatoms of North America \(2024\)](#) and [RoteListe \(2024\)](#) websites were utilized as additional resources to define the Biological Condition Gradient (BCG) and determine the threatened status of species (Red List). These websites offered valuable insights into the ecological status and conservation concerns associated with species. The checklist is attached in [Appendix 1](#).

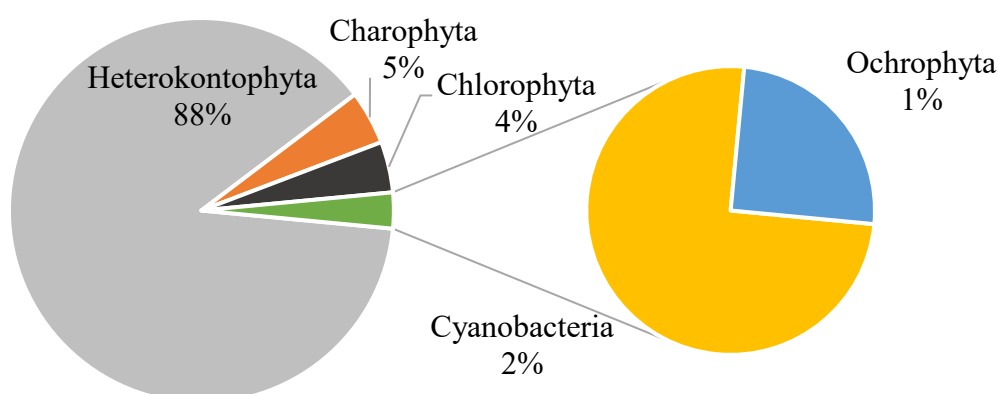
Assessment of species sensitivity and threat status

We employed specific methods and criteria to examine species sensitivity and identify highly threatened species. The Biological Condition Gradient (BCG) framework evaluated

species sensitivity based on their ecological requirements and responses to environmental stressors. The criteria included habitat specificity, pollution tolerance, and reproductive capacity. The threatened status of species was determined using the Red List categories provided by the [RoteListe \(2024\)](#) website. This approach allowed us to systematically classify species into different threat levels, ranging from least concern to critically endangered. Detailed assessments and justifications for each species' sensitivity and threat status are documented in the checklist.

RESULTS

The checklist included 398 algal species from 132 genera and five phyla (Appendix 1). Heterokontophyta had the highest species (351 sp), followed by Charophyta (18 sp), Chlorophyta (17 sp), Cyanobacteria (9 sp), and Ochrophyta (3 sp). Their percentages are given in [Figure 2](#). The highest number of species is related to the *Nitzschia* and *Navicula* genera.

**Figure 2.** Percentages of phyla in the checklist

DISCUSSION

The currently accepted species names were checked according to the [Algaebase \(2024\)](#), documented in the checklist ([Appendix 1](#)) due to the possibility of changing some species' scientific and old names.

Some diatom species were commonly found in Afghanistan, like *Achnanthydium minutissimum*, *Caloneis leptosome*, *Cymbella neoleptoceros*, *Diatomella balfouriana*, *Encyonopsis microcephala*, *Mastogloia smithii*, *Muelleria gibbula*, *Navicula ramosissima*, and *Ulnaria ulna*. Some of these species have a widespread distribution and were reported from different ecoregions as dominant taxa. Intense Ulnaria ulna was reported as the dominant species from the Patagonian River in Argentina ([Espinosa et al., 2020](#)). Aras River in Northwestern Iran ([Parikhani et al., 2023](#)), and also *Achnanthydium minutissimum* was defined as the dominant species in the Sava River ([Zelnik and Sušin, 2020](#)) and Kordan River in Iran ([Adl et al., 2020](#)).

A few diatom species, such as *Denticula thermalis*, *Pinnularia kneuckeri*, and *Stauroneis agrestis*, are scarce. *Achnanthydium minutissimum*, *Brachysira serians*, *Cymbella affinis*, *Diploneis ovalis*, *Eucoconeis flexella*, *Eunotia praerupta*, *Euastrum spinulosum*, *Psammothidium ventrale* are in highly threatened and *Cymbella helvetica*, *Encyonema perpusillum*, *Closterium cornu*, *Cosmarium contractum*, *Cosmarium pyramidatum*, *Cosmarium undulatum*, *Desmidium quadratum* are in threatened in the checklist (for more see [Appendix 1](#)). Unfortunately, *Cymbella latens*, with the currently accepted name of *Encyonema latens* (Krasske) D.G. Mann reported by [Foged \(1959\)](#) from the country, has been extinct or lost ([RoteListe, 2024](#)).

A further feature of this checklist is the availability of BCG of most of the species included in the checklist, which were discovered and included in the checklist from reliable sources. The [Diatoms of North America \(2024\)](#) website and the paper of [Hausmann et al. \(2016\)](#) were used extensively to find the BCG of diatoms species. Many of species in the checklist such as *Tabellaria fenestrata*, *Sellaphora bacillum*, *Reimeria sinuata*, *Meridion circulare*, *Hannaea arcus*, *Grunowia sinuate*, *Genkalia digitulus*, *Fragilariforma virescens*, *Eunotia rhomboide*, *Epithemia turgida*, *Denticula tenuis*, and *Cymbella aspera* are in level 2 of BCG (BCG = 2). This means that their environments were in natural status with minimum changes. Conversely, there are several species, for example, *Bacillaria paxillifera*, *Craticula accomoda*, *Cyclotella comata*, *Gyrosigma attenuatum*, *Halamphora veneta*, *Hippodonta hungarica*, *Navicula cincta*, *Navicula peregrina*, *Navicula tripunctata*, *Nitzschia amphibia*, *Nitzschia communis*, *Nitzschia microcephala*, *Nitzschia palea*, *Surirella ovalis*, *Tryblionella hungarica* were defined in level five of BCG (BCG = 5). This matter shows that some of the taxa in the checklist had lived in ecosystems with significant changes ([Hausmann et al., 2016](#); [Gerritsen et al., 2017](#); [Paul et al., 2020](#); [Diatoms of North America, 2024](#)).

Endemic species such as; *Cymbella farakulumensis*,

Cymbella helmandensis, *Cymbella panjaoensis*, *Cymbella sabzewarensis*, *Gomphonema farakulumensis*, *Navicula anderabensis*, *Navicula chasmaensis*, *Navicula farakulumensis*, *Navicula helmandensis*, and *Nitzschia anderabensis* were documented in the checklist ([Foged, 1959](#)). These species need to more investigation.

Trophic conditions are among the most crucial factors influencing the freshwater diatom habitats in rivers and lakes ([Besse-Lototskaya et al., 2011](#)). TI and TIT have been widely used in recent decades to evaluate running water ecosystems and surface water quality. For this reason, we have included the TI and TIT trophic weight of diatom species that were available in the checklist ([Rott et al., 1999](#); [Çelekli et al., 2019](#)). In the checklist, there are many pollution-sensitive species, such as *Achnanthes coarctata*, *Achnanthydium minutissimum*, *Cymbella affinis*, and *Eunotia parallela*, and pollution-tolerant species, such as *Nitzschia paleacea*, *Nitzschia palea*, *Nitzschia pamirensis*, *Nitzschia nana*, and *Gomphonema parvulum* according to the trophic weight of diatom species in TI-Trophic Index ([Rott et al., 1999](#)) and TIT-Trophic Index Turkey ([Çelekli et al., 2019](#)).

As a comprehensive study for the first time, forty specimens of diatoms from the territory of Afghanistan (fresh and slightly saline water) were collected by the third Danish Central Asiatic Expedition in 1948-1949. Diatoms in the samples have been investigated. It has been attempted to determine every sample's pH and halation spectra to evaluate the locales' ecological status. All diatom species discovered in the material were listed, along with information about how frequently they occur in the samples and their most notable ecological relationships. Information including diagnoses of 17. nov. spec. 13 plates with 201 figure drawings from the Afghan material of diatoms were collected, and the result was published as a helpful book titled *Diatoms from Afghanistan* ([Foged, 1959](#)). Apart from this study, a comprehensive study in this field has not been published in the country. This book was a beneficial and contributing source for us to prepare the current checklist.

Although the number of species covered in this checklist is limited owing to a lack of resources, it includes species ultimately confirmed and recognized in the country. Most of these species have been reported from streams and rivers, but some species have been sampled from soil habitats. In the checklist, a column is titled the species' habitat, and the soil habitat is marked with an asterisk ([Schaarschmidt, 1884](#); [Foged, 1959](#); [Rahmatzai et al., 2016](#)).

In this study, we utilized autecological parameters derived from predominantly European studies. It is important to note that the ecological characteristics of these taxa may differ in Afghan ecosystems, and caution should be exercised when interpreting these parameters.

