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DIJATOMEJE
SLIJEVA JADRANSKOG MORA U BOSNI I HERCEGOVINI

DIATOMS
OF THE ADRIATIC SEA BASIN IN BOSNIA AND HERZEGOVINA

Dubravka Hafner i Anita Dedić

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Kazalo

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PREDGOVOR

Dijatomeje (alge kremenjašice) su fotosintetski eukariotski protisti čija je važnost prvenstveno u primarnoj proizvodnji organskih tvari i kisika za sve organizme u biosferi, pa tako i za čovjeka. Brojnost im je toliko velika da se računa da svaki peti udah dugujemo upravo njima (Mann, 2010).

Iako su ekološki važna skupina organizama, za većinu ljudi još uvijek su nepoznata. Kako bismo ukazali na njihovu važnost i veliku raznolikost u našem okruženju predstavljamo ovu monografiju. Monografija ne nudi konačni broj dijatomeja Bosne i Hercegovine ali je dobra početna točka koja nas uvodi u bogatstvo naše prirodne baštine.

Nastala je kao rezultat znanstvenog rada profesorice Dubravke Hafner koja je cijeli svoj životni i radni vijek posvetila istraživanju cijanobakterija i algi, s posebnim interesom prema dijatomejama.

FOREWORD

Diatoms are photosynthetic eukaryotic protists which are responsible for a large proportion of primary production on the planet and, as a result, are a major supplier of oxygen to all organisms in the biosphere, including humans**.** Their number is so great that, according to Mann (2010), we owe every fifth breath to them.

Although they are an ecologically important group of organisms, most people know nothing about them. We present this monograph in order to show their importance and great diversity in the landscape of Bosnia and Herzegovina. Our monograph does not offer a definitive account of the diatoms of Bosnia and Herzegovina but is a starting point, giving an insight into the richness of our natural heritage.

It was created as a result of the scientific work of professor Dubravka Hafner, who has dedicated her entire life and work to research on cyanobacteria and algae, with a particular interest in diatoms.

1. UVOD

1.1. Dijatomeje

Dijatomeje su vrstama najbogatija skupina algi, s do danas opisanih oko 12 000 vrsta u preko 260 rodova. Pretpostavlja se da bi broj vrsta mogao biti i do 100 000 (John, 2012).

Brojna su i široko rasprostranjena skupina jednostaničnih eukariotskih mikroorganizama koje obitavaju u svim staništima gdje je voda prisutna u bilo kojem obliku. Naseljavaju sva vodena i vlažna kopnena staništa na Zemlji. Neke obitavaju kao slobodno plivajući organizmi, raspršeni u vodenom stupcu (fitoplankton), a drugi kao pričvršćeni za anorgansku ili organsku podlogu (perifiton, fitobentos) (Stevenson, 1996).

Stanična stijenka građena im je od silicijevog dioksida ili kremena (SiO_2 x nH_2O), a naziva se frustulom (*lat. Frustulum - mali dio*) te sadrži silicijeve strukture koje se koriste kao determinacijsko svojstvo.

Od pigmenata posjeduju *klorofile* i *karotenoide*, i to klorofil (*chl a* i *c*), fukoksantin i druge ksantofile (neufukoksantin, diadinoksantin, diatiksantin). Rezervna tvar su im krizolaminarin (polimer glukoze) i lipidi (uljna tjelešca) (Round i sur., 1990; Gelzinis i sur., 2015).

Veličina, oblik i ornamentika stanične stijenke su im značajne odlike za taksonomsku pripadnost vrste. Zahvaljujući građi silikatne stanične stijenke, dijatomeje su dobro sačuvane i kao fosilni ostaci. Fosili su im sačuvani još iz razdoblja krede.

Na rast i razvoj dijatomeja, kao i svih algi općenito, utječu različiti čimbenici kao što su svjetlost, temperatura, strujanje vode, brzina strujanja vode, tip podloge,

1. INTRODUCTION

1.1. Diatoms

Diatoms are the largest group of algae by number of species, with about 12,000 species in over 260 genera described to date. It is estimated that the total number of species could be as high as 100,000 (John, 2012). They are a numerous and widespread group of unicellular eukaryotic microorganisms found in all habitats where water is present in any form. Some live as free-floating organisms, dispersed in the water column (phytoplankton) whilst others live attached to inorganic or organic surfaces (periphyton, phytobenthos) (Stevenson, 1996).

The cell wall, made of silicon dioxide or silica (SiO_2 x nH_2O), is called a frustule (*lat. Frustulum - a small part*). Diatoms contain two types of pigments involved in light harvesting and photoprotection: *chlorophylls and carotenoids*. They possess the photosynthetic pigments chlorophyll (*chl a* and *c*), fucoxanthin and other xanthophylls (neufucoxanthin, diadinoxanthin, diatixanthin). Their reserve substance is chrysolaminarin (glucose polymer) and lipids (oil bodies) (Round et al., 1990; Gelzinis et al., 2015).

Size, shape and cell wall ornamentation are significant features for the classification of diatom species. Due to their silica cell walls, diatoms are well preserved as fossils (Smol and Stoermer, 2010). Preserved fossils date back to the Cretaceous period.

The growth and development of diatoms, and algae in general, is influenced by various factors such as light, temperature, water flow, flow rate, type of substrate,

pH, tvrdoća, salinitet, koncentracija otopljenog kisika, zasićenje kisikom, električna vodljivost, koncentracija hranjivih soli, itd. (Hynes, 1979, Vrhovšek, 2006, Soininen, 2007).

Važnost im se ogleda na njihovoj ulozi u hranidbenom lancu (Lamberti, 1996), obogaćivanju površinskog sloja kisikom, te ulozi u biokemijskim ciklusima (Mulholland, 1996). Značajan su segment bioraznolikosti kao i genetski izvor u rijekama i potocima (Patrick, 1961, Smol i Stoermer, 2010)

Primjenjuju se kao indikatori okolišnih promjena u lotičkim i lentičkim vodenim ekosustavima (Palmer, 1962, Smol i Stoermer, 2010). Najbolji su pokazatelji kakvoće vode u ocjeni ekološkog stanja.

No s druge strane, ako su u vodi prisutne u velikom broju, mogu predstavljati i problem na način da smanjuju kvalitetu vode (Smol i Stoermer, 2010), daju miris i okus vodi (Smol i Stoermer, 2010), začepljuju filtere za vodu u industrijskim uređajima te uzrokuju toksična cvjetanja vode (Palmer, 1962; Smol i Stoermer, 2010). Više znanja o dijatomejama povećalo je njihovu važnost i primjenu u komercijalne i industrijske svrhe kao što su biogoriva, lijekovi, zdrava hrana, biomolekule, materijali relevantni za nanotehnologiju i kao bioremediatori kontaminirane vode (Bozarth i sur., 2009).

1.2. Dosadašnja istraživanja cijanobakterija i algi u Bosni i Hercegovini

Prvi radovi o algama u Bosni i Hercegovini objavljeni su krajem 19. (Kummer 1849; Beck 1886, 1890; Protić 1897a, b, 1899; Gutwinski 1896, 1897, 1899a, b, c) i početkom 20. stoljeća (Beck 1928; Protić 1901, 1904, 1907, 1908, 1935, 1942).

Kummer (1849) je objavio prvi algološki rad nakon određivanja svojti; *Cladophora glomerata* Kützing u

pH, hardness, salinity, dissolved oxygen concentration, electrical conductivity, nutrient concentration and more (Hynes, 1979, Vrhovšek, 2006, Soininen, 2007).

They play important roles in the food chain (Lamberti, 1996) and biogeochemical cycles (Mulholland, 1996) and contribute oxygen to surface. They form a significant segment of biodiversity, as well as a genetic resources in rivers and streams (Patrick, 1961, Smol and Stoermer, 2010). They are used as indicators of environmental changes in lotic and lentic aquatic ecosystems (Palmer, 1962, Smol and Stoermer, 2010). On the other hand, a large number of diatoms in water can also pose problems such as reducing the quality of the water (Smol and Stoermer, 2010), giving water a distinct smell and taste (Smol and Stoermer, 2010), clogging water filters in industrial devices and causing toxic algal blooms (Palmer, 1962, Smol and Stoermer, 2010).

More knowledge about diatoms has also enhanced their importance and usefulness in commercial and industrial applications such as biofuels, pharmaceuticals, health foods, biomolecules, and materials relevant to nanotechnology, and as bioremediators of contaminated water (Bozarth et al., 2009).

1.2. Previous research on cyanobacteria and algae in Bosnia and Herzegovina

The first papers on algae in Bosnia and Herzegovina were published in the late 19th (Kummer 1849; Beck 1886, 1890; Protić 1897a, b, 1899; Gutwinski 1896, 1897, 1899a, b, c) and early 20th centuries (Beck 1928; Protić 1901, 1904, 1907, 1908, 1935, 1942).

Kummer (1849) published the first phycological paper after determining the taxa; *Cladophora glomerata*

rijeci Trstenici kod Kraljeve Sutjeske i *Chara gymnophylla* A. Braun u rijeci Stavnji kod Podlugova (Jerković, 1981). U navedenim radovima su predstavljeni biogeografski i ekološki podaci u oblicima jednostavnih popisa, uglavnom svedenih na florističke liste algi određenih postaja. Nažalost iz tog razdoblja nema sačuvanih mikroskopskih preparata kao niti konzerviranih uzoraka (Jerković i Rončević 1981, Jerković 1981). Od 1945. istraživanja je započeo Hustedt, ali su bila uglavnom usmjerena na dijatomeje u jugoistočnoj Europi. Dao je detaljan opis, relativnu učestalost, areal i autoekološke podatke za 346 vrsta i 95 formi koje je utvrdio u Hrvatskoj, Bosni i Hercegovini, Crnoj Gori i Makedoniji s posebnim osvrtom na fosilne, recentne i endemične dijatomeje (Hustedt, 1945). Dao je i pregled dijatomejske flore navedenih područja, srednje i sjeverne Europe te Alpa (Hustedt, 1945.).

Istraživanja dijatomeja su intenzivirana i brojna u razdoblju od 1960. do 1990. (Jerković 1971, 1978a, b, 1981; Jerković i Remeta 1972., 1974 a,b,c; Blagojević 1976; Blagojević i Hafner 1979 a, b, c, 1980 a, b, 1981, 1983, 1991; Blagojević i sur., 1996; Hafner 1989 a, b, 1991). Godine 1966. započela su istraživanja dijatomejskih ljušturica korištenjem elektronske i stereoscan mikroskopije (Jerković 1969, 1970, 1971, 1981; Jerković i Remeta 1972, 1974 a, b, c).

U novije vrijeme u okviru magistarskih i doktorskih radova istraživanjima cijanobakterija i algi, s najvećim naglaskom na dijatomeje bavili su se Kapetanović T. (2007), Kamberović J. (2015) i Dedić A. (2015). Algološka i dijatomejska istraživanja postaju sve intenzivnija i brojnija o čemu svjedoče i objavljeni radovi (Hafner 2000, 2008, 2009; Hafner i Blagojević, 2003; Hafner i Jasprica 2007, 2010; Hafner i sur. 2006, 2007, 2013, 2015 a, b; Kapetanović i Hafner, 2007; Kapetanović i sur., 2011, 2014; Ivanković i Hafner 2010, 2012; Ivanković i sur. 2010; Kamberović i Barudanović 2012; Kamberović i sur. 2016, 2017, 2018a, b; 2019a, b; Dedić i sur., 2013, 2014, 2015a, b, 2019 a, b).

Kützing in the Trstenica River near Kraljeva Sutjeska and *Chara gymnophylla* A. Braun in the Stavnja River near Podlugovi (Jerković, 1981). The aforementioned papers presented biogeographical and ecological data in the form of simple lists of algae from certain sites.

Unfortunately, there are no preserved microscopic preparations or preserved specimens from this period (Jerković and Rončević 1981, Jerković 1981). After 1945, research was started by Hustedt, but the main focus was on diatoms in South-eastern Europe. He provided a detailed description, relative frequency, species distribution and autoecological data for 346 species and 95 forms that he recorded in Croatia, Bosnia and Herzegovina, Montenegro and Macedonia with particular reference to fossil, extant and endemic diatoms (Hustedt, 1945). He also gave an overview of the diatom flora of this area as well as Central and Northern Europe and the Alps (Hustedt, 1945).

In the period from 1960 to 1990 research on diatoms intensified (Jerković 1971, 1978a, b, 1981; Jerković and Remeta 1972, 1974 a, b, c; Blagojević 1976; Blagojević and Hafner 1979 a, b, c, 1980 a, b, 1981, 1983, 1991; Blagojević et al., 1996; Hafner 1989 a, b, 1991). In 1966, diatom frustules were investigated using electron and stereoscan microscopy (Jerković 1969, 1970, 1971, 1981; Jerković i Remeta 1972, 1974 a, b, c).

More recently, within master's and doctoral studies on cyanobacteria and algae, Kapetanović T. (2007), Kamberović J. (2015) and Dedić A. (2015) have put the most emphasis on diatoms. Research on algae and diatoms has become more intensive and numerous, as evidenced by published papers (Hafner 2000, 2008, 2009; Hafner and Blagojević, 2003; Hafner and Jasprica 2007, 2010; Hafner et al. 2006, 2007, 2013, 2015 a, b ; Kapetanović and Hafner, 2007; Kapetanović et al., 2011, 2014; Ivanković and Hafner 2010, 2012; Ivanković et al. 2010; Kamberović and Barudanović 2012; Kamberović et al. 2016, 2017, 2018 a, b; 2019 a, b; Dedić et al., 2013, 2014, 2015 a, b, 2019 a, b).

Na području Neumskog zaljeva 2010. započeta su istraživanja fitoplanktona i fitobentosa. Fitoplankton Neumskog zaljeva istraživali su Jasprica i sur. (2013). Navedeni autori su također objavili i radove o bentoskim (pridnenim) dijatomejama u Neumskom zaljevu (Hafner i sur., 2018 a, b). Navedena istraživanja daju prve detaljne podatke o morskim planktonskim i bentoskim dijatomejama.

1.3. Raznolikost cijanobakterija i algi u Bosni i Hercegovini

U tablici 1. predstavljeni su podaci o raznolikosti cijanobakterija i algi Bosne i Hercegovine (Redžić i sur., 2008). Ukupno je za cijanobakterije i alge utvrđeno 1859 vrsta iz 217 rodova (Tablica 1).

Tablica 1. Popis raznolikosti cijanobakterija i algi na području Bosne i Hercegovine (Redžić i sur., 2008).

Research on phytoplankton and phytobenthos began in the area of the Neum Bay (only costal part of the country) in 2010. The phytoplankton of the Neum bay was researched by Jasprica et al. (2013). The aforementioned authors have also published papers on benthic (bottom-dwelling) diatoms in the Neum bay (Hafner et al., 2018 a, b). These studies provide the first detailed data on marine planktonic and benthic diatoms in Bosnia and Herzegovinia.

1.3. Diversity of cyanobacteria and algae in Bosnia and Herzegovina

Table 1 presents data on the diversity of cyanobacteria and algae in Bosnia and Herzegovina (Redžić et al., 2008). In total, 1859 species from 217 genera were identified for cyanobacteria and algae (Table 1). A total of 47% algal species are diatoms.

Table 1. List of cyanobacteria and algae diversity in Bosnia and Herzegovina (Redžić et al., 2008).

	Rod Genus	Vrsta Species	Podvrsta Subspecies	Varijetet Variety	Forma Form
Cyanobacteria	36	303		1	4
Rhodophyta	7	20		1	
Charophyceae	33	319		31	5
Chlorophyceae	65	242		25	2
Euglenophyceae	4	21	-	-	-
Dinoflagellata	5	20	-	-	2
Bacillariophyceae	57	881	1	222	15
Xantophyta	4	21	-	-	-
Chrysophyta	12	32	-	4	-
Ukupno/Total	**217**	**1859**	**1**	**284**	**28**

Navedeni rezultati ukazuju da su dijatomeje najbogatije vrstama (881), varijetetima (222) i formama (15). Rodovi najbogatiji vrstama su: *Navicula*, *Eunotia* i *Cymbella*. U tablici 2. prikazana je raznolikost cijanobakterija i algi na sedrenim naslagama četiriju rijeka Bosne i Hercegovine (Redžić i sur, 2008).