CONCLUSION

Owing to the myriad challenges Afghanistan has faced over recent decades, there has been a significant lack of

scientific research on ecological studies, species distribution, and detailed taxonomy. Consequently, the country has seen very limited studies focused on algae. There has not been a published checklist of diatom and algae species in the nation in recent decades. The current checklist includes 398 species of diatoms and algae from 132 different genera and five phyla collected from reliable sources. Most of these species were reported from 19 stations in Afghanistan. The currently accepted name of species, BCG of species, the status of species in the Red List of Germany, and trophic weight of some diatom species according to TIT and TI were defined in the Checklist. Some species in the checklist, such as *Pantocsekiella kuetzingiana*, *Pinnularia appendiculata*, *Planothidium lanceolatum*, *Surirella ovalis*, and *Cosmarium granatum*, are not threatened. Eight species (*Caloneis leptosoma*, *Cymbopleura similis*, *Diatomella balfouriana*, *Eunotia rhomboidei*, *Eunotia tenella*, *Fallacia vitrea*, *Muelleria gibbula*, and *Planothidium hauckianum*) are under threat of unknown extent according to the Red List of Germany in the checklist. This study not only fills a significant gap in Afghanistan's existing ecological and taxonomical data but also underscores the broader implications for biodiversity conservation and management. The checklist is critical for future researchers and conservationists aiming to protect and preserve Afghanistan's unique aquatic ecosystems. Future research should prioritize comprehensive surveys and advanced taxonomic studies to further document and understand Afghanistan's biodiversity of diatoms and algae. By

expanding the scope of this research, we can better inform conservation strategies and contribute to global efforts in biodiversity preservation. This study marks a new beginning for this field of study and aims to lay the framework for future research, which will benefit the work of others interested in this topic. We are committed to expanding this checklist with additional research within Afghanistan's boundaries. Ultimately, the continuation and expansion of this research will enhance our understanding of Afghanistan's ecological richness and support global biodiversity records and conservation initiatives.

AUTHOR CONTRIBUTION STATEMENT

Abuzer Çelekli and Mostafa Mohammadi designed the overall work.

ETHICAL APPROVAL

There is no need for ethical approval for this study.

FUNDING STATEMENT

The authors do not declare any funds.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

Data used in this study are available from the corresponding author upon reasonable request.

REFERENCES

- Adl, M.M., Iranbakhsh, A., Noroozi, M., Asri, Y., & Saadatmand, S. (2020). Epipelagic diatoms flora of Kordan River, Alborz province in Iran. *Modern Phytomorphology*, 14, 40–48.
- Ahlers, R., Brandimarte, L., Kleemans, I., & Sadat, S.H. (2014). Ambitious development on fragile foundations: Criticalities of current large dam construction in Afghanistan. *Geoforum*, 54, 49–58. <https://doi.org/10.1016/j.geoforum.2014.03.004>
- Algaebase (2024). Listing the World's Algae. <https://www.algaebase.org>
- Álvarez, Y., Fernández, D.M., Minno, M.C., & Núñez, R. (2023). The butterflies (Lepidoptera: Papilionoidea) of the Nipe-Sagua-Baracoa mountains: a preliminary checklist of the most biodiverse Cuban region. *Tropical Lepidoptera Research*, 50–63.
- Bacci, T., Targusi, M., Lattanzi, L., Marusso, V., Trabucco, B., & Tomassetti, P. (2024). Decapod crustacean records from a collection of marine soft-bottom macrofauna of the Italian waters supporting the update of checklists and registers of the Mediterranean basin. *Diversity*, 16(1), 2, 1–18. <https://doi.org/10.3390/d16010002>
- Besse-Lototskaya, A., Verdonshot, P.F.M., Coste, M., & Van de Vijver, B. (2011). Evaluation of European diatom trophic indices. *Ecological Indicators*, 11(2), 456–467. <https://doi.org/10.1016/j.ecolind.2010.06.017>
- Breckle, S.W., Hedge, I.C., & Rafiqpoor, M.D. (2013). Vascular plants of Afghanistan: An augmented check-list. In A. Dittmann (Ed.). *Bonn: Scientia Bonnensis*, 598 pp. Hardback. ISBN 978 3 94076664 9
- Çelekli, A., Sidar, Y., & Zariç, Ö.E. (2023). Lakes of Turkey: Comprehensive review of Lake Abant. *Acta Aquatica Turcica*, 19(4), 368–380. <https://doi.org/10.22392/actaqua.1272430>
- Çelekli, A., Toudjani, A., Gümüç, E.Y., Kayhan, S., Lekesiz, H., & Cetin, T. (2019). Determination of trophic weight and indicator values of diatoms in Turkish running waters for water quality assessment. *Turkish Journal of Botany*, 43(1), 90–101. <https://doi.org/10.3906/bot-1704-40>
- Çelekli, A., & Zariç, Ö. (2023a). Utilization of herbaria in ecological studies: biodiversity and landscape monitoring. *Herbarium Turcicum*. Advance Online Publication. <https://doi.org/10.26650/ht.2023.1345916>
- Çelekli, A., & Zariç, Ö.E. (2023b). From emissions to environmental impact: understanding the carbon footprint. *International Journal of Environment and Geoinformatics*, 10(4), 146–156. <https://doi.org/10.30897/ijegeo.1383311>
- Çelekli, A., & Zariç, Ö.E. (2024a). Breathing life into Mars: Terraforming and the pivotal role of algae in atmospheric genesis. *Life Sciences in Space Research*, 41, 181–190. <https://doi.org/10.1016/j.lssr.2024.03.001>
- Çelekli, A., & Zariç, Ö.E. (2024b). Plasma-enhanced microalgal cultivation: a sustainable approach for biofuel and biomass production. In A. Shahzad & M. He (Eds.), *Emerging Applications of Plasma Science in Allied Technologies* (p. 300). IGI Global. <https://doi.org/10.4018/979-8-3693-0904-9>
- Daniel, G.M., Strümpher, W.P., & Josso, J.-F. (2023). Dung beetle fauna from Mount Mabu, Mozambique. Part 1: A new species of *Onthophagus* Latreille, 1802, and a checklist of species belonging to group 3 (d'Orbigny 1913)(Coleoptera: Scarabaeidae: Scarabaeinae). *Zootaxa*, 5258(4), 429–442. <https://doi.org/10.11646/zootaxa.5258.4.4>
- Dayrat, B. (2011). A warning for ecologists and conservation biologists using species checklists: How the European marine fauna 'lost' all of its 16 *Discodoris* species (Mollusca: Gastropoda). *Organisms Diversity & Evolution*, 11, 75–82.
- Delgado, C., & Pardo, I. (2015). Comparison of benthic diatoms from Mediterranean and Atlantic Spanish streams: community changes in relation to environmental factors. *Aquatic Botany*, 120, 304–314. <https://doi.org/10.1016/j.aquabot.2014.09.010>
- Della Bella, V., Pace, G., Barile, M., Zedde, A., Puccinelli, C., Ciadamidaro, S., Danieli, P.P., Andreani, P., Aulicino, F.A., Belfiore, C., & Mancini, L.

- (2012). Benthic diatom assemblages and their response to human stress in small-sized volcanic-siliceous streams of central Italy (Mediterranean eco-region). *Hydrobiologia*, 695, 207-222. <https://doi.org/10.1007/s10750-012-1195-9>
- Diatoms of North America (2024). Diatoms of North America is a collaborative work in progress, growing and changing as science advances. <https://diatoms.org>
- Espinosa, M.A., Vélez-Agudelo, C., & Isla, F.I. (2020). Diatom responses to natural and anthropogenic environmental changes in a Patagonian river, Argentina. *Journal of South American Earth Sciences*, 102, 102677. <https://doi.org/10.1016/j.jsames.2020.102677>
- Foged, N. (1959). Diatoms from Afganistan. *Biologiske Skrifter Udgivet Af Det Kingelige Danske Videnskaberne Selskab*, 11(1), 1–95.
- Funk, V.A. (2006). Floras: a model for biodiversity studies or a thing of the past? *Taxon*, 55(3), 581–588. <https://doi.org/10.2307/25065635>
- Gerritsen, J., Bouchard Jr, R.W., Zheng, L., Leppo, E.W., & Yoder, C.O. (2017). Calibration of the biological condition gradient in Minnesota streams: a quantitative expert-based decision system. *Freshwater Science*, 36(2), 427–451. <https://doi.org/10.1086/691712>
- Hausmann, S., Charles, D.F., Gerritsen, J., & Belton, T.J. (2016). A diatom-based biological condition gradient (BCG) approach for assessing impairment and developing nutrient criteria for streams. *Science of the Total Environment*, 562, 914-927. <https://doi.org/10.1016/j.scitotenv.2016.03.173>
- Hayat, E., & Tayfur, G. (2023). Meteorological drought and trend effects on transboundary river basins in Afghanistan. *Theoretical and Applied Climatology*, 154(3), 1253–1275. <https://doi.org/10.1007/s00704-023-04602-1>
- Parikhani, F., Atazadeh, E., Razeghi, J., Mosafieri, M., & Kulikovskiy, M. (2023). Using Algal Indices to Assess the Ecological Condition of the Aras River, Northwestern Iran. *Journal of Marine Science and Engineering*, 11(10), 1867. <https://doi.org/10.3390/jmse11101867>
- Paul, M.J., Jessup, B., Brown, L.R., Carter, J.L., Cantonati, M., Charles, D.F., Gerritsen, J., Herbst, D.B., Stancheva, R., Howard, J., Isham, B., Lowe, R., Mazor, R.D., Mendez, P.K., Ode, P.R., O'Dowd, A., Olson, J., Pan, Y., Rehn, A.C.,..... & Theroux, S. (2020). Characterizing benthic macroinvertebrate and algal biological condition gradient models for California Wadeable Streams, USA. *Ecological Indicators*, 117, 106618. <https://doi.org/10.1016/j.ecolind.2020.106618>
- Rahmatzai, N., Habibi, A., Akmuhanova, N.R., Zayaadan, B.K., Sadvakasova, A.K., & Baizhigitova, A. (2016). The soil algal flora as bio-indicators of the soil condition in the Baghlan region (Afghanistan). *International Journal of Biology and Chemistry*, 9(2), 11–16. <https://doi.org/10.26577/2218-7979-2016-9-2-11-16>
- RoteListe (2024). Arzneimittelinformationen für Deutschland. <https://www.rote-liste.de>
- Rott, E., Pipp, E., Pfister, P., van Dam, H., Ortler, K., Binder, N., & Pall, K. (1999). Indikationslisten für Aufwuchsalgen in österreichischen Fließgewässer Trophieindikation (sowie geochemische Präferenzen, taxonomische und toxikologische Anmerkungen). *Bundesministerium Für Land-Und Forstwirtschaft, Wasserwirtschaftskataster, Wien*, 248 pp.
- Schaarschmidt, J. (1884). Notes on Afghanistan algae. *Botanical Journal of the Linnean Society*, 21(134), 241–250. <https://doi.org/10.1111/j.1095-8339.1884.tb00542.x>
- Schlüter, M.H., Kraberg, A., & Wiltshire, K.H. (2012). Long-term changes in the seasonality of selected diatoms related to grazers and environmental conditions. *Journal of Sea Research*, 67(1), 91–97. <https://doi.org/10.1016/j.seares.2011.11.001>
- Singh, R., Khan, A.A., & Khan, A.A. (2023). An updated checklist of the spider fauna (Arachnida: Araneae) in different districts of Gujarat state, India. *Serket*, 19(2).
- Smol, J.P., & Stoermer, E.F. (2010). *The diatoms: applications for the environmental and earth sciences*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511763175>
- Stevens, K., Dehgan, A., Karlstetter, M., Rawan, F., Tawhid, M.I., Ostrowski, S., Ali, J.M., & Ali, R. (2011). Large mammals surviving conflict in the eastern forests of Afghanistan. *Oryx*, 45(2), 265–271. <https://doi.org/10.1017/S0030605310000517>
- Van Dam, H., Mertens, A., & Sinkeldam, J. (1994). A coded checklist and ecological indicator values of freshwater diatoms from the Netherlands. *Netherlands Journal of Aquatic Ecology*, 28, 117–133. <https://doi.org/10.1007/BF02334251>
- Wagner, P., Bauer, A.M., Leviton, A.E., Wilms, T.M., & Böhme, W. (2016). *A Checklist of the Amphibians and Reptiles of Afghanistan*.
- Yool, A., & Tyrrell, T. (2003). Role of diatoms in regulating the ocean's silicon cycle. *Global Biogeochemical Cycles*, 17(4), 1103. <https://doi.org/10.1029/2002GB002018>
- Zariç, Ö.E., & Çelekli, A. (2024). Biotechnological Potential of Algae in Sustainable Development. *3rd International Conference on Engineering, Natural and Social Sciences*.
- Zariç, Ö.E., Çelekli, A., & Yaygır, S. (2024). Lakes of Turkey: Comprehensive review of Lake Çıldır. *Aquatic Sciences and Engineering*, 39(1), 54–63. <https://doi.org/10.26650/ASE20241353730>
- Zelink, I., & Sušin, T. (2020). Epilithic diatom community shows a higher vulnerability of the river sava to pollution during the winter. *Diversity*, 12(12), 465. <https://doi.org/10.3390/d12120465>