Tablica 2. Raznolikost cijanobakterija i algi na sedrenim naslagama (Redžić i sur., 2008).

These results indicate that diatoms are richest in species (881), varieties (222), and forms (15). The genera richest in species are: *Navicula, Eunotia* and *Cymbella*. Table 2 shows the diversity of cyanobacteria and algae on the travertine deposits of the four rivers of Bosnia and Herzegovina (Redžić et al, 2008).

Table 2. Diversity of cyanobacteria and algae on the travertine deposits (Redžić et al., 2008).

	Unac	Una	Pliva	Trebižat
Cyanobacteria	2	31	6	7
Rhodophyta	2	6	1	2
Charophyceae	6	13	2	3
Chlorophyceae	4	18	2	2
Bacillariophyceae	9	115	2	1
Xantophytceae	2	4	1	1
Chrysophyceae	1	1	-	1
Ukupno/Total	**26**	**188**	**14**	**17**

Osobitost raznolikosti algi daju i oblici u bočatnim te slanim vodama bosanskohercegovačkog dijela Jadranskog mora. Tu su posebno značajni predstavnici smeđih, crvenih i zelenih algi. Prema podacima o algama Neumskog zaljeva koje su objavili (Jasprica i sur., 2013, Hafner i sur., 2018 a, b) ukupno je određeno 537 svojti dijatomeja, 57 svojti dinoflagelata, jedna zelena alga te dvije kokolitoforide.

Prema Redžiću i sur. (2008) svijet algi Bosne i Hercegovine je nepoznanica te iziskuje još dodatnih istraživanja u svrhu upotpunjavanja popisa algi i cijanobakterija. Najveći problem u istraživanjima predstavlja raznovrsnost staništa što zahtjeva i različite pristupe u istraživanju zajednica. S jedne strane, sedrene barijere, cretovi, termalni, mineralni, krški izvori, a s druge strane bočate vode i more.

Forms in the brackish and salty waters of Bosnia and Herzegovina's part of the Adriatic Sea also have distinctive algal floras. Representatives of brown, red and green algae are of particular significance here. A total of 537 diatom taxa, 57 dinoflagellate taxa, one green alga and two coccolithophores were confirmed from [phytoplankton and phytobenthos] in Neum Bay (Jasprica et al., 2013; Hafner et al., 2018 a, b).

Despite these studies, Redžić et al. (2008) regard the algae world of Bosnia and Herzegovina as still largely unknown and additional research is needed in order to supplement the list of algae and cyanobacteria. The biggest problem in research in Bosnia and Herzegovina is great habitat diversity, which requires different approaches to research. On the one hand, travertine barriers, streams, thermal, mineral and karst springs, and on the other, brackish water and sea.

1.4. Ugroženost dijatomeja

Kao i većina država Europe, ni Bosna i Hercegovina nema crvene popise ugroženih svojti cijanobakterija i algi. Države koje imaju objavljene crvene popise ili knjige su: Njemačka (Rudolph i sur., 2017); Ukrajina (Palama-Mordvintseva i Tsarenko, 2004); Hrvatska (Antolić i sur., 2011) i sl. Objavljeni popisi se najviše odnose na nedijatomejske skupine algi.

Za dijatomeje je uvriježeno mišljenje da nisu ugrožena skupina organizama budući da se vrlo brzo razmnožavaju i naseljavaju nove prostore. Ali u novije vrijeme, zahvaljujući rezultatima o osjetljivosti dijatomejskih svojti, taksonomskim, biološkim i biogeografskim studijima to mišljenje se nastoji promijeniti. Mnoge dijatomeje su endemične svojte, mogu biti ograničene na manje geografsko područje, na njih utječu okolišni čimbenici, kako na razvoj tako i na rasprostranjenje, i sve to zajedno ih čini kandidatima za zaštitu (Vyvermat i sur., 2016).

U Bosni i Hercegovini, iako nemamo popise za alge općenito, postoje navodi za recentne oblike cijanobacteria i algi (Redžić i sur., 2008).

Do sad nema opisanih endema među cijanobakterijama i algama, ali pretpostavljamo da ih može biti. U raznovrsnosti područja (planinski izvori i potoci, termalni, mineralni, krški izvori, sedrene naslage, pećine) zasigurno ih ima te je nužno napraviti nova detaljnija istraživanja, nove popise kao i revizije dosadašnjih kako bismo dobili podatke kojim bismo navedeno potvrdili.

1.4. Endangerment of diatoms

Like most European countries, Bosnia and Herzegovina does not have Red Lists of endangered taxa of cyanobacteria and algae. Countries that have published red lists or books are: Germany (Rudolph et al., 2017); Ukraine (Palama-Mordvintseva and Tsarenko, 2004); Croatia (Antolić et al., 2011) etc. The published lists are mostly confined to algae other than diatoms.

Diatoms were once thought not to be endangered, as they were cosmopolitan and did not have distinct biogeographies, but more recently, this opinion has changed. Many diatoms are endemic to particular regions or restricted to limited geographical areas due to environmental factors, which all together makes them candidates for protection (Vyvermat et al., 2016).

Although Bosnia and Herzegovina does not have checklists for algae in general, there are lists of extant forms of cyanobacteria and algae (Redžić et al., 2008).

So far, no endemics have been reported among cyanobacteria and algae, but their existence is suspected, particularly due to the vast diversity of habitats (mountain springs and streams, thermal, mineral, karst springs, travertine deposits, caves) that have not yet been studied in detail, and it is necessary to conduct more detailed research, create new lists and revise the current ones in order to obtain data to confirm this.

2. PODRUČJE ISTRAŽIVANJA

Ukupna površina Bosne i Hercegovine iznosi 51 129 km^2, od čega Crnomorskom slijevu gravitira 38 719 km^2 ili 75,7 %, a slijevu Jadranskog mora 12 410 km^2 ili 24,3 % (Slika 1) (www.fhmzbih.gov.ba).

Granica između površinskog otjecanja u Crnomorski i Jadranski slijev uglavnom je podzemna. Kao orografska razvodnica između ta dva slijeva navode se gorski hrptovi i sedla: Plješevica, Brusovac, Vijenac, Šator, Vagan, Cincar, Molovan, Raduša, Makljen, Bitovnja, Ivan Sedlo, Bjelašnica, Treskavica, Zelengora, Čemerno i Lebršnik iznad Gatačkog polja. Razvodnicu između Jadranskog i Crnomorskog slijeva čine najvećim dijelom vapnenačke planine (Musa, 2007).

Najviša točka kao razvodnica Jadranskog i Crnomorskog slijeva nalazi se u području Bjelašnice na njezinom istoimenom vrhu, na nadmorskoj visini od 2 067 m (Musa, 2007). Najbliža točka razvodnice Jadranskog i Crnomorskog slijeva je na planini Cincar i udaljena je oko 60 km od Jadranskog mora (Musa, 2007.).

U vapnenačkim terenima zapadnog dijela Bosne i Hercegovine, topografsko razvođe se ne poklapa s hidrološkim, pa tako ponornice ovih terena često topografski pripadaju jednom, a hidrološki drugom slijevu. Primjer je rijeka Milač u Kupreškom polju čije vode odlaze i u Vrbas (Crnomorski slijev) i u Šuicu (Jadranski slijev) (Musa 2007).

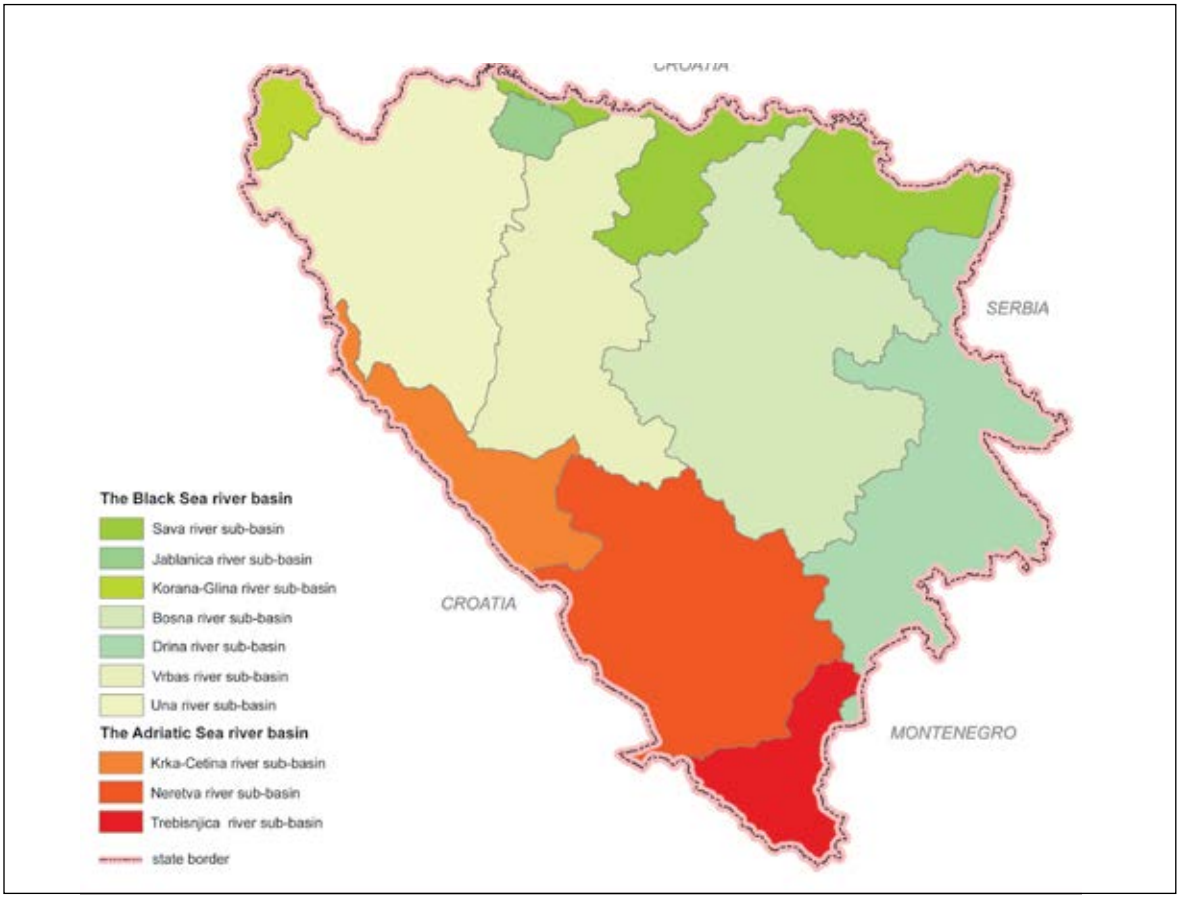
2. RESEARCH AREA

The total area of Bosnia and Herzegovina is 51 129 km^2, of which 38 719 km^2 or 75.7% drain towards the Black Sea and 12 410 km^2 or 24.3% to the Adriatic Sea (Figure 1) (www.fhmzbih.gov.ba).

The boundary between surface runoff into the Black Sea and Adriatic Sea basins is mostly underground. The following mountain ridges and saddles are referred to as the orographic divides between the two basins: Plješevica, Brusovac, Vijenac, Šator, Vagan, Cincar, Molovan, Raduša, Makljen, Bitovnja, Ivan Sedlo, Bjelašnica, Treskavica, Zelengora, Čemerno and Lebršnik above the Gatačko field. The divides between the Adriatic and the Black Sea basins are mostly made up of limestone mountains (Musa, 2007).

The highest point used as a drainage divide between the Adriatic and Black Sea basins is in the Bjelašnica region, at its eponymous peak, at an altitude of 2.067 m (Musa, 2007). The nearest point of division between the Adriatic and Black Sea basin is on Mount Cincar, about 60 km from the Adriatic Sea (Musa, 2007).

In the limestone terrains of the western part of Bosnia and Herzegovina, the topographic catchment does not coincide with the hydrologic one, so the subterranean rivers of these terrains often belong topographically to one basin, but hydrologically to the other. An example of this is the Milač river in Kupreško field, whose waters drain to both the Vrbas (Black Sea basin) and the Šuica (Adriatic Sea basin) (Musa, 2007).



Slika 1. Slijevovi u Bosni i Hercegovini. (izvor: D. Šakić)

Figure 1. Basins in Bosnia and Herzegovina (source: D. Šakić)

2.1. Slijev Jadranskog mora u Bosni i Hercegovini

Područje slijeva Jadranskog mora u Bosni i Hercegovini obuhvaća krški prostor na kojem su formirani značajni površinski tokovi: Neretva, Trebišnjica, Krka i Cetina (Slika 2). Teritorijalno gledajući navedeni slijevovi obuhvaćaju područja triju država (Slika 1). Veći, sjeveroistočni dio pripada Bosni i Hercegovini, manji, jugozapadni dio prostoru Republike Hrvatske, a najmanji jugoistočni dio je u Crnoj Gori (Slika 1).

2.1. The Adriatic Sea basin in Bosnia and Herzegovina

The area of the Adriatic Sea basin in Bosnia and Herzegovina encompasses a karst area where significant surface waters have been formed: Neretva, Trebišnjica, Krka and Cetina (Figure 2). Territorially speaking, these river basins encompass parts of three countries. The larger, north-eastern part belongs to Bosnia and Herzegovina, the smaller, south-western part to the territory of the Republic of Croatia, and the smallest south-east part is in Montenegro.

Slika 2. Slijev Jadranskog mora u Bosni i Hercegovini. (Izvor: D. Šakić)

Figure 2. The Adriatic Sea basin in Bosnia and Herzegovina (Source: D. Šakić)

Ukupna površina vodnog područja Jadranskog mora u Bosni i Hercegovini je 8 782 km^2 od čega je površina Neretve i Trebišnjice 6 041,6 km^2, Cetine 2 655,6 km^2, a Krke 84,8 km^2. Značajni vodotoci, odnosno slijevovi su: rijeke Neretve i rijeke Krke s Cetinom.

The total surface area of the Adriatic Sea basin district in Bosnia and Herzegovina is 8.782 km^2, of which the surface of Neretva and Trebišnjica is 6.041km^2, Cetina 2.655 km^2, and Krka 84.8 km^2. Significant watecourse are: the Neretva river and the Krka river with the Cetina.

Jadranski slijev ima relativno malo rijeka s površinskim otjecanjem. Prevladavaju ponornice i podzemni tokovi. Rijeke Jadranskog slijeva obično nastaju od izvora u kršu, a najčešće su to vode nekih cijelih tokova koji su negdje u nekom višem dijelu reljefa ponorile (Bonacci, 2003). Dolina rijeke Neretve je najvećim dijelom kanjonskog tipa, a korita su sa čestim brzacima, slapovima i vodopadima. U proširenim dolinama i poljima, padovi su mali.

Geološka građa i petrografski sastav terena Jadranskog slijeva koji se nalazi u području Dinarida razvijao se tijekom paleozoika te kenozoika i pripada razvijenom kršu (Goluža, 2003). Izgrađen je uglavnom od vodopropusnih stijena, krških krečnjaka i manjim dijelom vodopropusne stijenske mase dolomita (Goluža, 2003).

The Adriatic basin has relatively few rivers with surface runoff; it is dominated by subterranean rivers and subsurface flows. The rivers of the Adriatic basin usually originate from karst springs, and they are most often the waters of some entire watercourses that have sunk somewhere in a higher part of the topography (Bonacci, 2003). The valley of the Neretva river is mostly of a canyon type, and its river beds have frequent rapids, cascades and waterfalls. In the broad valleys and fields, the waterfalls are small.