Appendix 1. The checklist of algae from Afghanistan. Red list (RL), Extinct or Lost (0), Threatened with Extinction (1), Highly Threatened (2), Threatened (3), Threat of Unknown Extent (G), Extremely Rare (R), Near Threatened (V), Not Threatened (*), Data Deficient (D), Not established (-), (RoteListe, 2024). BCG (biological condition gradient); BCG scores means: 1. Native or natural condition - 2. Minimal loss of species; some density changes may occur - 3. Some replacement of sensitive-rare species; functions fully maintained - 4. Some sensitive species maintained but notable replacement by more-tolerant taxa; altered distributions; functions largely maintained - 5. Tolerant species show increasing dominance; sensitive species are rare; functions altered - 6. Severe alteration of structure and function.

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rud1)	Band-i Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lal-i-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmatshir and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahiha	Upper Helmand Rud2 (Farakulum)	indeterminate sampling place country	RL	BCG		
Heterokontophyta	<i>Achnanthes coarctata</i>	<i>Achnanthes coarctata</i> (Brébisson ex W.Smith) Grunow																								
	<i>Achnanthes okamuræ</i>	<i>Achnanthes okamuræ</i> Skvortzov																								
	<i>Achnanthes pseudolinearis</i>	<i>Achnanthes pseudolinearis</i> Hustedt																								
	<i>Achnanthes affinis</i>	<i>Achnantheidium affine</i> (Grunow) Czarniecki																								
	<i>Achnanthes linearis</i>	<i>Achnantheidium lineare</i> W.Smith																								
	<i>Achnanthes microcephala</i>	<i>Achnantheidium minutissimum</i> (Kützing) Czarniecki	+			+																				
	<i>Achnanthes pyrenaica</i>	<i>Achnantheidium pyrenaicum</i> (Hustedt) H.Kobayasi																								
	<i>Navicula aquaeductae</i>	<i>Adlafia aquaeductae</i> (Krasske) Lange-Bertalot																								
	<i>Navicula bryophila</i>	<i>Adlafia bryophila</i> (J.B.Petersen) Lange-Bertalot																								
	<i>Amphipleura pellucida</i>	<i>Amphipleura pellucida</i> (Kützing) Kützing																								
	<i>Amphora lineolata</i>	<i>Amphora lineolata</i> (Ehrenberg) Ehrenberg																								
	<i>Amphora mutabunda</i>	<i>Amphora mutabunda</i> Manguin																								
	<i>Amphora ovalis</i>	<i>Amphora ovalis</i> (Kützing) Kützing																								
	<i>Navicula tuscula</i>	<i>Aneumastus tusculus</i> (Ehrenberg) D.G.Mann & A.J.Stickle																								
	<i>Anomoeoneis sphaerophora</i>	<i>Anomoeoneis sphaerophora</i> Pfizter																								
	<i>Asterionella formosa</i>	<i>Asterionella formosa</i> Hassall																								
	<i>Asterionella gracillima</i>	<i>Asterionella tekellii</i> D.M.Williams, T.M.Schuster, E.Cesar & Jüthner																								
	<i>Melosira granulata</i>	<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen																								
	<i>Melosira italica</i>	<i>Aulacoseira italica</i> (Ehrenberg) Simonsen																								
	<i>Bacillaria paradoxa</i>	<i>Bacillaria paxillifera</i> (O.F.Müller) T.Marsson																								
	<i>Anomoeoneis exilis</i>	<i>Brachysira exilis</i> (Kützing) Round & D.G.Mann																								
	<i>Anomoeoneis serians</i>	<i>Brachysira serians</i> (Brébisson) Round & D.G.Mann																								
	<i>Cymbella lanceolata</i>	<i>Brebissonia lanceolata</i> (C.Agardh) R.K.Mahoney & Reimer																								
	<i>Caloneis alpestris</i>	<i>Caloneis alpestris</i> (Grunow) Cleve																								
	<i>Caloneis bacillum</i>	<i>Caloneis bacillum</i> (Grunow) Cleve																								
	<i>Caloneis beccariana</i>	<i>Caloneis beccariana</i> (Grunow) Grunow ex Cleve																								
	<i>Caloneis macedonica</i>	<i>Caloneis budensis</i> (Grunow) Krammer																								
	<i>Caloneis clevei</i>	<i>Caloneis clevei</i> (Lagerstedt) Cleve																								
	<i>Caloneis desertorum</i>	<i>Caloneis desertorum</i> Hustedt																								
	<i>Caloneis fasciata</i>	<i>Caloneis fasciata</i> (Lagerstedt) Cleve																								
	<i>Pinnularia leptosoma</i>	<i>Caloneis leptosoma</i> (Grunow) Krammer																								
	<i>Navicula limosa</i>	<i>Caloneis limosa</i> (Kützing) R.M.Patrick																								
<i>Pinnularia molaris</i>	<i>Caloneis molaris</i> (Grunow) Krammer																									
<i>Caloneis permagna</i>	<i>Caloneis permagna</i> (Bailey) Cleve																									
<i>Caloneis schumanniana</i>	<i>Caloneis schumanniana</i> (Grunow) Cleve																									
<i>Caloneis silicula</i>	<i>Caloneis silicula</i> (Ehrenberg) Cleve																									
<i>Pinnularia undulata</i>	<i>Caloneis undosa</i> Krammer																									
<i>Navicula cocconeiformis</i>	<i>Cavinula cocconeiformis</i> (W.Gregory ex Greville) D.G.Mann & A.J.Stickle																									
<i>Navicula variostrata</i>	<i>Cavinula variostrata</i> (Krasske) D.G.Mann & A.J.Stickle																									
<i>Navicula begeri</i>	<i>Chamaepinnularia begeri</i> (Krasske) Lange-Bertalot																									