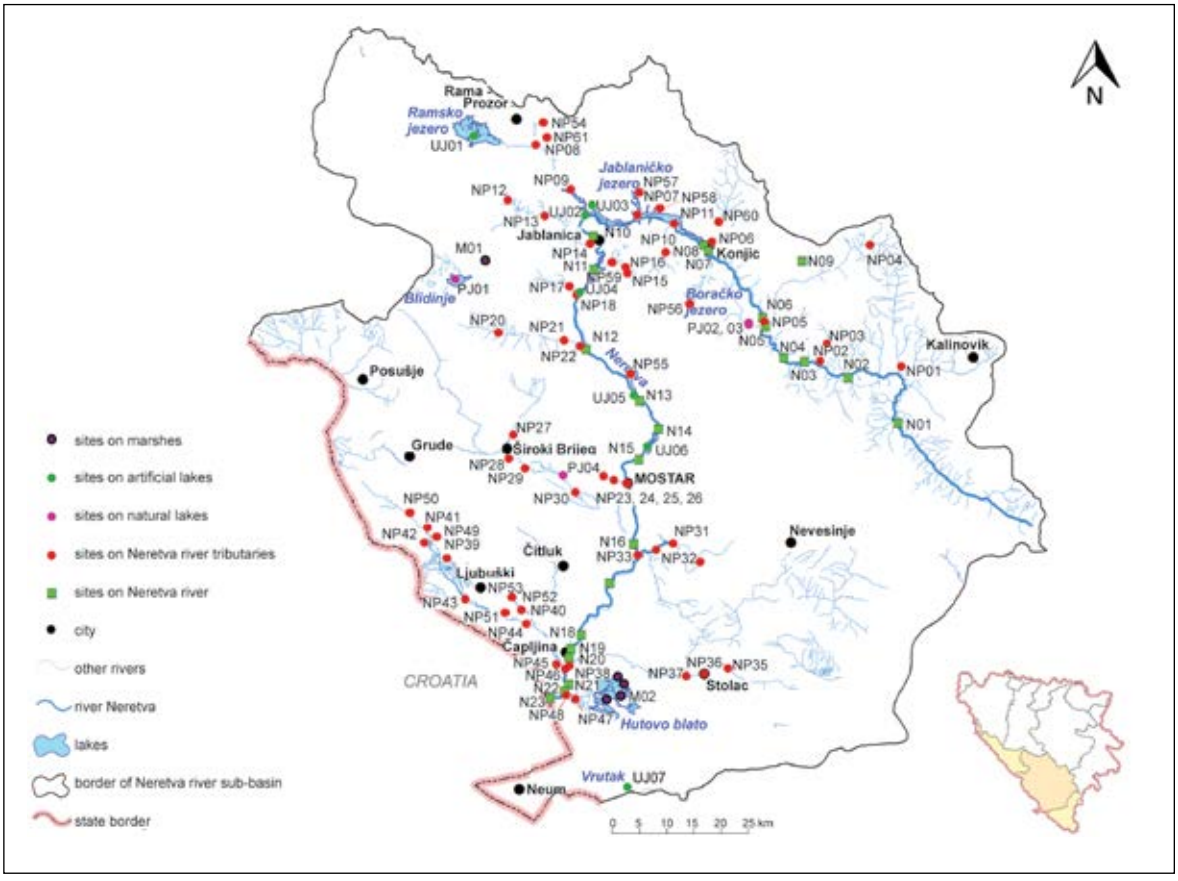
The geological structure and petrographic composition of the terrain of the Adriatic basin, which is located in the Dinaric region, evolved during the Paleozoic and Cenozoic era and belongs to a developed karst (Goluža, 2003). It is mainly made of water-permeable rocks, karst limestone and, to a lesser extent, of the water-permeable rock mass of dolomites (Goluža, 2003).

2.1.1. Slijev Neretve

Slijev rijeke Neretve (Slika 3) zauzima najveći dio vodnog područja Jadranskog mora. Rijeka Neretva je najduža krška rijeka ovog područja, s dužinom od 205,12 km^2. Izvire na sjeverozapadnim padinama planine Gredelj, točnije, zapadno od vrha Držirep (1410 m), koji je ujedno i najviši vrh planine Gredelj.

2.1.1. Neretva basin

The Neretva river basin (Figure 3) occupies most of the water basin district of the Adriatic Sea. It is the longest karst river in the region, with a length of 205 km^2. Its spring is located on the north-western slopes of Mount Gredelj, more precisely, west of the Držirep peak (1410 m), which is also the highest peak of Mount Gredelj.



Slika 3. Slijev rijeke Neretve s označenim položajem postaja. Oznake postaja navedene su u naslovu 3.3. (izvor: D. Šakić)

Figure 3. The Neretva river basin with the indicated site locations. Site designations are listed in Title 3.3. (source: D. Šakić)

Rijeka Neretva nastaje od pet izvora, četiri izvora su stalni, a jedan povremen. Najviši izvor se nalazi na nadmorskoj visini od 1 340 m, a najniži na 1 200 m. U gornjem toku, Neretva teče kanjonom i prima desne pritoke: Jasenicu, Rakitnicu, Trešanicu, Kraljušnicu, Neretvicu i Ramu, dok su lijevi pritoci: Šištica i Biština (Slika 3). U srednjem toku, nizvodno od grada Jablanice, prima desne pritoke Doljanku i Drežanku i lijevu-Prenjsku rijeku (Slika 3). U donjem toku, nizvodno od Mostara prima desne pritoke: Radobolju, Lištiču i Ugrovaču, koje dolaze preko Mostarskog Blata i Jasenice. A nizvodno od Čapljine prima i rijeku Trebižat (Slika 3). Lijeve pritoke na tom dijelu su Buna, Bregava

The Neretva river is made up of five springs, four springs are perennial and one is periodic. The highest spring is located at an altitude of 1.340 m and the lowest at 1.200 m. In its upper course, the Neretva flows through a canyon and receives the right tributaries: Jasenica, Rakitnica, Trešanica, Kraljušnica, Neretvica and Rama, while the left tributaries are: Šištica and Biština (Figure 3). In its middle course, downstream of the town of Jablanica, it receives right tributaries of Doljanka and Drežanka and the Prenj river on the left (Figure 3). In its lower course, downstream of Mostar it receives the right tributaries: Radobolja, Lištica and Ugrovača, which come via Mostarsko Blato and Jasen-

i Krupa (Slika 3). Pritoke rijeke Neretve u srednjem dijelu slijeva dotječu iz krških polja s lijeve i desne strane toka: pritoke Lištica i Jasenica (s vodama iz Mostarskog blata), pritoka Buna (vode iz Nevesinjskog polja), pritoka rijeka Bregava (vode iz Dabarskog i dijela Fatničkog polja), pritoka Trebižat (nastaje u Imotskom polju) (Slika 3). Također, duž samih pritoka postoje krški izvori: Klokun, Vrioštica, Grudsko vrelo, izvor Lištice te izvori Bune i Bunice. Značajna je i Krupa kao lijeva pritoka koja dotječe iz Deranskog jezera (Hutovo blato), a prihvaća i vode s hidroelektrane Čapljina (Slika 3). I pored toga što je Neretva bogata vodom, njene pritoke s viših horizonata povremeno presušuju. Dio lijeve pritoke, rijeka Trebišnjica usmjerena je prema hidroelektrani Čapljina, djelomično reguliranim koritom kroz Popovo polje.

Na rijeci Neretvi izgrađene su hidroelektrane s akumulacijama Jablanica, Grabovica, Salakovac i Mostar. Prirodna jezera u slijevu rijeke Neretve su Blidinjsko i Boračko jezero. Glacijalnog su podrijetla.

Blidinjsko jezero je najveće planinsko jezero u Bosni i Hercegovini. Smješteno je na nadmorskoj visini od 1185 m. Odnos površine jezera u vrijeme visokih vodostaja prema površini u vrijeme niskih vodostaja je 3,6 : 2,5 km^2 (Spahić, 2001).

Boračko jezero se nalazi na sjeveroistočnoj strani planine Prenj, na nadmorskoj visini 405 m. Oblika je elipse, dugačko 786 m, široko 502 m i dubine do 14 metara (Leptirica, 2008).

Na jugu Bosne i Hercegovine je submediteranska močvara Hutovo Blato i pripada općinama Čapljina i Stolac. Hutovo Blato je skup više međusobno povezanih jezera kanalima i rijekom Krupom. Najveća jezera su Deransko, Jelim, Drijen, Orah, Škrka i Svitavsko. Svitavsko ili Donje jezero je potopljeni kompenzacijski bazen, nastao izgradnjom hidroelektrane Čapljina. Sva jezera Hutovog blata su kriptodepresije. Proglašeno je Parkom prirode 1995., a 2001. je uvršten na Popis

ica. Downstream of Čapljina it also receives the river Trebižat (Figure 3). The left tributaries in this part are Buna, Bregava and Krupa (Figure 3). The tributaries of the Neretva river in the middle part of the basin flow from the karst fields on the left and right sides of the stream: the tributaries of Lištica and Jasenica (with waters from Mostarsko Blato), the tributary of Buna (waters from Nevesinjsko field), the tributary of the Bregava river (waters from Dabarsko and parts of Fatničko field), the tributary of Trebižat (emerges in the Imotsko field) (Figure 3). Also, along the tributaries themselves there are karst springs: Klokun, Vrioštica, Grudsko spring, the spring of Lištica, and springs of Buna, Bunica and Krupa are also significant as is the left tributary flowing from Deransko lake (Hutovo Blato) and receiving water from the Čapljina hydroelectric power plant (Figure 3). Although the Neretva is rich in water, its tributaries from higher horizons occasionally dry up. Part of the left tributary, the Trebišnjica river, is directed towards the Čapljina hydroelectric power plant, partly regulated through Popovo field. Hydropower plants with the reservoirs Jablanica, Grabovica, Salakovac and Mostar have been built on the Neretva. Blidinje and Boračko are natural, glacial lakes in the Neretva river basin.

Blidinje lake is the largest mountain lake in Bosnia and Herzegovina, located at an altitude of 1.185 m. The ratio of the surface of the lake during high water levels to the surface during low water levels is 3.6 : 2.5 km^2 (Spahić, 2001).

Boračko lake is located on the northeast side of Mount Prenj, at an altitude of 405 m. It is elliptical, 786 m long, 502 m wide and up to 14 m deep (Leptirica, 2008).

The sub-Mediterranean swamp of Hutovo Blato is located in the southern part of Bosnia and Herzegovina and it belongs to the municipalities of Čapljina and Stolac. Hutovo Blato is a complex of several lakes interconnected with canals and the river Krupa. The biggest lakes are Deransko, Jelim, Drijen, Orah, Škrka and Svi-

močvara od međunarodne važnosti (Ramsar) i registrirano je pri UNESCO ravnateljstvu u Parizu. Nažalost, nekad poznati prirodni ornitološki rezervat ptica močvarica i ribljih populacija (jegulja) antropogenim djelovanjem izgubio je to obilježje.

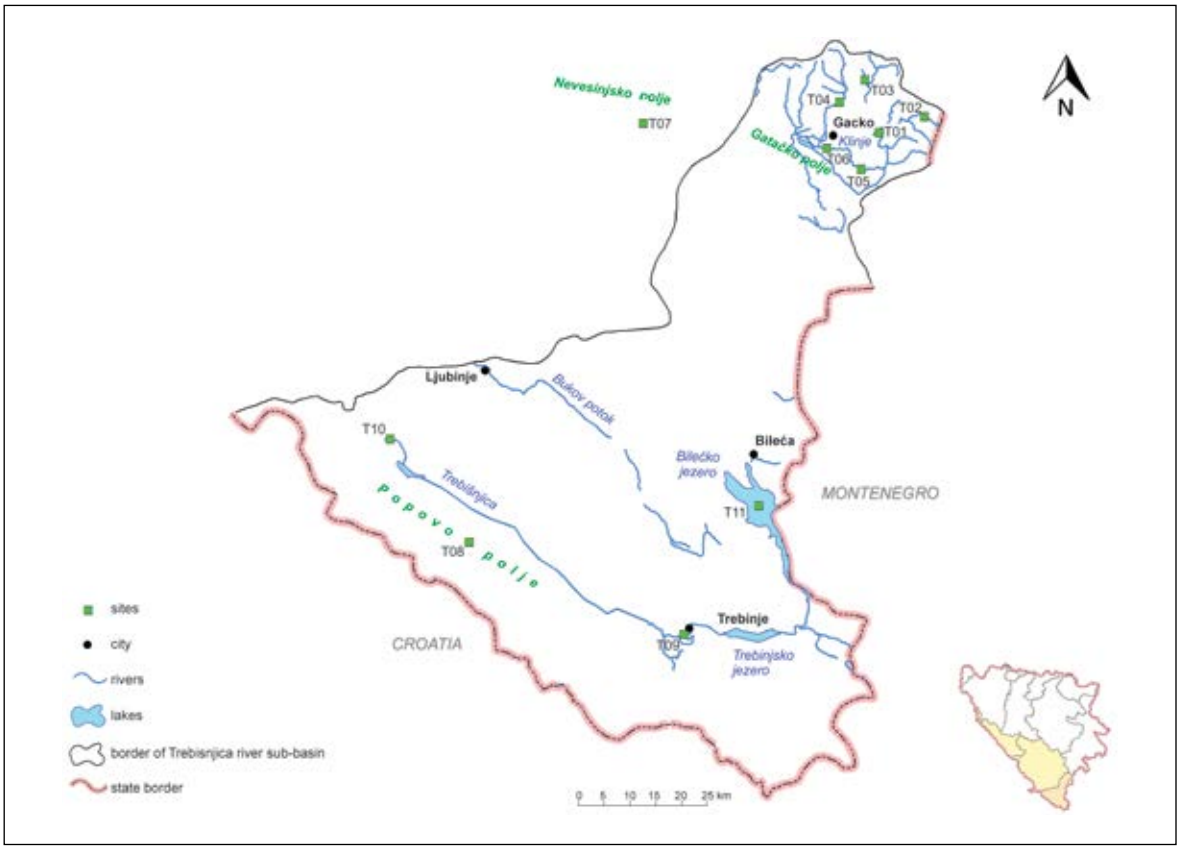
tavsko. Svitavsko or Donje lake is a flooded compensation basin created by the construction of the Čapljina hydroelectric power plant. All lakes of Hutovo Blato are cryptodepressions. Hutovo Blato was declared a Nature Park in 1995 and in 2001 it was included on the list of Wetlands of International Importance (Ramsar) and registered with the UNESCO Directorate in Paris. Unfortunately, this reserve has lost much of its diversity in recent years due to anthropogenic activity.

2.1.2. Slijev Trebišnjice

Područje slijeva rijeke Trebišnjice (Slika 4) jedno je od hidrološki i hidrogeološki najzanimljivijih područja

2.1.2. The Trebišnjica river basin

The area of the Trebišnjica river basin (Figure 4) is hydrologically and hydrogeologically one of the most



Slika 4. Slijev rijeke Trebišnjice s označenim položajem postaja. Oznake postaja navedene su u naslovu 3.3. (izvor: D. Šakić).

Figure 4. The Trebišnjica river basin with the indicated site locations. Site designations are listed in Title 3.3. (source: D. Šakić)

Dinarida. Obilje voda u jesensko-zimskom razdoblju i nestašica u vegetacijskom razdoblju, osnovna su značajka režima voda na ovom području. Područje obuhvaća širi slijev rijeke Trebišnjice sa svim krškim poljima koja se tu nalaze (Nevesinjsko, Gatačko, Dabarsko, Fatničko i Bilećko polje) (Goluža, 2003.).

2.1.2.1. Rijeka Trebišnjica

Rijeka Trebišnjica se nalazi u istočnoj Hercegovini, izvire uz južni rub grada Bileće, na zapadnom podnožju planine Vlainje, iz tri vrela: Dejanova pećina, Nikšićko vrelo i Oko. Izvor je potopljen nakon izgradnje hidroelektrane Trebinje i Bilećkog jezera (Slišković, 2014).

Prije ujezerenja Trebišnjica je bila duga oko 104 km, dok je danas duga oko 78 km, a ostali dio je pod površinom Bilećkog i Goričko akumulacijskog jezera. Površinski, prirodni tok ove rijeke prije regulacije kroz Popovo polje u vrijeme ljetnih malih voda, je iznosio oko 35 km, a u vrijeme zimskih velikih voda oko 90 km. Regulacijom toka Trebišnjice njen površinski tok je uređen i usmjeren do hidroelektrane Čapljina, odnosno gornjeg kompenzacijskog bazena i dalje do donjeg kompenzacijskog bazena Svitava, odakle se usmjerava prema Neretvi. Površina podslijeva Trebišnjice u Bosni i Hercegovini je 220 km.

Rijeka Trebišnjica, najveća je rijeka ponornica na Balkanu i jedna od najvećih ponornica na svijetu, dugačka je 98 km, s podzemnim tokovima 187 km (Milanović, 2006). Čini je složen sustav površinskih i podzemnih tokova.

Bilećko jezero na rijeci Trebišnjici je najveća umjetna akumulacija na Balkanu. Površina jezera je oko 33 km^2. Najveća dubina 104 metra, a nalazi se na oko 400 m nadmorske visine.

interesting areas of the Dinarides. The abundance of water in autumn and winter and its scarcity in the vegetation period are the main features of the water regime in this area. The area encompasses the wider basin of the Trebišnjica river with all the karst fields located there (Nevesinjsko, Gatačko, Dabarsko, Fatničko and Bilećko) (Goluža, 2003).

2.1.2.1. The Trebišnjica river

The Trebišnjica river is located in eastern Herzegovina, it rises at the southern edge of the town of Bileća, at the western foot of Mount Vlainje, from three springs: Dejanova pećina, Nikšićko spring and Oko. The spring was submerged after the construction of the Trebinje hydroelectric power plant and Bilećko lake (Slišković, 2014).

Before the lake was created, the Trebišnjica was about 104 km long. Today it is about 78 km long, and the rest is under the surface of the Bilećko and Goričko reservoirs. The surface, natural distance of this river before its regulation through Popovo field was about 35 km during the summer low waters, and about 90 km during the winter high waters. By regulating the flow of Trebišnjica, its surface flow is regulated and directed to the Čapljina hydroelectric power plant, i.e. the upper compensation basin, and further to the lower compensation basin Svitava, from where it is directed towards the Neretva river. The distance of the Trebišnjica sub-basin in Bosnia and Herzegovina is 220 km.

Trebišnjica is the largest sinking river in the Balkans and one of the largest sinking rivers in the world. It is 98 km long, with an underground flow of 187 km (Milanović, 2006). It is a complex system of surface and underground flows.

Bilećko lake on the Trebišnjica river is the largest artificial reservoir in the Balkans with a surface of around 33 km^2. It is located at the altitude of 400 m above sea level and its maximum depth is 104 meters.

2.1.3. Slijev Cetine

Slijev Cetine (Slika 5) u Bosni i Hercegovini zauzima površinu od 2, 876 km^2, a oblikuju ga porozni vapnenci i dolomiti bez stalnih površinskih tokova. Voda navedenog slijevnog područja otječe prema rijeci Cetini, a i prema drugim dijelovima slijeva gdje ga preusmjeravaju podzemni krški kanali, jame, spilje ili ponori. Pripada području karstificiranih propusnih vapnenaca i nepropusnih tercijarnih sedimenata te obuhvaća krška polja zapadnog dijela Bosne i Hercegovine na nadmorskim visinama od 700 do 1 200 m (Slišković, 2014).

Krška polja jugozapadnog područja Bosne i Hercegovine se prostiru od Kupreškog (1 150 m), do Jezerca (30-36 m). U krškim poljima značajno je pojavljivanje krških izvora što je značajka i ovog slijevnog područja. Krški izvori ovog slijeva su: Bistrica, Sturba, Žabljak i Šuica (Slika 5). Izvori formiraju vodotoke, koji su uglavnom kratki i ponorima otječu u rijeku Cetinu. Dotoci vode za krška polja smješteni su po sjeveroistočnim obodima dok su završeci vodenih tokova ili ponori, na jugozapadnim rubovima. Izgradnjom hidroelektrane Orlovac vode krških polja se uglavnom prikupljaju u akumulaciju Buško blato, odakle se, nakon energetske uporabe u Republici Hrvatskoj, ispuštaju u rijeku Cetinu.

Najveća akumulacija u koju se slijevaju vode na području slijeva Cetine je Buško Blato u Livanjskom polju, s kapacitetom od 831 106 m^3. U Buškom Blatu se akumulira voda za opskrbu hidroelektrane Orlovac smještene u Republici Hrvatskoj. Hidrogeološke studije su pokazale da se voda kreće od Kupreškog (1000 - 1200 m) i Glamočkog (850 - 1 100 m) polja prema izvorima koji okružuju Livanjsko polje (700 m) u blizini Buškog blata i rubnih područja Livna. Od Livanjskog polja i Buškog blata, voda teče prema zapadu, prema rijeci Cetini, i izvorima u blizini sjeveroistočnog ruba Sinjskog polja u Republici Hrvatskoj (Slišković, 2014).

2.1.3. The Cetina river basin

The Cetina river basin (Figure 5) in Bosnia and Herzegovina covers an area of 2.876 km^2 and is formed by porous limestones and dolomites without permanent surface flows. The water of the aforementioned drainage basin drains towards the Cetina river and to other parts of the basin where it gets diverted by underground karst channels, pits, caves or sinkholes. It belongs to the area of karstified permeable limestone and impermeable tertiary sediments and covers karst fields of the western part of Bosnia and Herzegovina at altitudes of 700 to 1.200m (Slišković, 2014).

The karst fields of southwestern Bosnia and Herzegovina extend from Kupreško field (1.150m) to Jezerce (30-36m). In karst fields, the occurrence of karst springs is significant, which is a feature of this drainage basin as well. The karst springs of this basin are: Bistrica, Sturba, Žabljak and Šuica (Figure 5). The springs form watercourses, which are mostly short and drain into the Cetina river. The water inflows for the karst fields are located along the north-eastern fringes, while the ends of watercourses, or sinkholes, are located at the southwestern edges. With the construction of the Orlovac hydroelectric power plant, the karst fields waters are mainly collected in the Buško Blato reservoir, where they are discharged into the Cetina river after energy use in the Republic of Croatia.

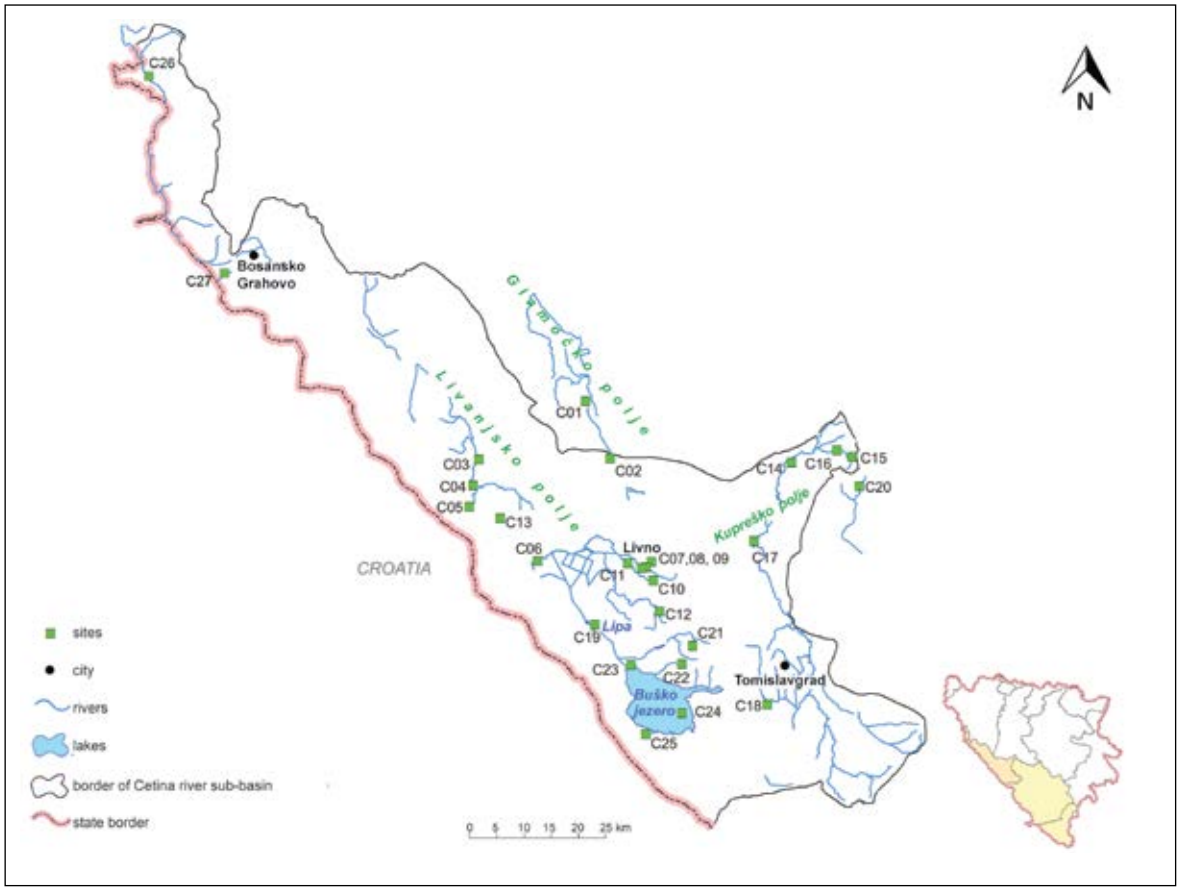
The largest reservoir into which the waters of the Cetina river basin flow is Buško Blato in Livanjsko field, with a capacity of 831.106 m^3. The water from the Buško Blato reservoir is used to supply Orlovac hydroelectric power plant located in the Republic of Croatia. Hydrogeological studies have shown that the water flows from Kupreško (1.000-1.200 m) and Glamočko field (850-1.100 m) to the springs that surround Livanjsko field (700 m) near Buško Blato and the outskirts of Livno. Water flows westwards from Livanjsko field and Buško Blato, towards the Cetina river and springs near the northeast edge of Sinjsko field in the Republic of Croatia (Slišković, 2014).

2.1.3.1. Rijeka Cetina

Rijeka Cetina nastaje od izvora na jugozapadnim padinama Dinare na visini od 380 metara i teče u smjeru jugoistoka do Šestanovca i povija prema zapadu do ušća u Jadransko more kod Omiša (Slišković, 2014). Drugi je najveći vodotok dinarskog krša. Značajno je da Cetini gravitiraju isključivo vode sa sjeverozapada što slijev čini veoma asimetričnim. Četiri umjetne akumulacije izgrađene su na rijeci Cetini, i to Peruča, Buško Blato, Đale i Prančević.

2.1.3.1. The Cetina river

The Cetina river springs on the southwestern slopes of Dinara at an altitude of 380 meters and flows in a south-easterly direction to Šestanovac, then winds westwards to the mouth of the Adriatic Sea near Omiš (Slišković, 2014). It is the second largest water course is the Dinaric karst. It is significant to note that only the waters from the north-west gravitate towards the Cetina river which makes its basin very asymmetrical. Four artificial reservoirs were built on the Cetina river, namely Peruča, Buško Blato, Đale and Prančević.



Slika 5. Slijev Cetine s označenim položajem postaja. Oznake postaja navedene su u naslovu 3.3. (izvor: D. Šakić)

Figure 5. The Cetina river basin with the indicated site locations. Site designations are listed in Title 3.3. (source: D. Šakić)

3. MATERIJAL I METODE

3.1. Literaturni izvori

U izradi monografije korišteni su podaci za razdoblje od 1896. do 2019. Većina podataka nije objavljena i rezultat je naših samoinicijativnih istraživačkih aktivnosti. Podaci dobiveni projektim aktivnostima Agencije za vodno područje Jadranskog mora, za koju smo tražene analize i determinacije radile, ustupljeni su nam na korištenje u svrhu izrade monografije i navedeni su u literaturi, a odnose se na razdoblje od 2008. do 2019.. Objavljeni znanstveno stručni radovi i literatura korištena u izradi monografije kronološki je predstavljena kako slijedi: Karlinski, 1896, 1897, Pavletić i Matoničkin, 1965, Kosorić i sur., 1974, Vuković i sur., 1976, Jerković, 1978 a, b, Blagojević i Hafner, 1979 a, b, Kosorić i sur., 1979, Blagojević i Hafner, 1980 b, 1981, 1983, Hafner, 1989 a, b, Blagojević i Hafner, 1991, Hafner, 2000, Petrović, 2000, Bogut i sur., 2004, 2007, Doko, 2005, Durbešić i sur., 2006, Hafner i sur., 2006, Hafner i Jasprica, 2007, Hafner, 2008, 2009, Hafner i Jasprica, 2010, Ivanković, 2010, Ivanković i Hafner, 2010, Ivanković i sur., 2010, Ivanković, 2013, Hafner i sur., 2013, 2015 a, b, Stanić-Koštroman i sur., 2015, Dedić i sur., 2013, 2014, 2015, 2019, Dedić, 2015.

3.2. Način predstavljanja podataka

Svojta

Napravljen je popis svojti dijatomeja abecednim redoslijedom. Nomenklatura svojti usklađena je prema bazi algi u ožujku 2019. (Guiry i Guiry, 2019) kada su preuzeti i sinonimi za svojte predstavljene u rezultatima u tablici 9. Crveno obojeni nazivi su sinonimi svojti prema podacima u našim literaturnim izvorima, a ostali nazivi preuzeti su iz navedene baze algi.

3. MATERIAL AND METHODS

3.1. Literary sources

Data for the period from 1896 to 2019 were used in the preparation of this book. Most of the data has not been published and is the result of our own research activities. The data obtained from the project activities of the Adriatic Sea Watershed Agency, for whom we have analysed many samples, have been made available to us for the purpose of creating a monograph relate to the period from 2008 to 2019. Scientific papers and literature used to create the monograph are as follows: Karlinski, 1896, 1897, Pavletić Matoničkin, 1965, Kosorić et al., 1974, Vuković et. al., 1976, Jerković, 1978 a, b, Blagojević and Hafner, 1979 a, b, Kosorić et. al., 1979, Blagojević and Hafner, 1980 a, b, 1981, 1983, Hafner, 1989 a, b, Blagojević and Hafner, 1991, Hafner, 2000, Petrović, 2000, Bogut et. al., 2004, 2007, Doko, 2005, Durbešić et. al., 2006, Hafner et. al., 2006, Hafner and Jasprica, 2007, Hafner, 2008, 2009, Hafner and Jasprica, 2010, Ivanković, 2010, Ivanković and Hafner, 2010, Ivanković et. al, 2010, Ivanković, 2013, Hafner et. al., 2013, 2015 a, b, Stanić-Koštroman et. al, 2015, Dedić at. al., 2013, 2014, 2015, 2019, Dedić, 2015.

3.2. Data presentation method

Taxa

A list of diatom taxa has been made in alphabetical order. The taxa nomenclature was aligned according to the AlgaeBase in March 2019 (Guiry and Guiry, 2019), from where synonyms for the taxa presented in the results in Table 9 were also taken. The names in red are taxa synonyms according to the data in our literary sources, and other names are taken from AlgaeBase.

Postaje

Zbog bolje transparentnosti rezultata za svaku svojtu su upisane postaje na kojima je ista pronađena. Popis postaja predstavljen je u poglavlju 3.3., a geografske koordinate u podpoglavlju 3.3.1 (Tablica 8).

Uključeno je ukupno 139 postaje od čega slijevu rijeke Neretve pripadaju 101, slijevu rijeke Trebišnjice 11 i slijev rijeke Cetine 27. Na geografskim kartama po slijevnim područjima navedenih rijeka postaje su označene. Za sve postaje nisu u pregledanoj literaturi zabilježene koordinate, ali smo ih na temelju postojećih deskriptivnih opisa odredili i na karti označili.

Dodatni podaci

Budući da će se monografija koristiti u nastavi navedeni su podaci o ekologiji i ugroženosti svojti (Lange-Bertalota i Steindorsa, 1996, Lange-Bertalota i Rumricha, 2000) kao i saprobni (Wegl i sur. 1983, Sladečček, 1986, Rott i sur., 1997) i trofički indeksi (Rott i sur., 1999, Plenković-Moraj i sur., 2009), odnosno indikatorska vrijednost i indikatorska težina. Zbog lakšeg praćenja podataka u tablici 9 u nastavku teksta su objašnjeni korišteni termini kao i tablični prikazi vrijednosti indeksa i razreda kvaliteta vode (Tablica 3, 4, 5, 6 , 7).

Legenda koja opisuje odgovarajuće kategorije ugroženosti (Lange-Bertalota i Steindorsa, 1996, Lange-Bertalota i Rumricha, 2000) uključuje:

1- Gotovo izumrla
2- Jako ugrožena
3- Ugrožena
G - Vjerojatno ugrožena
R – Vrlo rijetka,
V – Nije ugrožena, ali je u regresiji
D – Nedovoljni podaci,
* – Nije ugrožena,
** – Sigurno nije ugrožena,
• – Nije pronađena u Njemačkoj.