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rud1)	Band-i Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzewan) River	Girishk River	Andarab River	Dilaram River (The Khaash Rud)	Mokur Canal	Lah-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaishir and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahiha	Upper Helmand Rud2 (Farakulum)	Indeterminate sampling place country	RL	BCG		
Heterokontophyta	<i>Navicula ignobilis</i>	<i>Chamaepinnularia krookii</i> (Grunow) Lange-Bertalot & Krammer																					+	R	-	
	<i>Cocconeis diminuta</i>	<i>Cocconeis neodiminuta</i> Krammer																					+	*	3	
	<i>Cocconeis thumensis</i>	<i>Cocconeis neothumensis</i> Krammer																					+	*	-	
	<i>Cocconeis pediculus</i>	<i>Cocconeis pediculus</i> Ehrenberg				+	+											+					*	4		
	<i>Cocconeis placentula</i>	<i>Cocconeis placentula</i> Ehrenberg	+																					D	4	
	<i>Cocconeis scutellum</i>	<i>Cocconeis scutellum</i> Ehrenberg					+		+	+	+												*	-		
	<i>Navicula accomoda</i>	<i>Craticula accomoda</i> (Hustedt) D.G.Mann																					+	*	5	
	<i>Navicula ambigua</i>	<i>Craticula ambigua</i> (Ehrenberg) D.G.Mann				+	+																*	-		
	<i>Navicula cuspidata</i>	<i>Craticula cuspidata</i> (Kützing) D.G.Mann																+					*	4		
	<i>Navicula halophila</i>	<i>Craticula halophila</i> (Grunow) D.G.Mann					+																*	4		
	<i>Navicula simplex</i>	<i>Craticula simplex</i> (Kraske) Levkov																					+	-	-	
	<i>Navicula molesta</i>	<i>Craticula zizix</i> (VanLandingham) Guiry								+														-	-	
	<i>Synedra pulchella</i>	<i>Ctenophora pulchella</i> (Kützing) D.M.Williams & Round							+	+														*	4	
	<i>Cyclotella comata</i>	<i>Cyclotella comata</i> (Her.) Kützing		+	+																			-	5	
	<i>Cyclotella striata</i>	<i>Cyclotella striata</i> (Kützing) Grunow			+			+	+					+				+	+		+		*	-		
	<i>Cymatopleura elliptica</i>	<i>Cymatopleura elliptica</i> (Brébisson) W.Smith																					+	*	-	
	<i>Cymbella affinis</i>	<i>Cymbella affinis</i> Kützing													+									2	2	
	<i>Cymbella aspera</i>	<i>Cymbella aspera</i> (Ehrenberg) Cleve																					+	G	2	
	<i>Cymbella cistula</i>	<i>Cymbella cistula</i> (Ehrenberg) O.Kirchner																					+	-	-	
	<i>Cymbella cymbiformis</i>	<i>Cymbella cymbiformis</i> C.Agardh					+																	3	-	
	<i>Cymbella edelbergii</i>	<i>Cymbella edelbergii</i> Foged																					+	-	-	
	<i>Cymbella farakulumensis</i>	<i>Cymbella farakulumensis</i> Foged																					+	-	-	
	<i>Cymbella haslundii</i>	<i>Cymbella haslundii</i> Foged																					+	-	-	
	<i>Cymbella helmandensis</i>	<i>Cymbella helmandensis</i> Foged																					+	-	-	
	<i>Cymbella helvetica</i>	<i>Cymbella helvetica</i> Kützing					+			+														3	-	
	<i>Cymbella hustedtii</i>	<i>Cymbella hustedtii</i> Kraske																					+	G	-	
	<i>Cymbella koeiei</i>	<i>Cymbella koeiei</i> Foged																					+	-	-	
	<i>Cymbella kolbei</i>	<i>Cymbella kolbei</i> Hustedt																					+	R	-	
	<i>Cymbella laevis</i>	<i>Cymbella laevis</i> Nägeli																					+	3	-	
	<i>Navicula lanceolata</i>	<i>Cymbella lanceolata</i> C.Agardh																					+	-	3	
	<i>Cymbella leptoceros</i>	<i>Cymbella neoleptoceros</i> Krammer					+	+			+		+	+	+		+	+		+			*	-		
	<i>Cymbella obtusa</i>	<i>Cymbella obtusa</i> W.Gregory																					+	-	-	
	<i>Cymbella obtusiuscula</i>	<i>Cymbella obtusiuscula</i> Kützing																					+	-	-	
	<i>Cymbella panjaoensis</i>	<i>Cymbella panjaoensis</i> Foged																					+	-	-	
	<i>Cymbella parva</i>	<i>Cymbella parva</i> (W.Smith) Kirchner																					+	G	-	
	<i>Cymbella sabzewarensis</i>	<i>Cymbella sabzewarensis</i> Foged																					+	-	-	
	<i>Cymbella stuxbergii</i>	<i>Cymbella stuxbergii</i> (Cleve) Cleve					+	+		+														-	-	
	<i>Cymbella tumida</i>	<i>Cymbella tumida</i> (Brébisson) Van Heurck																					+	*	3	
	<i>Cymbella tumidula</i>	<i>Cymbella tumidula</i> Grunow																					+	-	-	
	<i>Cymbella amphicephala</i>	<i>Cymbopleura amphicephala</i> (Nägeli ex Kützing) Krammer																					+	G	2	
<i>Cymbella angustata</i>	<i>Cymbopleura angustata</i> (W.Smith) Krammer																					+	*	-		
<i>Cymbella cuspidata</i>	<i>Cymbopleura cuspidata</i> (Kützing) Krammer																					+	G	-		
<i>Cymbella ehrenbergii</i>	<i>Cymbopleura inaequalis</i> (Ehrenberg) Krammer																					+	V	-		
<i>Cymbella lata</i>	<i>Cymbopleura lata</i> (Grunow ex Cleve) Krammer																					+	3	-		
<i>Cymbella naviculiformis</i>	<i>Cymbopleura naviculiformis</i> (Auerswald ex Heiberg) Krammer																					+	*	3		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Bandi Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Muirghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	indefinite sampling place country	RL	BCG				
Heterokontophyta	<i>Cymbella rupicola</i>	<i>Cymbopleura rupicola</i> (Grunow) Krammer																					+	G	-			
	<i>Cymbella similis</i>	<i>Cymbopleura similis</i> (Kraske) Krammer	+				+		+					+	+					+					G	-		
	<i>Cymbella delicatula</i>	<i>Delicatophycus delicatulus</i> (Kützing) M. J. Wynne																						+		2		
	<i>Denticula subtilis</i>	<i>Denticula subtilis</i> Grunow					+																		*	4		
	<i>Denticula tenuis</i>	<i>Denticula tenuis</i> Kützing																						+	*	2		
	<i>Denticula thermalis</i>	<i>Denticula thermalis</i> Kützing					+																			R	-	
	<i>Diatoma elongatum</i>	<i>Diatoma elongata</i> f. <i>lata</i> Serbanescu & Serbanescu						+					+	+							+					-	-	
	<i>Diatoma vulgare</i>	<i>Diatoma vulgare</i> Bory																							+	*	3	
	<i>Diatomella balfouriana</i>	<i>Diatomella balfouriana</i> Greville					+	+	+	+	+				+							+				G	2	
	<i>Didymosphenia geminata</i>	<i>Didymosphenia geminata</i> (Lyngbye) Mart. Schmidt						+																		*	2	
	<i>Diploneis elliptica</i>	<i>Diploneis elliptica</i> (Kützing) Cleve		+					+	+																V	3	
	<i>Diploneis interrupta</i>	<i>Diploneis interrupta</i> (Kützing) Cleve																								+	*	-
	<i>Diploneis oculata</i>	<i>Diploneis oculata</i> (Brébisson) Cleve																							+	*	-	
	<i>Diploneis ovalis</i>	<i>Diploneis ovalis</i> (Hilse) Cleve																					+	+		2	3	
	<i>Diploneis puella</i>	<i>Diploneis puella</i> (Schumann) Cleve																							+	D	-	
	<i>Diploneis smithii</i>	<i>Diploneis smithii</i> (Brébisson) Cleve					+					+														*	-	
	<i>Navicula kotschy</i>	<i>Dorofeyukea kotschy</i> (Grunow) Kulikovskiy, Kocielek, Tusset & T. Ludwig																							+	D	4	
	<i>Melosira arenaria</i>	<i>Ellerbeckia arenaria</i> (D. Moore ex Ralfs) Dorofeyuk & Kulikovskiy																							+	*	2	
	<i>Cymbella turgida</i>	<i>Encyonema elginense</i> (Krammer) D. G. Mann																							+	2	-	
	<i>Cymbella gracilis</i>	<i>Encyonema gracile</i> Rabenhorst																							+	-	-	
	<i>Cymbella latens</i>	<i>Encyonema latens</i> (Kraske) D. G. Mann																							+	0	-	
	<i>Cymbella prostrata</i>	<i>Encyonema leibleinii</i> (C. Agardh) W. J. Silva, R. Jain, T. A. V. Ludwig & M. Menezes																							+	*	-	
	<i>Cymbella obscura</i>	<i>Encyonema obscurum</i> (Kraske) D. G. Mann																							+	3	-	
	<i>Cymbella perpusilla</i>	<i>Encyonema perpusillum</i> (A. Cleve) D. G. Mann		+		+	+	+	+	+																3	-	
	<i>Cymbella ventricosa</i>	<i>Encyonema ventricosum</i> (C. Agardh) Grunow											+													*	-	
	<i>Cymbella cesati</i>	<i>Encyonopsis cesatii</i> (Rabenhorst) Krammer																							+	V	2	
	<i>Cymbella delicatissima</i>	<i>Encyonopsis delicatissima</i> (Hustedt) Krammer																							+	-	-	
	<i>Navicula descripta</i>	<i>Encyonopsis descripta</i> (Hustedt) Krammer																							+	G	-	
	<i>Navicula falaisensis</i>	<i>Encyonopsis falaisensis</i> (Grunow) Krammer																							+	G	2	
	<i>Cymbella fonticola</i>	<i>Encyonopsis fonticola</i> (Hustedt) Krammer											+													*	-	
	<i>Cymbella subalpina</i>	<i>Encyonopsis mendosa</i> (Van Landingham) Da Silva & Menezes																							+	-	-	
	<i>Cymbella microcephala</i>	<i>Encyonopsis microcephala</i> (Grunow) Krammer		+	+	+	+	+	+	+		+		+	+	+								+	+	*	3	
	<i>Amphiprora alata</i>	<i>Entomoneis alata</i> (Ehrenberg) Ehrenberg							+	+											+			+	+	*	5	
	<i>Epithemia zebra</i>	<i>Epithemia adnata</i> (Kützing) Brébisson																							+	*	2	
	<i>Epithemia argus</i>	<i>Epithemia argus</i> (Ehrenberg) Kützing																							+	*	-	
	<i>Epithemia alpestris</i>	<i>Epithemia argus</i> var. <i>alpestris</i> (W. Smith) Grunow																							+	G	-	
	<i>Pinnularia gibba</i>	<i>Epithemia gibba</i> (Ehrenberg) Kützing																							+	-	2	
	<i>Epithemia muelleri</i>	<i>Epithemia muelleri</i> Fricke																							+	-	-	
	<i>Rhopalodia parallela</i>	<i>Epithemia parallela</i> (Grunow) Ruck & Nakov																							+	-	-	
	<i>Epithemia sorex</i>	<i>Epithemia sorex</i> Kützing																							+	*	2	
<i>Epithemia turgida</i>	<i>Epithemia turgida</i> (Ehrenberg) Kützing																							+	*	2		
<i>Achnanthes flexella</i>	<i>Eucoconeis flexella</i> (Kützing) F. Meister							+	+																2	2		
<i>Eunotia arcus</i>	<i>Eunotia arcus</i> Ehrenberg																							+	V	-		
<i>Eunotia gracilis</i>	<i>Eunotia exigua</i> (Brébisson ex Kützing) Rabenhorst													+											*	2		
<i>Eunotia montana</i>	<i>Eunotia montana</i> Hustedt																							+	-	-		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Bandi Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Muirghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	inderminate sampling place country	RL	BCG	
Heterokontophyta	<i>Eunotia parallela</i>	<i>Eunotia parallela</i> Ehrenberg									+												-	-	
	<i>Eunotia praerupta</i>	<i>Eunotia praerupta</i> Ehrenberg															+						2	-	
	<i>Eunotia rhomboidea</i>	<i>Eunotia rhomboidea</i> Hustedt			+																		G	2	
	<i>Eunotia tenella</i>	<i>Eunotia tenella</i> (Grunow) Hustedt							+														G	-	
	<i>Eunotia tschirchiana</i>	<i>Eunotia tschirchiana</i> O.Müller									+												-	-	
	<i>Navicula insociabilis</i>	<i>Fallacia insociabilis</i> (Krasske) D.G.Mann																					+	* -	
	<i>Navicula omissa</i>	<i>Fallacia omissa</i> (Hustedt) D.G.Mann																					+	D -	
	<i>Navicula pygmaea</i>	<i>Fallacia pygmaea</i> (Kützling) Stickle & D.G.Mann																+						*	5
	<i>Navicula subhamulata</i>	<i>Fallacia subhamulata</i> (Grunow) D.G.Mann				+																		*	4
	<i>Navicula vitrea</i>	<i>Fallacia vitrea</i> (Østrup) D.G.Mann			+	+					+											+		G	-
	<i>Synedra amphicephala</i>	<i>Fragilaria amphicephaloides</i> Lange-Bertalot																					+	3	-
	<i>Fragilaria capucina</i>	<i>Fragilaria capucina</i> Desmazières																					+	*	3
	<i>Fragilaria crotonensis</i>	<i>Fragilaria crotonensis</i> Kitting		+																				*	3
	<i>Synedra rumpens</i>	<i>Fragilaria rumpens</i> (Kützing) G.W.F. Carlson																					+	*	-
	<i>Synedra tenera</i>	<i>Fragilaria tenera</i> (W. Smith) Lange-Bertalot																					+	*	3
	<i>Fragilaria vaucheriae</i>	<i>Fragilaria vaucheriae</i> (Kützing) J.B. Petersen		+								+												*	3
	<i>Fragilaria virescens</i>	<i>Fragilariforma virescens</i> (Ralfs) D.M. Williams & Round																+						*	2
	<i>Frustulia rhomboides</i>	<i>Frustulia rhomboides</i> (Ehrenberg) De Toni					+																	-	-
	<i>Frustulia vulgaris</i>	<i>Frustulia vulgaris</i> (Thwaites) De Toni		+	+			+	+													+		*	4
	<i>Navicula schoenfeldii</i>	<i>Geissleria schoenfeldii</i> (Hustedt) Lange-Bertalot & Metzeltin																					+	*	-
	<i>Navicula digitulus</i>	<i>Genkalia digitulus</i> (Hustedt) Lange-Bertalot & Kulikovskiy																					+	3	2
	<i>Achnanthes exigua</i>	<i>Gogorevia exilis</i> (Kützing) Kulikovskiy & Kociolek					+				+													-	4
	<i>Gomphonema clevei</i>	<i>Gomphoneis clevei</i> (Fricke) Gil																					+	-	-
	<i>Gomphonema olivaceum</i>	<i>Gomphonella olivacea</i> (Hornemann) Rabenhorst																					+	-	3
	<i>Gomphonema olivaceoides</i>	<i>Gomphonella olivaceoides</i> (Hust.) Tuji				+				+														-	-
	<i>Gomphonema acuminatum</i>	<i>Gomphonema acuminatum</i> Ehrenberg																					+	*	3
	<i>Gomphonema longiceps</i>	<i>Gomphonema acuminatum</i> var. <i>longiceps</i> (Ehrenberg) N.Abarca & R.Jahn					+																	*	-
	<i>Gomphonema angustatum</i>	<i>Gomphonema angustatum</i> (Kützing) Rabenhorst		+																				*	3
	<i>Gomphonema constrictum</i>	<i>Gomphonema constrictum</i> Ehrenberg										+										+		-	-
	<i>Gomphonema dichotomum</i>	<i>Gomphonema dichotomum</i> Kützing							+	+														V	-
	<i>Gomphonema farakulumensis</i>	<i>Gomphonema farakulumense</i> Foged																					+	-	-
	<i>Gomphonema gracile</i>	<i>Gomphonema gracile</i> Ehrenberg					+																	D	-
	<i>Gomphonema lanceolatum</i>	<i>Gomphonema grunowii</i> R.M. Patrick & Reimer																	+					-	-
	<i>Gomphonema helveticum</i>	<i>Gomphonema helveticum</i> Brun																					+	-	-
	<i>Gomphonema intricatum</i>	<i>Gomphonema intricatum</i> Kützing					+										+	+				+		-	-
	<i>Gomphonema parvulum</i>	<i>Gomphonema parvulum</i> (Kützing) Kützing					+																	*	4
	<i>Gomphonema vamaensis</i>	<i>Gomphonema vamaensis</i> Foged																					+	-	-
	<i>Gomphonema hedinii</i>	<i>Gomphosinica hedinii</i> (Hustedt) Kociolek, Q.-M. You, Q.-X. Wang & Q. Liu																					+	-	-
	<i>Nitzschia sinuata</i>	<i>Grunowia sinuata</i> (Thwaites ex W. Smith) Rabenhorst																					+	-	2
	<i>Gyrosigma spenceri</i>	<i>Gyrosigma acuminatum</i> (Kützing) Rabenhorst																					+	*	4
<i>Gyrosigma attenuatum</i>	<i>Gyrosigma attenuatum</i> (Kützing) Rabenhorst																					+	*	5	
<i>Gyrosigma distortum</i>	<i>Gyrosigma distortum</i> (W. Smith) J.W. Griffith & Henfrey		+																				-	-	
<i>Gyrosigma scalproides</i>	<i>Gyrosigma scalproides</i> (Rabenhorst) Cleve						+																-	4	
<i>Amphora coffeiformis</i>	<i>Halamphora coffeiformis</i> (C. Agardh) Mereschkowsky		+																				*	4	
<i>Amphora dubiosa</i>	<i>Halamphora dubiosa</i> (Østrup) Levkov														+	+							-	-	