Sites

For the sake of transparency, the sites where each taxon were found have been entered. The list of sites is presented in Chapter 3.3, and the geographical coordinates in Section 3.3.1 (Table 8).

A total of 139 stations have been included, of which 101 belong to the Neretva river basin, 11 to the Trebišnjica river basin and 27 to the Cetina river basin. Sites are marked on the maps by river basin districts. For all sites, no coordinates were recorded in the reviewed literature, but they have been identified and marked on the map based on existing descriptions.

Additional data

Since the monograph will be used in teaching, data on the ecology and endangerment of taxa (Lange-Bertalot and Steindors, 1996; Lange-Bertalot and Rumrich, 2000) and saprobic data are provided (Wegl et al. 1983; Sladeček, 1986; Rott et al., 1997), as well as trophic indeces (Rott et al., 1999; Plenković-Moraj et al., 2009), i.e. indicator value and indicator weight. For ease of tracking the data in Table 9, the used terms are explained below, as well as table representations of the index values and water quality classes (Tables 3, 4, 5, 6, 7).

The legend describing the relevant categories of endangerment (Lange-Bertalot and Steindors, 1996; Lange-Bertalot and Rumrich, 2000) includes:

1- Almost extinct,
2- Highly endangered,
3- Endangered,
G - Probably endangered,
R – Very rare,
V – Not endangered but in regression,
D – Data deficient,
* - Not endangered,
** - Confirmed not endangered,
• – Not found in Germany.

Podaci o ekologiji dijatomeja (Lange-Bertalota i Steindorsa, 1996, Lange-Bertalota i Rumricha, 2000) dani su sljedećim kategorijama:
– ac-aerofili,
– oc-oligotrofne vode (kisele vode s manje ili više humusnih kiselina),
– od-oligotrofne vode (vapnenačke vode),
– o-oligotrofne vode (bez posebnih značajki),
– hal-halofili,
– eu-mezotrofne do eutrofne vode
– tol-od oligotrofnih do eutrofnih voda

Data on the ecology of diatoms (Lange-Bertalot and Steindors, 1996; Lange-Bertalot and Rumrich, 2000) are given in the following categories:
– ac-aerophiles,
– oc-oligotrophic water (acidic water with more or less humic acids),
– od-oligotrophic water (limestone water),
– o-oligotrophic water (without special features),
– hal-halophiles,
– eu-mesotrophic to eutrophic water
– tol-oligotrophic to eutrophic waters

Tablica 3. Sladečèkov indeks i kategorija kvaliteta vode (Sladečèk, 1986)

Table 3. Sladečèk index and water quality categories (Sladečèk, 1986)

Razredi kvalitete vode ***Water quality class***	**Saprobna zona** ***Saprobic zone***	**Sladečèk indeks saprobnosti** ***Sladečèk saprobity index*** (SLA)
I veoma siromašno/ *I very poor*	xenosaprobna/ *Xenosaprobic*	0
II siromašno/ *II poor*	oligosaprobna/ *Oligosaprobic*	1
III srednje/ *III medium*	betamezosaprobna/ *Betamezosaprobic*	2
IV zagađeno/ *IV polluted*	alfamezosaprobno/ *Alfamezosaprobic*	3
V veoma zagađeno/ *V very polluted*	polisaprobno/ *Polysaprobic*	4

Tablica 4. Weglov indeks i kategorija kvalitete vode (Wegl i sur., 1983)

Table 4. Wegl index and water quality categories (Wegl et al., 1983)

SAPROBNA ZONA ***SAPROBIC ZONE***	**INDEKS SAPROBNOSTI** ***SAPROBITY INDEX***	**OPIS VODENOG BIOTOPA** ***WATER BIOTOPE DESCRIPTION***
Oligosaprobno *Oligosaprobic*	1,00 - 1,50	Neopterećen ili veoma malo opterećen *No load or very light load*
Oligo do β-mezosaprobno *Oligo to β-mezosaprobic*	1,51 - 1,80	Malo opterećen *Light load*
β-mezosaprobno *β-mezosaprobic*	1,81 - 2,30	Umjereno opterećen *Moderate load*
β do α-mezosaprobno *β to α-mezosaprobic*	2,31 - 2,70	Srednje opterećen *Medium load*
α-mezosaprobno *α-mezosaprobic*	2,71 - 3,20	Srednje do puno opterećen *Medium to heavy load*
α do polisaprobno *α to polisaprobic*	3,21 - 3,50	Opterećen *Load*
Polisaprobno *Polysaprobic*	3,51 - 4,00	Jako puno opterećen *Heavy load*

Tablica 5. Rottov indeks i kategorija kvalitete vode (Rott i sur., 1997)

Table 5. Rott index and water quality category (Rott et al., 1997)

Kategorija svojte/ *Taxa category*	**Saprobne vrijednosti**/ *Saprobic values*	**Klasa** *Class*
Svojte koje izbjegavaju vode visoke saprobnosti Taxa that avoids high saprobity water	< 1,3	I
Tolerantne svojte Tolerant taxa	slabo razvijene populacije *Poorly developed populations* 1,4-1,7	I-II
	jako razvijene populacije *Very developed populations* 1,8-2,1	II
Svojte koje se pojavljujuu vodama visoke saprobnosti Taxa that occurs in high saprobity water	Saprofiti /*Saprophytes* 2,2-2,5 2,6-3,0	II-III III
	Saprobionti/ *Saprobionts* 3,1-3,4	III-IV
	>3,5	IV

Tablica 6. Trofička vrijednost u odnosu na koncentraciju ukupnog fosfora (Rott i sur., 1999)

Table 6. Trophic value relative to total phosphorus concentration (Rott et al., 1999)

Trofička vrijednost *Trophic value*	Trofički status *Trophic status*	Ukupni fosfor *Total phosphorus* (μgL^{-1})
< 0,5	Ultraoligotrofno/ *Ultra-oligotrophic*	< 5
0,6 – 1,0	Oligotrofno/ *Oligotrophic*	5 – 10
1,1 – 1,5	Oligo-mezotrofno/ *Oligo-mesotrophic*	10 – 20
1,6 – 2,0	Mezotrofno/ *Mesotrophic*	20 – 30
2,1 – 2,5	Mezo-eutrofno/ *Meso-eutrophic*	30 – 50
2,6 – 3,0	Eutrofno/ *Eutrophic*	50 – 100
3,1 – 3,5	Eu-politrofno/ *Eupolytrophic*	100 – 250
> 3,5	Politrofno/ *Polytrophic*	> 250

Tablica 7. Trofički status i vrijednost indeksa Republike Hrvatske (Plenković-Moraj i sur., 2009)

Table 7. Trophic status and index value of the Republic of Croatia (Plenković-Moraj et al., 2009)

Trofički status/ *Trophic status*	TID_{RH}
Oligotrofno/umjereno mezotrofno *Oligotrophic/moderately mesotrophic*	≤ 2,400
Mezotrofno/umjereno eutrofno *Mesotrophic/moderately eutrophic*	≤2,700
Eutrofno/umjereno politrofno *Eutrophic/moderately polytrophic*	≤3,200
Politrofno/ *Politrophic*	≤3,400
Hipertrofno/ *Hypertrophic*	≤3, 401

Za trofički indeks dijatomeja (TID_{RH}) indikatorska vrijednost definirana je od 1 do 4, pri čemu niže vrijednosti indeksa označavaju slabo osjetljive vrste, a više vrlo osjetljive vrste. Indikatorska težina definirana je od 1 do 3 tako da niže vrijednosti ukazuju na vrste s uskim rasponom tolerancije kao vrlo osjetljivim ekološkim pokazateljem.

For the trophic index of diatoms (TID_{RH}), the indicator value is defined from 1 to 4, with lower index values indicating less sensitive species and higher values highly sensitive species. Indicator weight range from 1 to 3, with lower values indicating species with a narrow tolerance range as a very sensitive ecological indicator.

3.3. Popis svih postaja na kojima su zabilježene dijatomejske svojte

Popis postaja na kojima su dijatomejske svojte zabilježene, te kratice koje su korištene pri izradi monografije su navedeni u nastavku teksta.

Korištene kratice za Slijev rijeke Neretve: Slijev rijeke Trebišnjice; Slijev rijeke Cetine su:

- N-Neretva
- NP- Pritoke Neretve
- J-Jezera
- M-Močvare
- T-Trebišnjica
- C-Cetina

N - RIJEKA NERETVA

N01. Ulog-uzvodno
N02. Ulog-nizvodno (Rajanac)
N03. Glavatičevo (Lađanica)-uzvodno
N04. Glavatičevo-nizvodno
N05. Ušće Rakitnice-uzvodno
N06. Ušće Rakitnice-nizvodno
N07. Konjic-uzvodno
N08. Konjic
N09. Konjic-slani izvori
N10. Jablanica-uzvodno
N11. Ušće Glogovke-nizvodno
N12. Ušće Drežanke-nizvodno
N13. Salakovac
N14. Potoci
N15. Raštani
N16. Baćevići
N17. Žitomislić
N18. Počitelj
N19. Čapljina-uzvodno
N20. Čapljina
N21. Gabela
N22. Višići
N23. Doljani

3.3. List of all sites where diatoms taxa were recorded

The list of sites where diatoms taxa were recorded and abbreviations used in the preparation of the monograph are listed below.

Abbreviations used for the Neretva river basin, the Trebišnjica river basin and the Cetina river basin are:

- N-Neretva
- NP- Neretva tributaries
- J-Lakes
- M-Marshes
- T-Trebišnjica
- C-Cetina

N – NERETVA RIVER

N01. Ulog-upstream
N02. Ulog-downstream (Rajanac)
N03. Glavatičevo (Lađanica)-upstream
N04. Glavatičevo-downstream
N05. Rakitnica river mouth-upstream
N06. Rakitnice river mouth-downstream
N07. Konjic-upstream
N08. Konjic
N09. Konjic-saline springs
N10. Jablanica-upstream
N11. Glogovka river mouth-downstream
N12. Drežanka river mouth-downstream
N13. Salakovac
N14. Potoci
N15. Raštani
N16. Baćevići
N17. Žitomislić
N18. Počitelj
N19. Čapljina-upstream
N20. Čapljina
N21. Gabela
N22. Višići
N23. Doljani

NP - PRITOKE RIJEKE NERETVE

NP01. Ljuta
NP02. Slatinica-iznad Lađanice
NP03. Slatnica-uzvodno od naselja
NP04. Rakitnica-selo Šabići
NP05. Rakitnica-ušće
NP06. Trešanica iznad Konjica (Ivan brdo)
NP07. Neretvica-ušće
NP08. Rama-Prozor nizvodno
NP09. Rama-ušće
NP10. Baščica-Idbar
NP11. Baščica-iznad ušća 300 m
NP12. Doljanka iznad Sovića
NP13. Doljanka-Doljani
NP14. Doljanka iznad Jablanice
NP15. Glogovka uzvodno od ušća
NP16. Glogovka ušće
NP17. Diva Grabovica-uzvodno
NP18. Diva Grabovica-ušće
NP19. Drežanka-G. Drežnica
NP20. Drežanka-uzvodno od D. Drežnice
NP21. Drežanka-uzvodno od ušća
NP22. Ljubovija-Studenac-izvor
NP23. Radobolja-uzvodno (Ilići)
NP24. Radobolja-Bare
NP25. Radobolja-Šemovac
NP26. Radobolja-ušće
NP27. Lištica-izvor Borak
NP28. Lištica ispod Širokog Brijega
NP29. Lištica-Uzarići
NP30. Lištica-Mostarsko blato
NP31. Buna-izvorište
NP32. Buna-Kosor (bara na obali)
NP33. Buna-ušće
NP34. Bunica-izvorište
NP35. Bregava-uzvodno od Stoca
NP36. Bregava-Stolac
NP37. Bregava-nizvodno od Stoca
NP38. Bregava-ušće
NP39. Vrioštica-Vitina (pritoka Trebižata)
NP40. Studenčica-Studenci (pritoka Trebižata)

NP – NERETVA RIVER TRIBUTARIES

NP01. Ljuta
NP02. Slatinica-above Lađanica
NP03. Slatnica-upstream of the settlement
NP04. Rakitnica-village of Šabići
NP05. Rakitnica-river mouth
NP06. Trešanica above Konjic (Ivan brdo)
NP07. Neretvica-river mouth
NP08. Rama-Prozor downstream
NP09. Rama-river mouth
NP10. Baščica-Idbar
NP11. Baščica-above the river mouth 300 m
NP12. Doljanka above Sovići
NP13. Doljanka-Doljani
NP14. Doljanka above Jablanica
NP15. Glogovka upstream from the river mouth
NP16. Glogovka river mouth
NP17. Diva Grabovica-upstream
NP18. Diva Grabovica-river mouth
NP19. Drežanka-G. Drežnica
NP20. Drežanka-upstream from D. Drežnica
NP21. Drežanka-upstream from the river mouth
NP22. Ljubovija-Studenac-spring
NP23. Radobolja-upstream (Ilići)
NP24. Radobolja-Bare
NP25. Radobolja-Šemovac
NP26. Radobolja-river mouth
NP27. Lištica-Borak spring
NP28. Lištica below Široki Brijeg
NP29. Lištica-Uzarići
NP30. Lištica-Mostarsko blato
NP31. Buna-spring
NP32. Buna-Kosor (pond on the river bank)
NP33. Buna-river mouth
NP34. Bunica-spring
NP35. Bregava-upstream from Stolac
NP36. Bregava-Stolac
NP37. Bregava-downstream from Stolac
NP38. Bregava-river mouth
NP39. Vrioštica-Vitina (Trebižat tributary)
NP40. Studenčica-Studenci (Trebižat tributary)

NP41. Tihaljina-Klobuk
NP42. Trebižat-Klokun (izvor)
NP43. Trebižat-Ljubuški (Humac)
NP44. Trebižat-Kravice
NP45. Trebižat-Struge
NP46. Trebižat-ušće
NP47. Krupa-Karaotok
NP48. Krupa-Dračevo
NP49. Izvor Nezdravica-Pritoka Trebižata
NP50. Izvor Modro oko-Pritoka Trebižata
NP51. Izvor Studena-Pritoka Trebižata
NP52. Mlinski izvor-Studenci
NP53. Kajtazovo vrelo-Studenci
NP54. Volujak-Rama
NP55. Bijela Salakovac
NP56. Bijela Konjic
NP57. Blurčića potok
NP58. Nevizračica
NP59. Šanica
NP60. Kraljuščica
NP61. Ljubunačka rijeka

PJ. PRIRODNA JEZERA

PJ01. Blidinjsko jezero
PJ02. Boračko jezero-sredina jezera
PJ03. Boračko jezero-obala
PJ04. Mostarsko blato

UJ. UMJETNA JEZERA

UJ01. Ramsko jezero
UJ02. Jablaničko jezero-brana
UJ03. Jablaničko jezero iznad postrojenja
UJ04. Grabovica
UJ05. Salakovac
UJ06. Mostar
UJ07. Vrutak

NP41. Tihaljina-Klobuk
NP42. Trebižat-Klokun (spring)
NP43. Trebižat-Ljubuški (Humac)
NP44. Trebižat-Kravice
NP45. Trebižat-Struge
NP46. Trebižat-river mouth
NP47. Krupa-Karaotok
NP48. Krupa-Dračevo
NP49. Nezdravica spring-Trebižat tributary
NP50. Modro oko spring-Trebižat tributary
NP51. Studena spring-Trebižat tributary
NP52. Mlinski spring-Studenci
NP53. Kajtaz spring-Studenci
NP54. Volujak-Rama
NP55. Bijela Salakovac
NP56. Bijela Konjic
NP57. Blurčića stream
NP58. Nevizračica
NP59. Šanica
NP60. Kraljuščica
NP61. Ljubunačka river

PJ. NATURAL LAKES

PJ01. Blidinjsko lake
PJ02. Boračko lake-mid lake
PJ03. Boračko lake-shore
PJ04. Mostarsko blato

UJ. ARTIFICIAL LAKES

UJ01. Ramsko lake
UJ02. Jablaničko lake-dam
UJ03. Jablaničko lake- above the plant
UJ04. Grabovica
UJ05. Salakovac
UJ06. Mostar
UJ07. Vrutak