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Bandi Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Muirghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	indeterminate sampling place country	RL	BCG	
Heterokontophyta	<i>Amphora triundulata</i>	<i>Halamphora dusenii</i> (Brun) Levkov																					+	D	-
	<i>Amphora obscura</i>	<i>Halamphora obscura</i> Levkov																					+	D	-
	<i>Amphora schroederi</i>	<i>Halamphora schroederi</i> (Hustedt) Levkov																					+	-	-
	<i>Amphora submontana</i>	<i>Halamphora submontana</i> (Hustedt) Levkov																					+	-	-
	<i>Amphora veneta</i>	<i>Halamphora veneta</i> (Kützing) Levkov													+									*	5
	<i>Ceratoneis arcus</i>	<i>Hannaea arcus</i> (Ehrenberg) R.M.Patrick			+							+												V	2
	<i>Hantzschia amphioxys</i>	<i>Hantzschia amphioxys</i> (Ehrenberg) Grunow					+																	*	4
	<i>Navicula hungarica</i>	<i>Hippodonta hungarica</i> (Grunow) Lange-Bertalot, Metzlin & Witkowski																+				+		*	5
	<i>Navicula contenta</i>	<i>Humidophila contenta</i> Grunow Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová																					+	D	-
	<i>Navicula perpusilla</i>	<i>Humidophila perpusilla</i> (Grunow) R.L.Lowe, Kociolek, J.R.Johansen, Van de Vijver, Lange-Bertalot & Kopalová			+	+					+	+			+	+								*	-
	<i>Pinnularia balfouriana</i>	<i>Hygropetra balfouriana</i> (Grunow ex Cleve) Krammer & Lange-Bertalot																					+	G	-
	<i>Suirella linearis</i>	<i>Iconella linearis</i> (W.Smith) Ruck & Nakov																					+	-	-
	<i>Suirella tenera</i>	<i>Iconella tenera</i> (W.Gregory) Ruck & Nakov																					+	-	-
	<i>Achnanthes clevei</i>	<i>Karayevia clevei</i> (Grunow) Bukhtiyarova																					+	*	3
	<i>Achnanthes plöenensis</i>	<i>Karayevia ploenensis</i> (Hustedt) Bukhtiyarova																					+	*	-
	<i>Achnanthes hungarica</i>	<i>Lemnicola hungarica</i> (Grunow) Round & Basson																					+	*	4
	<i>Cyclotella comta</i>	<i>Lindavia comta</i> (Kützing) T.Nakov & al																					+	-	-
	<i>Navicula cohnii</i>	<i>Luticola cohnii</i> (Hilse) D.G.Mann									+													V	-
	<i>Navicula lagerstedtii</i>	<i>Luticola lagerheimii</i> (Cleve) D.G.Mann																					+	-	-
	<i>Navicula mutica</i>	<i>Luticola mutica</i> (Kützing) D.G.Mann										+												*	-
	<i>Mastogloia braunii</i>	<i>Mastogloia braunii</i> Grunow										+												*	-
	<i>Mastogloia grevillei</i>	<i>Mastogloia danseyi</i> f. <i>grevillea</i> (W.Smith) Edlund & Burge																					+	*	-
	<i>Mastogloia elliptica</i>	<i>Mastogloia elliptica</i> (C.Agardh) Cleve																+				+		*	3
	<i>Mastogloia exigua</i>	<i>Mastogloia exigua</i> F.W.Lewis						+														+		-	-
	<i>Mastogloia smithii</i>	<i>Mastogloia smithii</i> Thwaites ex W.Smith			+	+	+	+		+		+	+	+	+	+	+					+		*	-
	<i>Navicula permitis</i>	<i>Mayamaea permitis</i> (Hustedt) K.Bruder & Medlin																					+	*	-
	<i>Melosira varians</i>	<i>Melosira varians</i> C.Agardh																					+	*	4
	<i>Meridion circulare</i>	<i>Meridion circulare</i> (Greville) C.Agardh		+				+	+		+	+			+							+		*	2
	<i>Navicula gibbula</i>	<i>Muelleria gibbula</i> (Cleve) Spaulding & Stoermer		+	+	+	+	+	+	+		+			+							+		G	-
	<i>Navicula disjuncta</i>	<i>Myriactula pulvinata</i> (Kützing) Kuntze																					+	-	-
	<i>Navicula accurata</i>	<i>Navicula accurata</i> Hustedt																					+	-	-
	<i>Navicula anderabensis</i>	<i>Navicula anderabensis</i> Foged																					+	-	-
	<i>Navicula bannajensis</i>	<i>Navicula bannajensis</i> J.B.Petersen																					+	-	-
	<i>Navicula chasmaensis</i>	<i>Navicula chasmaensis</i> Foged																					+	-	-
	<i>Navicula cincta</i>	<i>Navicula cincta</i> (Ehrenberg) Ralfs		+																				*	5
	<i>Navicula cinctiformis</i>	<i>Navicula cinctiformis</i> Hustedt						+			+			+										*	-
	<i>Navicula cryptocephala</i>	<i>Navicula cryptocephala</i> Kützing		+				+	+						+									*	4
	<i>Navicula digitoradiata</i>	<i>Navicula digitoradiata</i> (W.Gregory) Ralfs		+				+																*	-
	<i>Navicula exigua</i>	<i>Navicula exigua</i> W.Gregory, nom. illeg																					+	-	-
	<i>Navicula faceta</i>	<i>Navicula faceta</i> Hustedt																					+	-	-
<i>Navicula farakulumensis</i>	<i>Navicula farakulumensis</i> Foged																					+	-	-	
<i>Navicula gregaria</i>	<i>Navicula gregaria</i> Donkin																					+	*	4	
<i>Navicula helmandensis</i>	<i>Navicula helmandensis</i> Foged																					+	-	-	
<i>Navicula koeiei</i>	<i>Navicula koeiei</i> Foged																					+	-	-	