M. MOČVARE

M01. Blidinje-Masna luka
M02. Hutovo blato
M02.a Drijen
M02.b Deransko jezero
M02.c Jelim
M02.d Orah

M. MARSHES

M01. Blidinje-Masna luka
M02. Hutovo blato
M02.a Drijen
M02.b Deransko lake
M02.c Jelim
M02.d Orah

SLIJEV RIJEKE TREBIŠNJICE-T

T01. Akumulacija Klinje
T02. Rijeka Žanjevica
T03. Rijeka Vrba
T04. Rijeka Gračanica
T05. Rijeka Mušnica
T06. Gatačko polje
T07. Nevesinjsko polje
T08. Popovo polje
T09. Rijeka Trebišnjica-Trebinje
T10. Rijeka Trebišnjica-Ravno
T11. Bilećko jezero

T. TREBIŠNJICA RIVER BASIN

T01. Klinje reservoir
T02. Žanjevica river
T03. Vrba river
T04. Gračanica river
T05. Mušnica river
T06. Gatačko field
T07. Nevesinjsko field
T08. Popovo field
T09. Trebišnjica river-Trebinje
T10. Trebišnjica river-Ravno
T11. Bilećko lake

SLIJEV RIJEKE CETINE-C

C01. Glamočko polje
C02. Rijeka Vrba
C03. Rijeka Jaruga (Livanjsko polje)
C04. Potok Pjerkovići
C05. Veliki ponor (Plovuća Čajići-Rujani)
C06. Rijeka Plovuća
C07. Rijeka Bistrica-izvor Duman
C08. Rijeka Bistrica-Livno
C09. Rijeka Bistrica nizvodno od Livna
C10. Rijeka Žabljak-izvor
C11. Rijeka Žabljak
C12. Rijeka Sturba-izvor
C13. Rijeka Sturba-Ličtane
C14. Kupreško polje
C15. Kukavičko jezero

C. CETINA RIVER BASIN

C01. Glamočko field
C02. Vrba river
C03. Jaruga river (Livanjsko field)
C04. Pjerkovići stream
C05. Veliki ponor (Plovuća Čajići-Rujani)
C06. Plovuća river
C07. Bistrica river-Duman spring
C08. Bistrica river-Livno
C09. Bistrica river downstream from Livno
C10. Žabljak river-spring
C11. Žabljak river
C12. Sturba river-spring
C13. Sturba river-Ličtane
C14. Kupreško field
C15. Kukavičko lake

C16. Rijeka Milač
C17. Rijeka Šuica-Šuica
C18. Rijeka Šuica-Kovači
C19. Lipa-Lipsko jezero
C20. Suvi potok
C21. Potok Ružica
C22. Potok Grap
C23. Buško blato-Kraljičin nasip
C24. Buško Blato-Mukišnica
C25. Rijeka Ričina-ostaci
C26. Korana (Zvijezda)
C27. Dulerski potok
(uzvodno od ušća u rijeku Butižnicu)

C16. Milač river
C17. Šuica river-Šuica
C18. Šuica river-Kovači
C19. Lipa-Lipsko lake
C20. Suvi Potok stream
C21. Ružica stream
C22. Grap stream
C23. Buško blato-Kraljičin Nasip embankment
C24. Buško blato-Mukišnica
C25. Ričina river-remains
C26. Korana (Zvijezda)
C27. Dulerski stream
(upstream from the Butižnica river mouth)

3.3.1. Geografske koordinate postaja

U tablici 8. predstavljene su koordinate postaja, odnosno geografska širina i dužina svih postaja na kojima su zabilježene dijatomejske svojte.

3.3.1. Geographic coordinates of the sites

Table 8 presents the coordinates of the sites, i.e. the latitude and longitude of all sites where diatoms taxa were recorded.

Tablica 8. Geografske koordinate svih postaja na kojima su zabilježene dijatomeje

	G. širina (N)	G. dužina (E)	N:	E:
SLIJEV RIJEKE NERETVE				
RIJEKA NERETVA				
N01. Ulog – uzvodno	43,4167605	18,3097931	43°25'0.338"	18°18'35.255"
N02. Ulog – nizvodno (Rajanac)	43,4777092	18,2182163	43°28'39.753"	18°13'5.578"
N03. Glavatičevo (Ladanica)-uzvodno	43,4998647	18,1383604	43°29'59.513"	18°8'18.097"
N04. Glavatičevo-nizvodno	43,50483114	18,10072114	43°30'17.392"	18°6'2.596"
N05. Ušće Rakitnice-uzvodno	43,54658154	18,06688502	43°32'47.694"	18°4'0.786"
N06. Ušće Rakitnice-nizvodno	43,558666	18,061904	43°33'31.198"	18°3'42.854"
N07. Konjic-uzvodno	43,64779067	17,9616172	43°38'52.046"	17°57'41.821"
N08. Konjic	43,655042	17,953838	43°39'18.151"	17°57'13.816"
N09. Konjic – slani izvori	43,66607051	17,95263294	43°40'0.505"	17°57'9.478"
N10. Jablanica - uzvodno (2 km)	43,666739	17,750276	43°40'0.26"	17°45'0.993"
N11. Ušće Glogovke – nizvodno	43,6225429	17,7512653	43°37'21.154"	17°45'0.993"
N12. Ušće Drežanke – nizvodno	43,515834	17,737082	43°30'57.002"	17°44'13.495"
N13. Salakovac	43,4473354	17,8354593	43°26'50.407"	17°50'7.653"
N14. Potoci	43,409623	17,870382	43°24'34.643"	17°52'13.375"
N15. Raštani	43,3688693	17,83427264	43°22'7.929"	17°50'3.381"

N16. Baćevići	43,25540935	17,82521067	43°15'19.474"	17°49'30.758"
N17. Žitomislići	43,20323231	17,78172664	43°12'11.636"	17°46'54.215"
N18. Počitelj	43,1341714	17,7297901	43°8'3.017"	17°43'47.244"
N19. Čapljina – uzvodno	43,11529211	17,71126244	43°6'55.052"	17°42'40.544"
N20. Čapljina	43,10389718	17,70765385	43°6'14.03"	17°42'27.553"
N21. Gabela	43,059213	17,700163	43°3'33.167"	17°42'0.586"
N22. Višići	43,0682954	17,707136	43°4'5.863"	17°42'25.689"
N23. Doljani	43,049608	17,674219	43°2'58.589"	17°40'27.188"

PRITOKE RIJEKE NERETVE				
NP01. Ljuta	43,4933245	18,3166212	43°29'35.968"	18°18'59.836"
NP02. Slatinica - iznad Lađanice	43,5007455	18,1669472	43°30'2.684"	18°10'1009"
NP03. Slatnica - uzvodno od naselja	43,5061522	18,16803228	43°30'22.148"	18°10'4.916"
NP04. Rakitnica – selo Šabići	43,6554063	18,2593011	43°39'19.463"	18°15'33.483"
NP05. Rakitnica – ušće	43,558666	18,065433	43°33'16.438"	18°4'13.274"
NP06. Trešanica iznad Konjica	43,6597847	17,9687875	43°39'35.225"	17°58'7.634"
NP07. Neretvica – ušće	43,696146	17,831025	43°41'46.126"	17°49'51.69"
NP08. Rama – Prozor nizvodno	43,7895208	17,643058	43°47'22.275"	17°38'35.008"
NP09. Rama – ušće	43,7302429	17,7084479	43°43'48.874"	17°42'30.412"
NP10. Baščica - Idbar	43,6463253	17,8828764	43°38'46.771"	17°52'58.355"
NP11. Baščica – iznad ušća 300 m	43,6847037	17,899214	43°41'4.933"	17°53'57.17"
NP12. Doljanka iznad Sovića	43,7154715	17,5920271	43°42'55.697"	17°35'31.297"
NP13. Doljanka – Doljani	43,6945884	17,6605178	43°41'40.518"	17°39'37.864"
NP14. Doljanka iznad Jablanice	43,6576368	17,7439775	43°39'27.492"	17°44'38.318"
NP15. Glogovka uzvodno od ušća	43,6176254	17,8133591	43°37'3.451"	17°48'48.092"
NP16. Glogovka ušće	43,6260853	17,8097612	43°37'33.907"	17°48'35.14"
NP17. Diva Grabovica – uzvodno	43,600133	17,7061836	43°36'0.479"	17°42'22.26"
NP18. Diva Grabovica – ušće	43,588727	17,7195529	43°35'19.417"	17°43'10.39"

NP19. Drežanka - G. Drežnica	43,537932	17,5764897	43° 32'16.555"	17° 34'35.362"
NP20. Drežanka - uzvodno od D. Drežnice	43,5281323	17,6969861	43° 31'41.276"	17° 41'49.149"
NP21. Drežanka - uzvodno od ušća	43,5203575	17,7267092	43° 31'13.287"	17° 43'36.153"
NP22. Ljubovija – Studenac – izvor	43,405539	17,859856	43° 24'19.9"	17° 51'35.5"
NP23. Radobolja – uzvodno (Ilići)	43,3468605	17,7698073	43° 20'48.698"	17° 46'11.306"
NP24. Radobolja – Bare	43,3417788	17,7887777	43° 20'30.404"	17° 47'19.599"
NP25. Radobolja – Šemovac	43,3376351	17,8125314	43° 20'15.486"	17° 48'45.113"
NP26. Radobolja – ušće	43,3366294	17,8151007	43° 20'11.866"	17° 48'54.362"
NP27. Lištica – izvor Borak	43,4014615	17,6042347	43° 22'10.767"	17° 35'47.787"
NP28. Lištica ispod Širokog Brijega	43,3696574	17,5966076	43° 22'10.767"	17° 35'47.787"
NP29. Lištica – Uzarići	43,3565432	17,6258519	43° 21'23.556"	17° 37'33.066"
NP30. Lištica – Mostarsko blato	43,3250825	17,7187676	43° 19'30.297"	17° 43'7.563"
NP31. Buna – izvor	43,2567217	17,89817334	43° 15'24.198"	17° 53'53.424"
NP32. Buna – Kosor (bara na obali)	43,2482349	17,8668724	43° 14'53.646"	17° 52'0.74"
NP33. Buna – ušće	43,24133685	17,83320271	43° 14'28.813"	17° 49'59.529"
NP34. Bunica – izvor	43,2321682	17,9474363	43° 13'55.806"	17° 56'50.77"
NP35. Bregava – uzvodno od Stoca	43,0897921	17,9981515	43° 5'23.252"	17° 59'53.345"
NP36. Bregava – Stolac	43,0829465	17,9544491	43° 4'56.607"	17° 57'16.016"
NP37. Bregava - nizvodno od Stoca	43,079755	17,9219939	43° 4'47.118"	17° 55'19.178"
NP38. Bregava – ušće	43,09330487	17,7085395	43° 5'35.898"	17° 42'30.742"
NP39. Vrioštica	43,2367291	17,483598	43° 14'12.225"	17° 29'0.952"
NP40. Studenčica	43,167272	17,6206569	43° 10'12.179"	17° 37'14.364"
NP41. Tihaljina – Klobuk	43,27745	17,4485696	43° 16'38.82"	17° 26'54.85"
NP42. Trebižat – Klokun	43,2567348	17,4425212	43° 15'24.245"	17° 26'33.076"
NP43. Trebižat – Ljubuški – Humac	43,1817166	17,5180263	43° 10'54.18"	17° 31'4.894"
NP44. Trebižat – Kravice	43,1489003	17,6295402	43° 8'56.041"	17° 37'46.344"
NP45. Trebižat – Struge	43,0947709	17,6853102	43° 5'41.175"	17° 41'7.116"
NP46. Trebižat – ušće	43,0891302	17,7016071	43° 5'20.869"	17° 42'5.785"

NP47. Krupa – Karaotok	43,0486555	17,7199525	43°2'55.16"	17°43'11.829"
NP48. Krupa - Dračevo	43,0542652	17,7035234	43°3'15.355"	17°42'12.684"
NP49. Izvor Nezdravica	43,3168889	17,3886666	43°19'00.8"	17°23'19.2"
NP50. Izvor Modro oko	43,3041944	17,3931388	43°18'15.1"	17°23'35.3"
NP51. Izvor Studena	43,2545833	17,4455277	43°15'16.5"	17°26'43.9"
NP52. Mlinski izvor	43,1815	17,6030555	43°10'53.4"	17°36'11.0"
NP53. Kajtazovo vrelo	43,17	17,6280275	43°10'12.0"	17°37'40.9"
NP54. Volujak	43,81878	17,728611	43°49'07.6"	17°43'43.0"
NP55. Bijela Salakovac	43,4988889	17,80625	43°29'56"	17°48'22.5"
NP56. Bijela Konjic	43,608355	17,947177	43°36'30.1"	17°56'49.8"
NP57. Blurčića potok	43,737222	17,7963055	43°44'14"	17°47'46.7"
NP58. Nevizračica	43,7165833	17,8723055	43°42'59.7"	17°52'20.3"
NP59. Šanica	43,6205	17,7856666	43°37'13.8"	17°47'08.4"
NP60. Kraljuščica	43,71525	17,9195555	43°42'54.9"	17°55'10.4"
NP61. Ljubunačka rijeka	43,815	17,6410555	43°48'54.0"	17°38'27,8"

PRIRODNA JEZERA				
JP01. Blidinje jezero	43,60906908	17,49608131	43°36'32"	17°29'45"
JP02. Boračko jezero – sredina jezera	43,551774	18,030678	43°33'06.4"	18°01'50.4"
JP03. Boračko jezero - obala	43,55296	18,032931	43°33'10.7"	18°01'58.6"
JP04. Mostarsko blato	43,3479704	17,6958545	43°20'52"	17°41'45"

UMJETNA JEZERA				
UJ01. Ramsko jezero	43,8006148	17,5286451	43°48'2.213"	17°31'43.122"
UJ02. Jablaničko jezero - brana	43,692431	17,732416	43°41'32.8"	17°43'56.7"
UJ03. Jablaničko jezero iznad postrojenja	43,695301	17,733575	43°41'43.1"	17°44'00.9"
UJ04. Grabovica	43,59239524	17,72519594	43°35'32.623"	17°43'30,705"
UJ05. Salakovac	43,455369	17,825342	43°27'19.328"	17°49'31.231"

UJ06. Mostar	43,386564	17,850365	43°23'11.63"	17°51'1.314"
UJ07. Vrutak	42,9310285	17,814944	42°55'51.703"	17°48'53.798"

MOČVARE				
M01. Blidinje – Masna luka	43,6348426	17,5511647	43°38'5.433"	17°33'4.192"
M02. Hutovo blato	43,0484635	17,7759874	43°2'54.469"	17°46'33.554"
M02.a Drijen	43,055711	17,819306	43°03'20.6"	17°49'09.5"
M02.b Deransko jezero	43,045847	17,803232	43°02"45.1"	17°48'11.6"
M02.c Jelim	43,064774	17,802627	43°03'53.2"	17°48'09.5"
M02.d Orah	43,050732	17,81464	43°03'02.6"	17°48'52.7"

SLIJEV RIJEKE TREBIŠNJICE				
T01. Akumulacija Klinje	43,183647	18,571577	43°11'01.1"	8°34'17.7"
T02. Rijeka Žanjevica	43,186898	18,638885	43°11'12.8"	18°38'20.0"
T03. Rijeka Vrba	43,236552	18,577389	43°14'11.6"	18°34'38.6"
T04. Rijeka Gračanica	43,163508	18,513903	43°09'48.6"	18°30'50.1"
T05. Rijeka Mušnica	43,17232	18,488048	43°10'20.4"	18°29'17.0"
T06. Gatačko polje	43,140991	18,541977	43°08'27.6"	18°32'31.1"
T07. Nevesinjsko polje	43,271558	18,14847	43°16'17.6"	18°08'54.5"
T08. Popovo polje	44,799997	18,941831	44°47'60.0"	18°56'30.6"
T09. rijeka Trebišnjica – Trebinje	42,703941	18,336437	42°42'14.2"	18°20'11.2"
T10. rijeka Trebišnjica – Ravno	42,881684	17,975574	42°52'54.1"	17°58'32.1"
T11. Bilećko jezero	42,832243	18,438337	42°49'56.1"	18°26'18.0"

SLIJEV RIJEKE CETINE				
C01. Glamočko polje	44,131714	16,835083	44°07'54.2"	16°50'06.3"
C02. Rijeka Vrba	43,992621	16,913457	43°59'33.4"	16°54'48.5"
C03. Rijeka Jaruga	43,901556	16,796262	43°54'05.6"	16°47'46.5"
C04. Potok Pjerkovići	43899974	16,809155	43°53'59.9"	16°48'33.0"

C05. Veliki ponor	43,830008	16,81523	43°49'48.0"	16°48'54.8"
C06. Rijeka Plovuća	43,84303	16,870577	43°50'34.9"	16°52'14.1"
C07. Rijeka Bistrica (Duman)	43,831904	17,008292	43°49'54.9"	17°00'29.9"
C08. Rijeka Bistrica – Livno	43,827842	17,003899	43°49'40.2"	17°00'14.0"
C09. Rijeka Bistrica nizvodno od Livna	43,832285	16,981857	43°49'56.2"	16°58'54.7"
C10. Izvor Žabljak	43,810587	17,011672	43°48'38.1"	17°00'42.0"
C11. Rijeka Žabljak	43,816115	16,994338	43°48'58.0"	16°59'39.6"
12. Rijeka Sturba – izvor	43,761665	17,03295	43°45'42.0"	17°01'58.6"
13. Rijeka Sturba - Lištane	43,872996	16,782417	43°52'22.8"	16°46'56.7"
14. Kupreško polje	43,956426	17,237772	43°57'23.1"	17°14'16.0"
15. Kukavičko jezero	43,9502	17,331606	43°57'00.7"	17°19'53.8"
16. Rijeka Milač	43,96388	17,278281	43°57'50.0"	17°16'41.8"
17. Rijeka Šuica - Šuica	43,836657	17,181032	43°50'12.0"	17°10'51.7"
18. Rijeka Šuica - Kovači	43,671735	17,198373	43°40'18.3"	17°11'54.1"
19. Lipsko jezero	43,755712	16,918363	43°45'20.6"	16°55'06.1"
20. Suvi potok	43,921394	17,340384	43°55'17.0"	17°20'25.4"
21. Potok Ružica	43,739865	17,051286	43°44'23.5"	17°03'04.6"
22. Potok Grap	43,698306	17,008488	43°41'53.9"	17°00'30.6"
23. Buško blato - Kraljicin nasip	43,689876	16,982631	43°41'23.6"	16°58'57.5"
24. Buško blato - Mukišnica	43,65677	17,060238	43°39'24.4"	17°03'36.9"
25. Rijeka Ričina - ostaci	43,632885	17,005587	43°37'58.4"	17°00'20.1"
26. Korana (Zvijezda)	44,94688	15,747115	44°56'48.8"	15°44'49.6"
27. Dulerski potok	44,219881	16,263179	44°13'11.6"	16°15'47.4"

Table 8. Geographic coordinates of all sites where diatoms were recorded

	Latitude (N)	Longitude (E)	N:	E:
NERETVA RIVER BASIN				
NERETVA RIVER				
N01. Ulog – upstream	43,4167605	18,3097931	43°25'0.338"	18°18'35.255"
N02. Ulog – downstream (Rajanac)	43,4777092	18,2182163	43°28'39.753"	18°13'5.578"
N03. Glavatičevo (Ladanica)-upstream	43,4998647	18,1383604	43°29'59.513"	18°8'18.097"
N04. Glavatičevo-downstream	43,50483114	18,10072114	43°30'17.392"	18°6'2.596"
N05. Rakitnica river mouth-upstream	43,54658154	18,06688502	43°32'47.694"	18°4'0.786"
N06. Rakitnica river mouth-downstream	43,558666	18,061904	43°33'31.198"	18°3'42.854"
N07. Konjic-upstream	43,64779067	17,9616172	43°38'52.046"	17°57'41.821"
N08. Konjic	43,655042	17,953838	43°39'18.151"	17°57'13.816"
N09. Konjic – salient springs	43,66607051	17,95263294	43°40'0.505"	17°57'9.478"
N10. Jablanica - upstream (2 km)	43,666739	17,750276	43°40'0.26"	17°45'0.993"
N11. Glogovka river mouth – downstream	43,6225429	17,7512653	43°37'21.154"	17°45'0.993"
N12. Drežanka river mouth – downstream	43,515834	17,737082	43°30'57.002"	17°44'13.495"
N13. Salakovac	43,4473354	17,8354593	43°26'50.407"	17°50'7.653"
N14. Potoci	43,409623	17,870382	43°24'34.643"	17°52'13.375"
N15. Raštani	43,3688693	17,83427264	43°22'7.929"	17°50'3.381"
N16. Baćevići	43,25540935	17,82521067	43°15'19.474"	17°49'30.758"
N17. Žitomislići	43,20323231	17,78172664	43°12'11.636"	17°46'54.215"
N18. Počitelj	43,1341714	17,7297901	43°8'3.017"	17°43'47.244"
N19. Čapljina – upstream	43,11529211	17,71126244	43°6'55.052"	17°42'40.544"
N20. Čapljina	43,10389718	17,70765385	43°6'14.03"	17°42'27.553"
N21. Gabela	43,059213	17,700163	43°3'33.167"	17°42'0.586"

N22. Višići	43,0682954	17,707136	43°4'5.863"	17°42'25.689"
N23. Doljani	43,049608	17,674219	43°2'58.589"	17°40'27.188"

NERETVA RIVER TRIBUTARIES				
NP01. Ljuta	43,4933245	18,3166212	43°29'35.968"	18°18'59.836"
NP02. Slatinica - above Lađanica	43,5007455	18,1669472	43°30'2.684"	18°10'1009"
NP03. Slatnica – upstream from the settlement	43,5061522	18,16803228	43°30'22.148"	18°10'4.916"
NP04. Rakitnica – Šabići village	43,6554063	18,2593011	43°39'19.463"	18°15'33.483"
NP05. Rakitnica – river mouth	43,558666	18,065433	43°33'16.438"	18°4'13.274"
NP06. Trešanica above Konjica	43,6597847	17,9687875	43°39'35.225"	17°58'7.634"
NP07. Neretvica – river mouth	43,696146	17,831025	43°41'46.126"	17°49'51.69"
NP08. Rama – Prozor downstream	43,7895208	17,643058	43°47'22.275"	17°38'35.008"
NP09. Rama – river mouth	43,7302429	17,7084479	43°43'48.874"	17°42'30.412"
NP10. Baščica - Idbar	43,6463253	17,8828764	43°38'46.771"	17°52'58.355"
NP11. Baščica – above river mouth 300 m	43,6847037	17,899214	43°41'4.933"	17°53'57.17"
NP12. Doljanka above Sovići	43,7154715	17,5920271	43°42'55.697"	17°35'31.297"
NP13. Doljanka – Doljani	43,6945884	17,6605178	43°41'40.518"	17°39'37.864"
NP14. Doljanka above Jablanica	43,6576368	17,7439775	43°39'27.492"	17°44'38.318"
NP15. Glogovka upstream from river mouth	43,6176254	17,8133591	43°37'3.451"	17°48'48.092"
NP16. Glogovka river mouth	43,6260853	17,8097612	43°37'33.907"	17°48'35.14"
NP17. Diva Grabovica – upstream	43,600133	17,7061836	43°36'0.479"	17°42'22.26"
NP18. Diva Grabovica – river mouth	43,588727	17,7195529	43°35'19.417"	17°43'10.39"
NP19. Drežanka - G. Drežnica	43,537932	17,5764897	43°32'16.555"	17°34'35.362"
NP20. Drežanka - upstream from D. Drežnice	43,5281323	17,6969861	43°31'41.276"	17°41'49.149"
NP21. Drežanka – upstream from river mouth	43,5203575	17,7267092	43°31'13.287"	17°43'36.153"

NP22. Ljubovija – Studenac – spring	43,405539	17,859856	43°24'19.9"	17°51'35.5"
NP23. Radobolja – upstream (Ilići)	43,3468605	17,7698073	43°20'48.698"	17°46'11.306"
NP24. Radobolja – Bare	43,3417788	17,7887777	43°20'30.404"	17°47'19.599"
NP25. Radobolja – Šemovac	43,3376351	17,8125314	43°20'15.486"	17°48'45.113"
NP26. Radobolja – river mouth	43,3366294	17,8151007	43°20'11.866"	17°48'54.362"
NP27. Lištica – Borak spring	43,4014615	17,6042347	43°22'10.767"	17°35'47.787"
NP28. Lištica below Široki Brijeg	43,3696574	17,5966076	43°22'10.767"	17°35'47.787"
NP29. Lištica – Uzarići	43,3565432	17,6258519	43°21'23.556"	17°37'33.066"
NP30. Lištica – Mostarsko blato	43,3250825	17,7187676	43°19'30.297"	17°43'7.563"
NP31. Buna – spring	43,2567217	17,89817334	43°15'24.198"	17°53'53.424"
NP32. Buna – Kosor (pond on the river bank)	43,2482349	17,8668724	43°14'53.646"	17°52'0.74"
NP33. Buna – river mouth	43,24133685	17,83320271	43°14'28.813"	17°49'59.529"
NP34. Bunica – spring	43,2321682	17,9474363	43°13'55.806"	17°56'50.77"
NP35. Bregava – upstream from Stolac	43,0897921	17,9981515	43°5'23.252"	17°59'53.345"
NP36. Bregava – Stolac	43,0829465	17,9544491	43°4'56.607"	17°57'16.016"
NP37. Bregava – downstream from Stolac	43,079755	17,9219939	43°4'47.118"	17°55'19.178"
NP38. Bregava – river mouth	43,09330487	17,7085395	43°5'35.898"	17°42'30.742"
NP39. Vrioštica	43,2367291	17,483598	43°14'12.225"	17°29'0.952"
NP40. Studenčica	43,167272	17,6206569	43°10'12.179"	17°37'14.364"
NP41. Tihaljina – Klobuk	43,27745	17,4485696	43°16'38.82"	17°26'54.85"
NP42. Trebižat – Klokun	43,2567348	17,4425212	43°15'24.245"	17°26'33.076"
NP43. Trebižat – Ljubuški – Humac	43,1817166	17,5180263	43°10'54.18"	17°31'4.894"
NP44. Trebižat – Kravice	43,1489003	17,6295402	43°8'56.041"	17°37'46.344"
NP45. Trebižat – Struge	43,0947709	17,6853102	43°5'41.175"	17°41'7.116"
NP46. Trebižat – river mouth	43,0891302	17,7016071	43°5'20.869"	17°42'5.785"
NP47. Krupa – Karaotok	43,0486555	17,7199525	43°2'55.16"	17°43'11.829"
NP48. Krupa - Dračevo	43,0542652	17,7035234	43°3'15.355"	17°42'12.684"

NP49. Nezdravica spring	43,3168889	17,3886666	43°19'00.8"	17°23'19.2"
NP50. Modro oko spring	43,3041944	17,3931388	43°18'15.1"	17°23'35.3"
NP51. Studena spring	43,2545833	17,4455277	43°15'16.5"	17°26'43.9"
NP52. Mlinski spring	43,1815	17,6030555	43°10'53.4"	17°36'11.0"
NP53. Kajtaz spring	43,17	17,6280275	43°10'12.0"	17°37'40.9"
NP54. Volujak	43,81878	17,728611	43°49'07.6"	17°43'43.0"
NP55. Bijela Salakovac	43,4988889	17,80625	43°29'56"	17°48'22.5"
NP56. Bijela Konjic	43,608355	17,947177	43°36'30.1"	17°56'49.8"
NP57. Blurčića stream	43,737222	17,7963055	43°44'14"	17°47'46.7"
NP58. Nevizračica	43,7165833	17,8723055	43°42'59.7"	17°52'20.3"
NP59. Šanica	43,6205	17,7856666	43°37'13.8"	17°47'08.4"
NP60. Kraljuščica	43,71525	17,9195555	43°42'54.9"	17°55'10.4"
NP61. Ljubunačka river	43,815	17,6410555	43°48'54.0"	17°38'27,8"
NATURAL LAKES				
PJ01. Blidinje lake	43,60906908	17,49608131	43°36'32"	17°29'45"
PJ02. Boračko lake – mid lake	43,551774	18,030678	43°33'06.4"	18°01'50.4"
PJ03. Boračko lake - shore	43,55296	18,032931	43°33'10.7"	18°01'58.6"
PJ04. Mostarsko blato	43,3479704	17,6958545	43°20'52"	17°41'45"
ARTIFICIAL LAKES				
UJ01. Ramsko lake	43,8006148	17,5286451	43°48'2.213"	17°31'43.122"
UJ02. Jablaničko lake - dam	43,692431	17,732416	43°41'32.8"	17°43'56.7"
UJ03. Jablaničko lake above the plant	43,695301	17,733575	43°41'43.1"	17°44'00.9"
UJ04. Grabovica	43,59239524	17,72519594	43°35'32.623"	17°43'30,705"
UJ05. Salakovac	43,455369	17,825342	43°27'19.328"	17°49'31.231"
UJ06. Mostar	43,386564	17,850365	43°23'11.63"	17°51'1.314"
UJ07. Vrutak	42,9310285	17,814944	42°55'51.703"	17°48'53.798"

MARSHES				
M01. Blidinje – Masna luka	43,6348426	17,5511647	43°38'5.433"	17°33'4.192"
M02. Hutovo blato	43,0484635	17,7759874	43°2'54.469"	17°46'33.554"
M02.a Drijen	43,055711	17,819306	43°03'20.6"	17°49'09.5"
M02.b Deransko lake	43,045847	17,803232	43°02"45.1"	17°48'11.6"
M02.c Jelim	43,064774	17,802627	43°03'53.2"	17°48'09.5"
M02.d Orah	43,050732	17,81464	43°03'02.6"	17°48'52.7"

TREBIŠNJICA RIVER BASIN				
T01. Klinje reservoir	43,183647	18,571577	43°11'01.1"	8°34'17.7"
T02. Žanjevica river	43,186898	18,638885	43°11'12.8"	18°38'20.0"
T03. Vrba river	43,236552	18,577389	43°14'11.6"	18°34'38.6"
T04. Gračanica river	43,163508	18,513903	43°09'48.6"	18°30'50.1"
T05. Mušnica river	43,17232	18,488048	43°10'20.4"	18°29'17.0"
T06. Gatačko field	43,140991	18,541977	43°08'27.6"	18°32'31.1"
T07. Nevesinjsko field	43,271558	18,14847	43°16'17.6"	18°08'54.5"
T08. Popovo field	44,799997	18,941831	44°47'60.0"	18°56'30.6"
T09. Trebišnjica river– Trebinje	42,703941	18,336437	42°42'14.2"	18°20'11.2"
T10. Trebišnjica river – Ravno	42,881684	17,975574	42°52'54.1"	17°58'32.1"
T11. Bilećko lake	42,832243	18,438337	42°49'56.1"	18°26'18.0"

CETINA RIVER BASIN				
C01. Glamočko field	44,131714	16,835083	44°07'54.2"	16°50'06.3"
C02. Vrba river	43,992621	16,913457	43°59'33.4"	16°54'48.5"
C03. Jaruga river	43,901556	16,796262	43°54'05.6"	16°47'46.5"
C04. Pjerkovići stream	43899974	16,809155	43°53'59.9"	16°48'33.0"
C05. Veliki ponor	43,830008	16,81523	43°49'48.0"	16°48'54.8"
C06. Plovuća river	43,84303	16,870577	43°50'34.9"	16°52'14.1"