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Bandi Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	indeterminate sampling place country	RL	BCG				
Heterokontophyta	<i>Navicula kuripanensis</i>	<i>Navicula kuripanensis</i> Hustedt																						+	-	-		
	<i>Navicula paulseniana</i>	<i>Navicula lacustris</i> var. <i>paulseniana</i> (J.B.Petersen) Zabelina																							+	*	-	
	<i>Navicula menisculus</i>	<i>Navicula menisculus</i> Schumann																							+	*	4	
	<i>Navicula monodi</i>	<i>Navicula monodi</i> Guermeur																							+	-	-	
	<i>Navicula oblonga</i>	<i>Navicula oblonga</i> (Kützing) Kützing																							+	G	4	
	<i>Navicula oblongata</i>	<i>Navicula oblongata</i> Kützing																							+	-	-	
	<i>Navicula peregrina</i>	<i>Navicula peregrina</i> (Ehrenberg) Kützing																	+							*	5	
	<i>Navicula praeterita</i>	<i>Navicula praeterita</i> Hustedt																							+	2	-	
	<i>Navicula pseudannulata</i>	<i>Navicula pseudannulata</i> Frenguelli																	+							-	-	
	<i>Navicula pseudogracilis</i>	<i>Navicula pseudogracilis</i> Hustedt																					+			-	-	
	<i>Navicula radiosa</i>	<i>Navicula radiosa</i> Kützing																							+	*	4	
	<i>Navicula ramosissima</i>	<i>Navicula ramosissima</i> (C.Agardh) Cleve		+	+	+		+	+			+	+				+			+						-	-	
	<i>Navicula rhynchocephala</i>	<i>Navicula rhynchocephala</i> Kützing																							+	*	4	
	<i>Navicula salinarum</i>	<i>Navicula salinarum</i> Grunow		+													+										*	5
	<i>Navicula seminoides</i>	<i>Navicula seminoides</i> Cleve																							+	-	-	
	<i>Navicula certa</i>	<i>Navicula splendida</i> VanLandingham																							+	G	-	
	<i>Navicula subrhynchocephala</i>	<i>Navicula subrhynchocephala</i> Hustedt																							+	R	3	
	<i>Navicula gracilis</i>	<i>Navicula tripunctata</i> (O.F.Müller) Bory																							+	*	5	
	<i>Navicula veneta</i>	<i>Navicula veneta</i> Kützing																							+	*	4	
	<i>Navicula viridula</i>	<i>Navicula viridula</i> (Kützing) Ehrenberg																							+	*	5	
	<i>Cymbella pusilla</i>	<i>Navicymbella pusilla</i> (Grunow) Krammer														+										*	-	
	<i>Navicula decussis</i>	<i>Navigeia decussis</i> (Østrup) Bukhtiyarova																							+	-	-	
	<i>Neidium binode</i>	<i>Neidiomorpha binodis</i> (Ehrenberg) M.Cantonati, Lange-Bertalot & N. Angeli																							+	V	-	
	<i>Neidium affine</i>	<i>Neidium affine</i> (Ehrenberg) Pflizer																	+							V	-	
	<i>Neidium bisulcatum</i>	<i>Neidium bisulcatum</i> (Lagerstedt) Cleve																							+	3	-	
	<i>Neidium iridis</i>	<i>Neidium iridis</i> (Ehrenberg) Cleve																							+	2	-	
	<i>Nitzschia acicularis</i>	<i>Nitzschia acicularis</i> (Kützing) W.Smith																							+	*	4	
	<i>Nitzschia subfrustulum</i>	<i>Nitzschia aequorea</i> Hustedt																							+	*	-	
	<i>Nitzschia amphibia</i>	<i>Nitzschia amphibia</i> Grunow				+																		+	*	5		
	<i>Nitzschia amphibioides</i>	<i>Nitzschia amphibioides</i> Hustedt																							+	-	-	
	<i>Nitzschia anderabensis</i>	<i>Nitzschia anderabensis</i> Foged																							+	-	-	
	<i>Nitzschia bacillariaeformis</i>	<i>Nitzschia bacillariaeformis</i> Hustedt																						+	*	-		
	<i>Nitzschia communis</i>	<i>Nitzschia communis</i> Rabenhorst						+	+																	*	5	
	<i>Nitzschia commutata</i>	<i>Nitzschia commutata</i> Grunow								+							+	+								*	-	
	<i>Nitzschia denticula</i>	<i>Nitzschia denticula</i> Grunow						+																		V	-	
	<i>Nitzschia dissipata</i>	<i>Nitzschia dissipata</i> (Kützing) Rabenhorst																							+	*	3	
	<i>Nitzschia dubia</i>	<i>Nitzschia dubia</i> W.Smith														+										*	-	
	<i>Nitzschia romana</i>	<i>Nitzschia fonticola</i> (Grunow) Grunow																+								*	4	
	<i>Nitzschia frustulum</i>	<i>Nitzschia frustulum</i> (Kützing) Grunow																							+	*	3	
	<i>Nitzschia gruendleri</i>	<i>Nitzschia gruendleri</i> Grunow																						+		-	-	
<i>Nitzschia terricola</i>	<i>Nitzschia harderi</i> Hustedt																							+	R	-		
<i>Nitzschia heidenii</i>	<i>Nitzschia heidenii</i> (F.Meister) Hustedt, nom. inval																	+							-	-		
<i>Nitzschia intermedia</i>	<i>Nitzschia intermedia</i> Hantzsch ex Cleve & Grunow																							+	*	3		
<i>Nitzschia invisitata</i>	<i>Nitzschia invisitata</i> Hustedt																							+	-	-		
<i>Nitzschia linearis</i>	<i>Nitzschia linearis</i> W.Smith																	+							*	3		
<i>Nitzschia mahihaensis</i>	<i>Nitzschia mahihaensis</i> Foged																							+	-	-		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Bandi Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	La-i-Sarjangel (Upper Hari Rud)	Muirghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	inderminate sampling place country	RL	BCG			
Heterokontophyta	<i>Nitzschia maxima</i>	<i>Nitzschia maxima</i> Grunow	+																				*	-			
	<i>Nitzschia microcephala</i>	<i>Nitzschia microcephala</i> Grunow																					+	* 5			
	<i>Nitzschia ignorata</i>	<i>Nitzschia nana</i> Grunow					+						+										+	* -			
	<i>Nitzschia obsidialis</i>	<i>Nitzschia obsidialis</i> Hustedt																					+	* -			
	<i>Nitzschia obtusa</i>	<i>Nitzschia obtusa</i> W.Smith			+	+									+	+							+	* -			
	<i>Nitzschia palea</i>	<i>Nitzschia palea</i> (Kützing) W.Smith					+					+											+	+	* 5		
	<i>Nitzschia paleacea</i>	<i>Nitzschia paleacea</i> (Grunow) Grunow					+	+															+	+	* 3		
	<i>Nitzschia paleaeformis</i>	<i>Nitzschia paleaeformis</i> Hustedt																					+	G	-		
	<i>Nitzschia ostenfeldii</i>	<i>Nitzschia pamirensis</i> Hustedt		+		+	+		+	+	+						+								-		
	<i>Nitzschia salinicola</i>	<i>Nitzschia salinicola</i> Aleem & Hustedt																					+	-	-		
	<i>Nitzschia sigma</i>	<i>Nitzschia sigma</i> (Kützing) W.Smith								+							+								* 4		
	<i>Nitzschia sigmoidea</i>	<i>Nitzschia sigmoidea</i> (Nitzsch) W.Smith																					+	+	* 4		
	<i>Nitzschia amphioxoides</i>	<i>Nitzschia subamphioxoides</i> Hustedt																					+	-	-		
	<i>Nitzschia valida</i>	<i>Nitzschia valida</i> Cleve & Grunow				+				+			+	+			+								-		
	<i>Nitzschia vana</i>	<i>Nitzschia vana</i> Cholnokiy																						+	-	-	
	<i>Nitzschia vermicularis</i>	<i>Nitzschia vermicularis</i> (Kützing) Hantzsch		+					+	+						+								+	* -		
	<i>Nitzschia vitrea</i>	<i>Nitzschia vitrea</i> G.Norman																						+	* -		
	<i>Diatoma hyemalis</i>	<i>Odontidium hyemale</i> (Roth) Kützing				+																			-	-	
	<i>Melosira roeseana</i>	<i>Orthosira roeseana</i> (Rabenhorst) Pfister											+				+								D	3	
	<i>Cyclotella kuetzingiana</i>	<i>Pantocsekiella kuetzingiana</i> (Thwaites) K.T.Kiss & E.Acs											+													* -	
	<i>Navicula appendiculata</i>	<i>Pinnularia appendiculata</i> (C.Agardh) Schaarschmidt		+	+															+			+	+		* -	
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i> Ehrenberg																						+	* 3		
	<i>Navicula brebissonii</i>	<i>Pinnularia brebissonii</i> (Kützing) Rabenhorst		+		+			+							+	+								* -		
	<i>Pinnularia divergens</i>	<i>Pinnularia divergens</i> W.Smith											+				+								V	-	
	<i>Pinnularia gentilis</i>	<i>Pinnularia gentilis</i> (Donkin) Cleve																						+	G	-	
	<i>Pinnularia gracillima</i>	<i>Pinnularia gracillima</i> W.Gregory															+	+						+		-	
	<i>Pinnularia intermedia</i>	<i>Pinnularia intermedia</i> (Lagerstedt) Cleve																						+	3	-	
	<i>Pinnularia interrupta</i>	<i>Pinnularia interrupta</i> W.Smith				+																				-	
	<i>Pinnularia kneuckeri</i>	<i>Pinnularia kneuckeri</i> Hustedt				+	+																			R	-
	<i>Pinnularia lata</i>	<i>Pinnularia lata</i> (Brébisson) W.Smith																						+	3	-	
	<i>Pinnularia mesolepta</i>	<i>Pinnularia mesolepta</i> (Ehrenberg) W.Smith																						+	-	-	
	<i>Pinnularia microstauron</i>	<i>Pinnularia microstauron</i> (Ehrenberg) Cleve																						+	V	3	
	<i>Pinnularia parva</i>	<i>Pinnularia parva</i> Ehrenberg																						+	-	-	
<i>Pinnularia saxicola</i>	<i>Pinnularia saxicola</i> J.W.G.Lund																						+	-	-		
<i>Pinnularia silvatica</i>	<i>Pinnularia silvatica</i> J.B.Petersen																								D	-	
<i>Navicula tabellaria</i>	<i>Pinnularia tabellaria</i> Ehrenberg																							+	-		
<i>Pinnularia tibetana</i>	<i>Pinnularia tibetana</i> Hustedt																								-		
<i>Navicula viridis</i>	<i>Pinnularia viridis</i> (Nitzsch) Ehrenberg		+					+	+																D	-	
<i>Navicula abiskoensis</i>	<i>Placoneis abiskoensis</i> (Hustedt) Lange-Bertalot & Metzeltin																						+	R	3		
<i>Navicula dicephala</i>	<i>Placoneis dicephala</i> (Ehrenberg) Mereschkowsky																						+	-	-		
<i>Dimeregramma minus</i>	<i>Plagiogramma minus</i> (W.Gregory) Chunlian Li, Ashworth & Witkowski										+	+			+	+	+						+		-		
<i>Plagiogramma pulchellum</i>	<i>Plagiogramma pulchellum</i> Greville				+																				-		
<i>Achnanthes hauckiana</i>	<i>Planothidium hauckianum</i> (Grunow) Bukhtiyarova																						+	G	-		
<i>Achnanthes grimmei</i>	<i>Planothidium grimmei</i> (Krasske) I.W.Bishop & Spaulding																								-		
<i>Achnanthes lanceolata</i>	<i>Planothidium lanceolatum</i> (Brébisson ex Kützing) Lange-Bertalot																								* 4		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rud)	Band-i Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzewar) River	Girshk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmais hir and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahila	Upper Helmand Rud2 (Farakulum)	inderminate sampling place country	RL	BCG		
Heterokontophyta	<i>Achnanthes conspicua</i>	<i>Platessa conspicua</i> (Ant.Mayer) Lange-Bertalot	+				+										+						*	3		
	<i>Pleurosigma elongatum</i>	<i>Pleurosigma elongatum</i> W.Smith															+						*	-		
	<i>Navicula ventralis</i>	<i>Psammothidium ventral</i> (Kraske) Bukhtiyarova & Round, nom. inval.																+		+			2	-		
	<i>Fragilaria brevistriata</i>	<i>Pseudostausira brevistriata</i> (Grunow) D.M.Williams & Round																					+	*	3	
	<i>Synedra parasitica</i>	<i>Pseudostausira parasitica</i> (W.Smith) E.Morales																					+	*	4	
	<i>Cymbella sinuata</i>	<i>Reimeria sinuata</i> (W.Gregory) Kociolek & Stoermer																					+	*	2	
	<i>Rhoicosphenia curvata</i>	<i>Rhoicosphenia abbreviata</i> (C.Agarth) Lange-Bertalot																					+	*	3	
	<i>Rhopalodia gibberula</i>	<i>Rhopalodia gibberula</i> (Ehrenberg) O.Müller																			+			D	-	
	<i>Rhopalodia musculus</i>	<i>Rhopalodia musculus</i> (Kützing) O.Müller					+																	*	-	
	<i>Navicula bacillum</i>	<i>Sellaphora bacillum</i> (Ehrenberg) D.G.Mann																					+	*	2	
	<i>Navicula pseudoventralis</i>	<i>Sellaphora pseudoventralis</i> (Hustedt) Chudaeve & Gololobova																					+	-	-	
	<i>Navicula pupula</i>	<i>Sellaphora pupula</i> (Kützing) Mereschkovskiy																					+	D	3	
	<i>Navicula stroemii</i>	<i>Sellaphora stroemii</i> (Hustedt) H.Kobayasi																					+	2	3	
	<i>Navicula submuralis</i>	<i>Sellaphora submuralis</i> (Hustedt) C.E.Wetzel, Ector, B.Van de Vijver, Compère & D.G.Mann																					+	-	-	
	<i>Navicula tridentula</i>	<i>Sellaphora tridentula</i> (Kraske) C.E.Wetzel																					+	-	-	
	<i>Stauroneis agrestis</i>	<i>Stauroneis agrestis</i> J.B.Petersen					+																+	R	-	
	<i>Stauroneis anceps</i>	<i>Stauroneis anceps</i> Ehrenberg																					+	V	3	
	<i>Stauroneis kriegeri</i>	<i>Stauroneis kriegeri</i> R.M.Patrick																					+	*	3	
	<i>Stauroneis phoenicenteron</i>	<i>Stauroneis phoenicenteron</i> (Nitzsch) Ehrenberg																							V	3
	<i>Stauroneis smithii</i>	<i>Stauroneis smithii</i> Grunow																					+	*	4	
	<i>Stauroneis sphaerophora</i>	<i>Stauroneis sphaerophora</i> Ehrenberg																					+	-	-	
	<i>Stauroneis palustris</i>	<i>Stauroneis palustris</i> (Hustedt) Bahls																					+	-	-	
	<i>Fragilaria construens</i>	<i>Staurosira construens</i> Ehrenberg																						*	4	
	<i>Fragilaria leptostauron</i>	<i>Staurosira leptostauron</i> (Ehrenberg) Kulkovskiy & Genkal																					+	-	-	
	<i>Fragilaria pinnata</i>	<i>Staurosirella pinnata</i> (Ehrenberg) D.M.Williams & Round					+	+															+	+	-	4
	<i>Cyclotella meneghiniana</i>	<i>Stephanocyclus meneghinianus</i> (Kützing) Kulkovskiy, Genkal & Kociolek																					+	*	5	
	<i>Stephanodiscus astraea</i>	<i>Stephanodiscus astraea</i> (Kützing) Grunow																					+	-	-	
	<i>Surirella angusta</i>	<i>Surirella angusta</i> Kützing																					+	*	4	
	<i>Cymatopleura solea</i>	<i>Surirella librule</i> (Ehrenberg) Ehrenberg																					+	-	4	
	<i>Suriraya ovalis</i>	<i>Surirella ovalis</i> Brébisson																					+	*	5	
	<i>Surirella robusta</i>	<i>Surirella robusta</i> Ehrenberg																					+	3	-	
	<i>Tabellaria fenestrata</i>	<i>Tabellaria fenestrata</i> (Lyngbye) Kützing																					+	V	2	
	<i>Tabellaria flocculosa</i>	<i>Tabellaria flocculosa</i> (Roth) Kützing																					+	*	2	
<i>Synedra tabulata</i>	<i>Tabularia tabulata</i> (C.Agarth) Snoeijis																					+	*	3		
<i>Nitzschia angustata</i>	<i>Tryblionella angustata</i> W.Smith																					+	-	-		
<i>Nitzschia apiculata</i>	<i>Tryblionella apiculata</i> W.Gregory																					+		-	4	
<i>Nitzschia tryblionella</i>	<i>Tryblionella hantzschiana</i> Grunow																					+	+	-		
<i>Nitzschia hungarica</i>	<i>Tryblionella hungarica</i> (Grunow) Frenguelli																					+	+	-	5	
<i>Synedra acus</i>	<i>Ulnaria acus</i> (Kützing) Aboal																					+	*	-		
<i>Synedra capitata</i>	<i>Ulnaria capitata</i> (Ehrenberg) Compère																					+	*	-		
<i>Synedra ulna</i>	<i>Ulnaria ulna</i> (Nitzsch) Compère																					+	+	-		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Band-i Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girshk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaishir and Shamarq	Hari Rud River2	Upper Helmand3Hauz-i-Mahliha	Upper Helmand Rud2 (Farakulum)	Indeterminate sampling place country	RL	BCG	
Charophyta	<i>Closterium comu</i>	<i>Closterium comu</i> Ehrenberg ex Ralfs																				+	3	-	
	<i>Coleochaete scutata</i>	<i>Coleochaete scutata</i> Brébisson																					+	-	-
	<i>Cosmarium abruptum</i>	<i>Cosmarium abruptum</i> P.Lundell																					+	-	-
	<i>Cosmarium aitchisonii</i>	<i>Cosmarium aitchisonii</i> Schaarschmidt																					+	-	-
	<i>Cosmarium botrytis</i>	<i>Cosmarium botrytis</i> Meneghini ex Ralfs																					+	V	-
	<i>Cosmarium minutum</i>	<i>Cosmarium contractum</i> var. <i>minutum</i> (Delpon) Coesel																					+	3	-
	<i>Cosmarium granatum</i>	<i>Cosmarium granatum</i> Brébisson ex Ralfs																					+	*	-
	<i>Cosmarium hookeri</i>	<i>Cosmarium hookeri</i> Schaarschmidt																					+	-	-
	<i>Cosmarium meneghini</i>	<i>Cosmarium meneghini</i> Brébisson ex Ralfs																					+	V	-
	<i>Cosmarium oliveri</i>	<i>Cosmarium oliveri</i> Schaarschmidt																					+	-	-
	<i>Cosmarium pulcherrimum</i>	<i>Cosmarium pulcherrimum</i> Nordstedt																					+	-	-
	<i>Cosmarium pyramidatum</i>	<i>Cosmarium pyramidatum</i> Brébisson ex Ralfs																					+	3	-
	<i>Cosmarium undulatum</i>	<i>Cosmarium undulatum</i> Corda ex Ralfs																					+	3	-
	<i>Desmidium quadratum</i>	<i>Desmidium quadratum</i> Nordstedt																					+	3	-
	<i>Euastrum spinulosum</i>	<i>Euastrum spinulosum</i> Delpon																					+	2	-
	<i>Spirogyra mirabilis</i>	<i>Spirogyra mirabilis</i> (Hassall) Kützing																					+	-	-
<i>Spirogyra porticalis</i>	<i>Spirogyra porticalis</i> (O.F.Müller) Dumortier																					+	-	-	
<i>Spirogyra punctata</i>	<i>Temnogyra punctata</i> (Cleve) Yamagishi																					+	-	-	
Chlorophyta	<i>Bulbochaete pygmaea</i>	<i>Bulbochaete pygmaea</i> Pringsheim ex Hirn																					+	-	-
	<i>Chlamydomonas minutissima</i>	<i>Chlamydomonas minutissima</i> Korshikov																					+	-	-
	<i>Chlorella vulgaris</i>	<i>Chlorella vulgaris</i> Beijerinck																					+	-	-
	<i>Chlorococcum infusionum</i>	<i>Chlorococcum infusionum</i> (Schrank) Meneghini																					+	-	-
	<i>Chlorella ellipsoidea</i>	<i>Chloridium ellipsoideum</i> (Gerneck) Darienko & al																					+	-	-
	<i>Dactylococcus infusionum</i>	<i>Dactylococcus infusionum</i> Nägeli																					+	-	-
	<i>Desmococcus olivaceus</i>	<i>Desmococcus olivaceus</i> (Persoon ex Acharius) J.R.Laundon																					+	-	-
	<i>Chlamydomonas debaryana</i>	<i>Edaphochlamys debaryana</i> (Goroschankin) Pröschold & Darienko																					+	-	-
	<i>Gloeocystis vesiculosa</i>	<i>Gloeocystis vesiculosa</i> Nägeli																					+	-	-
	<i>Oedogonium pringsheimii</i>	<i>Oedogonium pringsheimii</i> C.E.Cramer ex Hirn																					+	-	-
	<i>Oocystis geminata</i>	<i>Oocystis geminata</i> Nägeli ex A.Braun																					+	-	-
	<i>Pandorina morum</i>	<i>Pandorina morum</i> (O.F.Müller) Bory																					+	-	-
	<i>Pleurococcus mucosus</i>	<i>Pleurococcus mucosus</i> (Kützing) Rabenhorst																					+	-	-
	<i>Pediastrum boryanum</i>	<i>Pseudopediastrum boryanum</i> (Turpin) E.Hegewald																					+	-	-
<i>Scenedesmus quadricauda</i>	<i>Scenedesmus quadricauda</i> (Turpin) Brébisson																					+	-	-	
<i>Scenedesmus acutus</i>	<i>Tetradesmus obliquus</i> (Turpin) M.J.Wynne																					+	-	-	
<i>Conferva bombycina</i>	<i>Tribonema bombycinum</i> (C.Agardh) Derbès & Solier																					+	-	-	
Cyanobacteria	<i>Cylindrospermum licheniforme</i>	<i>Cylindrospermum licheniforme</i> Kützing ex Bornet & Flahault																				+	-	-	
	<i>Gomphosphaeria aponina</i>	<i>Gomphosphaeria aponina</i> Kützing																				+	-	-	
	<i>Oscillatoria chlorina</i>	<i>Kamptomena chlorinum</i> (Kützing ex Gomont) Strunecký, Komárek & J.Smarda																				+	-	-	
	<i>Phormidium autumnale</i>	<i>Microcoleus autumnalis</i> (Gomont) Strunecký, Komárek & J.R.Johansen																				+	-	-	
	<i>Nostoc commune</i>	<i>Nostoc commune</i> Vaucher ex Bornet & Flahault																				+	-	-	
<i>Nostoc verrucosum</i>	<i>Nostoc verrucosum</i> Vaucher ex Bornet & Flahault																				+	-	-		

Appendix 1. (Continued)

PHYLUM	Synonym species from articles	Current accepted name from Algaebase (2024)	Upper Helmand River	Upper Herat River (Hari Rudf)	Band-i Amir (Bamyan province)	Panjao small River	Sar-i Chasma	Panjshir River	Shin Dand (Sabzwar) River	Girishk River	Andarab River	Dilaram. River (The Khash Rud)	Mokur. Canal	Lai-i-Sarjangel (Upper Hari Rud)	Murghab-Maimana	Qala Nau-Murghab	Nuristan (Kuner River)	Sar-i chashma Chashmaisair and Shamarg	Hari Rud River2	Upper Helmand3Hauz-i Mahiha	Upper Helmand Rud2 (Farakulum)	Indeterminate sampling place country	RL	BCG	
			Cyanobacteria	<i>Oscillatoria brevis</i>	<i>Phormidium breve</i> (Kützing ex Gomont) Anagnostidis & Komárek																+				
	<i>Phormidium uncinatum</i>	<i>Phormidium uncinatum</i> Gomont																	+					-	-
	<i>Pseudanabaena catenata</i>	<i>Pseudanabaena catenata</i> Lauterborn																	+					-	-
Ochrophyta	<i>Characiopsis anabaenae</i>	<i>Characiopsis anabaenae</i> Pascher																	+					-	-
	<i>Heterococcus caespitosus</i>	<i>Heterococcus caespitosus</i> Vischer																	+					-	-
	<i>Polyedrium minimum</i>	<i>Tetraëdron minimum</i> (A.Braun) Hansgirg																				+		-	-