C07. Bistrica river (Duman)	43,831904	17,008292	43°49'54.9"	17°00'29.9"
C08. Bistrica river – Livno	43,827842	17,003899	43°49'40.2"	17°00'14.0"
C09. Bistrica river downstream from Livno	43,832285	16,981857	43°49'56.2"	16°58'54.7"
C10. Žabljak spring	43,810587	17,011672	43°48'38.1"	17°00'42.0"
C11. Žabljak river	43,816115	16,994338	43°48'58.0"	16°59'39.6"
C12. Sturba river – spring	43,761665	17,03295	43°45'42.0"	17°01'58.6"
C13. Sturba river - Lištane	43,872996	16,782417	43°52'22.8"	16°46'56.7"
C14. Kupreško field	43,956426	17,237772	43°57'23.1"	17°14'16.0"
C15. Kukavičko lake	43,9502	17,331606	43°57'00.7"	17°19'53.8"
C16. Milač river	43,96388	17,278281	43°57'50.0"	17°16'41.8"
C17. Šuica river - Šuica	43,836657	17,181032	43°50'12.0"	17°10'51.7"
C18. Šuica river - Kovači	43,671735	17,198373	43°40'18.3"	17°11'54.1"
C19. Lipsko lake	43,755712	16,918363	43°45'20.6"	16°55'06.1"
C20. Suvi Potok stream	43,921394	17,340384	43°55'17.0"	17°20'25.4"
C21. Ružica stream	43,739865	17,051286	43°44'23.5"	17°03'04.6"
C22. Grap stream	43,698306	17,008488	43°41'53.9"	17°00'30.6"
C23. Buško blato - Kraljicin Nasip embankment	43,689876	16,982631	43°41'23.6"	16°58'57.5"
C24. Buško blato – Mukišnica	43,65677	17,060238	43°39'24.4"	17°03'36.9"
C25. Ričina river – remains	43,632885	17,005587	43°37'58.4"	17°00'20.1"
C26. Korana (Zvijezda)	44,94688	15,747115	44°56'48.8"	15°44'49.6"
C27. Dulerski stream	44,219881	16,263179	44°13'11.6"	16°15'47.4"

OSVRT

U izradi Monografije dijatomeja slijeva Jadranskog mora za razdoblje od 1896. do 2019. uključeno je ukupno 139 postaja (slijev rijeke Neretve: 101, slijev rijeke Trebišnjice: 11 i slijev rijeke Cetine: 27). Ukupno je zabilježeno 549 svojti dijatomeja svrstanih u 90 rodova. Određeno je 69 varijeteta i osam formi. Samo jednom na jednoj postaji zabilježeno je 136 (24,7 %) svojti. Rodovi s najvećim brojem utvrđenih svojti su: *Navicula* (s 48 svojti), *Gomphonema* (s 37 svojti), *Nitzschia* (s 35 svojti), *Pinnularia* (s 32 svojte), a slijede ih *Fragilaria* (s 24 svojte), *Eunotia* (s 20 svojti), *Cymbella* (s 19 svojti), *Surirella* (s 17 svojti), te *Diatoma* i *Cocconeis* (svaki s 14 svojti). Prema podacima o ugroženosti svojti (Lange-Bertalot i Steindors (1996), Lange-Bertalot i Rumrich (2000)) 91 (16,5%), odnosno 81 (14, 7%) svojti je u kategoriji svojti koje sigurno nisu ugrožene ili nisu ugrožene. 53 (9,6%) nisu ugrožene ali su u regresiji, 19 (3,45%) ugrožene, 22 (4%) vjerojatno ugrožene, 7 (1,27) jako ugrožene, 11 (2%) vrlo rijetke, 5 (0,9%) nije zabilježeno na prostoru Njemačke te nedovoljni podaci za njih 17 (3,09). Prema ekološkim podacima 75 (13,6%) svojti je u kategoriji mezotrofnih do eutrofnih voda, 66 (0,18%) od oligotrofnih do eutrofnih, 30 (5,45%) oligotrofnih (bez posebnih značajki), 24 (4,36%) oligotrofne vapnenačke vode, 17 (3,09%) oligotrofne kisele vode, 13 (2,36%) halofila, sedam aerofila te jedna oligo do aerofilna.

Prema saprobnim indeksima vrijednosti su se kretale od 0,1 do 2, 9 (Sladecèk,1986), 1-2,9 (Wegl, 1983), 1-3,4 (Rott, 1997). Indikatorske vrijednosti prema Hrvatskom trofickom indeksu dijatomeja (TID_{RH}) bile su u rasponu od 1 do 5 (Plenković Moraj i sur., 2009), a prema Rottovom indeksu od 0 do 5 (Rott, 1999).

Na temelju svega navedenog možemo zaključiti da je prisutna velika raznolikost dijatomejskih svojti na području slijeva Jadranskog mora što zajedno s dijatomejama morskog područja (Neuma) broji 1086 svojti.

REVIEW

In the preparation of the Monograph of the diatoms of the Adriatic Sea basin for the period of 1896 to 2019 549 diatom taxa classified into 90 genera were recorded from a total of 139 sites. At one site alone, as many as 136 (24.7%) taxa were recorded. The genera with the highest number of identified taxa are: *Navicula* (48 taxa), *Gomphonema* (37 taxa), *Nitzschia* (35 taxa), *Pinnularia* (32 taxa), then *Fragilaria* (24 taxa), *Eunotia* (20 taxa), *Cymbella* (19 taxa), *Surirella* (17 taxa), and *Diatoma* and *Cocconeis* (14 taxa each). Based on (Lange-Bertalot and Steindors (1996), Lange-Bertalot and Rumrich (2000)); on the taxa endangerment data, 91 (16.5%) and 81 (14.7%) taxa respectively fall inside the category of taxa which are confirmed not endangered or not endangered, 53 (9.6%) not endangered but in regression, 19 (3.45%) endangered, 22 (4%) probably endangered, 7 (1.27%) very endangered, 11 (2%) very rare, 5 (0.9%) not found in Germany and for 17 taxa (3.09%) data is deficient. According to the ecological data, 75 (13.6%) of taxa fall into the category of mesotrophic to eutrophic water, 66 (0.18%) from oligotrophic to eutrophic, 30 (5.45%) oligotrophic (without special features), 24 (4.36%) oligotrophic limestone water, 17 (3.09%) oligotrophic acidic water, 13 (2.36%) halophiles, 7 aerophiles and 1 oligo to aerophile.

According to the saprobic value index, it ranged from 0.1 to 2.9 (Sladecèk,1986), 1-2.9 (Wegl, 1983), 1-3.4 (Rott, 1997). Indicator values based on the Croatian trophic diatom index (TID_{RH}) ranged between 1 to 5 (Plenković-Moraj et al., 2009), and based on the Rott index from 0 to 5 (Rott, 1999).

Based on all of the above, we can conclude that there is a large number of diatom taxa in the region of the Adriatic Sea basin, which, along with the diatoms of the marine area (Neum), amounts to 1086 taxa.

Cjelovit i opsežan tekst o dijatomejama Bosna i Hercegovine nikada nije napisan. Unatoč objavljenim znanstvenim i stručnim radovima domaćih i stranih autora, do sad nije bilo moguće navesti sve svojte dijatomeja zabilježene na području Bosne i Hercegovine.

Ova monografija će barem djelomično ispuniti tu prazninu. Sve su informacije prikupljene iz literature, i vjerojatno je potrebno provjeriti neke ranije rezultate. Međutim, zabilježene su u literaturi. Ostaje nam da potvrdimo ili demantiramo ove zapise.

Ova monografija predstavlja prvi popis dijatomeja u regiji te će se u idućem izdanju upotpuniti s dijatomejskim i nedijatomejskim svojtama preostalih područja Bosne i Hercegovine. Namjenjena je širokoj publici. Glavni korisnici zasigurno će biti algolozi, botaničari, nastavnici i studenti biologije, kao i brojni ljubitelji prirode.

The complete and comprehensive text of the diatoms flora of Bosnia and Herzegovina has never been written. Despite published scientific and professional papers by local and foreign authors, it has not been possible to list all the diatoms recorded in Bosnia and Herzegovinia so far. This Monograph will at least partially fill that void. All of the information was collected from the literature, and probably some of the earlier results need to be checked. However, has been recorded in the literature. It remains for us to confirm or deny these records.

This book represents the first list of diatoms in the region and will be supplemented in the next edition with the list of diatoms and non-diatoms taxa from the remaining regions of Bosnia and Herzegovina. The book is intended for a wide audience. The main beneficiaries will certainly be phycologists, botanists, biology students, teachers as well as a numerous nature lovers.

4. REZULTATI

Tablica 9. Popis dijatomeje slijeva Jadranskog mora

Taxa=valid datas of recorded taxa according to the AlgaeBase in March 2019. Station= Station codes where taxa are recorded. The stations are explained in Chapter 3.3. SYN= synonym, the red colored names are according to our literary names, and all others are according to the AlgaeBase. Status = category in Germany's red list, according to Lange-Bertalot and Steindorf (1996): *, ** = no taxa endangered, D = insufficient data, V = almost endangered, G = dependent on conservation, R = questionable, 0 = extinct, 1 = critical, 2 = endangered, 3 = sensitive, o = Central European taxa, not found in Germany but because of the ecology, considers it to be there.

Taxa	Station
Achnanthes	
Achnanthes brevipes var. *intermedia* (Kützing) Cleve	N08, NP14, NP20
Achnanthes exigua var. *constricta* (Torka) Hustedt	T01
Achnanthes hoermanni Gutwinski	C23
Achnanthes inflata (Kützing) Grunow	NP07, NP08, NP09, NP23, NP27, NP28, NP31, NP39, NP48, PJ02, M02d
Achnanthes lanceolata (Brébisson) Grunow var. *minuta* (Skvortzow) Sheshukova	M02, M02b
*Achnanthes lanceolata (*Brébisson) Grunow var. *rostrata* (Østrup)Hustedt	N22, NP01, NP31, NP34, NP42, NP49, NP50, NP51, NP52, NP53, PJ02, M02a, M02b, T01, C18
Achnanthes minutissima var. *gracilima* (Meister) Lange-Bertalot	C16
Achnanthes minutissima var. *jackii* Lange-Bertalot & Rupel	NP31, PJ03

4. RESULTS

Table 9. List of diatoms of the Adriatic Sea basin

Ecology=ecological datas for diatoms according to Lange-Bertalot and Steindorfu (1996): eu = mesotrophic to eutrophic water, tol = from oligotrophic to eutrophic water, o = oligotrophic water (without special features), od = oligotrophic water (carbonate water), oc = oligotrophic water (acidic water, with more, or less humic acids), hal = halophilic, ae = aerophilic. Saprobic values: according to Rott et al. (1997)-S1, Sladaček (1986)-S2 and Wegl (1983)-S3. The categories are given in the section Materials and Methods. Trophic values: according to Rott et al. (1999)-T1 and Plenković Moraj et al. (2009)-T2A, T2B. The categories are given in the section Materials and Methods.

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Achnanthes subsessilis Kützing, *Achnanthes intermedia* Kützing	**	hal				1		
Achnanthes hörmanni Gutwinski								
Achnanthes interrupta Carter, *Stauroneis inflata* Kützing, *Achnanthidium inflatum* (Kützing) Hutton	R					5		
						1		
Achnanthes pyrenaica Hustedt								

Taxa	Station
Achnanthes petersenii Hustedt	NP31
Achnanthes sp.	N03, N07, N15, N16, N17, N22, NP01, NP07, NP12, NP19, NP29, NP33, NP34, NP35, NP37, NP45, NP46, NP48, NP56, NP57, NP58, UJ05, M02a, M02b, M02c, M02d, C02, C07, C10, C11, C12, C16, C17, C21, C22, C23, C25, C26, C27
Achnanthes trinodis (W.Smith) Grunow	NP31
Achnanthidium	
Achnanthidium affine (Grunow) Czarnecki	NP03, NP14, NP23, NP35, NP47, M02, M02b

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Achnanthes kryophila Petersen var. *densestriata* Hustedt, *Achnanthes petersenii* Hustedt, *Navicula densestriata* Hustedt, *Achnanthes procera* Hustedt, *Achnanthes jakovljevicii* Hustedt, *Achnanthes hustedtii* Bily & Marvan, *Achnanthes parallela* J.R.Carter, *Achnanthes pusilla* var. *petersenii* (Hustedt) Lange-Bertalot & Ruppel, *Achnanthes sonyda* J.R.Carter, *Achnanthes grubei* Simonsen	3	o				5	0.6	1
				2		5		
	3	oc			1	2	0.6	2
Achnanthes affinis Grunow, *Achnanthes minutissimum* Kützing var. *affinis* (Grunow) Lange-Bertalot, *Achnanthes affinis* Grunow, *Microneis affinis* (Grunow) Cleve, *Actinoneis affinis* (Grunow) Hollerbach & Krasavina, *Achnanthes minutissima* var. *affinis* (Grunow) Lange-Bertalot, *Achnanthidium minutissimum* var. *affine* (Grunow) Lange-Bertalot	D		0.4		1.3	1	1.2	3

Taxa	Station
Achnanthidium contractum Schumann	N01,T06, T07
Achnanthidium exile (Kützing) Heiberg	PJ02, C12, NP49, NP42, NP37
Achnanthidiun exiguum (Grunow) Czarnecki	N03, N22, NP01, NP19, NP29, NP31, NP34, NP39, NP42, NP47, NP49, NP50, NP51, NP52, M02, M02b, M02c, M02d, C10, C16, T01, C12
Achnanthidium lineare W.Smith	N01, N02, N03, N05, N17, N22, NP01, NP03, NP05, NP07, NP08, NP11, NP14, NP19, NP27, NP31, NP34, NP35, NP37, NP42, NP45, NP49, NP50, NP54, NP56, M01, T03, T04, C07, C10, C11, C12, C16, C26
Achnanthidium microcephalum Kützing	M02b
Achnanthidium minutissimum (Kützing) Czarnecki	N02, N07, N16, N17, N22, NP01, NP03, NP07, NP08, NP10, NP11, NP14, NP15, NP16, NP18, NP20, NP23, NP24, NP29, NP31, NP33, NP34, NP35, NP37, NP39, NP42, NP45, NP46, NP47, NP49, NP50, NP51, NP52, NP53, NP60, NP61, PJ02, PJ04, M01, M02b, M02d, T01, T03, T04, T05, C10, C12, C14, C18, C23
Achnanthidium pyrenaicum (Hustedt)	NP29, NP31, NP34, NP42, NP49, NP50, NP51, NP52, NP53, C12, C27
Actinocyclus	
Actinocyclus normanii f. *subsalsus* (Juhlin-Dannfelt) Hustedt	NP22, NP47, M02, M02b, M02d
Adafia	
Adlafia bryophila (J.B.Petersen) Lange-Bertalot	PJ02
Adlafia minuscula (Grunow) Lange-Bertalot	NP47, M02, M02b, T03,T04

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Achnanthes contracta Schumann								
Achnanthes exiloides Carter in Carter & Watts, *Achnanthes exilis* Kützing	V	tol			1.3	5	1.2	3
Achnanthes exigua Grunow var. *heterovalvata* Krasske, *Microneis exigua* (Grunow) Comber	**	eu				5		
Achnanthes linearis W. Smith	3	o	0.4	1.5		5		
Achnanthes microcephala (Kützing) Grunow								
Achnanthes minutissimum Kützing, *Achnanthes minutissima* Kützing var. *cryptocephala* Grunow	**	tol	1.45	2		2	1.2	1
Achnanthidium biasolettianum (Grunow) Bukhtiyarova						3		
Coscinodiscus rothii (Ehrenberg) Grunow var. *subsalsa* Hustetd								
Navicula bryophila Petersen	V	tol			1.1	1		
Navicula miniscula Grunow	*	tol				1		

Taxa	Station
Amphipleura	
Amphipleura pellucida (Kützing) Kützing	N02, N05, N16, N22, NP01, PJ03, PJ04, M02, T05, C07, C16, C26
Amphora	
Amphora affinis Kützing	C12, C23
Amphora commutata Grunow	M02a, M02d
Amphora elegans H. Peragallo	N08, NP07, NP36, PJ02, PJ04, M02, M02b, T06
Amphora gracilis Ehrenberg	N01, N03, M02b, T06, T07
Amphora libyca Ehrenberg	N08, NP07, NP08, NP09, NP36, PJ04, M01, T06
Amphora normanii Rabenhorst	PJ04
Amphora ovalis (Kützing) Kützing	N01, N03, N05, N06, N07, N11, N13, N14, N15, N16, N17, N22, NP01, NP07, NP08, NP10, NP12, NP14, NP19, NP22, NP23, NP25, NP26, NP27, NP28, NP29, NP30, NP31, NP33, NP34, NP35, NP37, NP39, NP40, NP41, NP42, NP43, NP44, NP45, NP46, NP47, NP48, NP49, NP50, NP51, NP52, NP53, NP61, PJ02, PJ04, JU04, UJ06, M01, M02, M02a, M02b, M02c, M02d, T01, T03, C05, C07, C10, C11, C12, C16, C17, C18, C23, C26

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Frustulia pellucida Kützing, *Navicula pellucida* (Kützing) Ehrenberg, *Aulacocystis pellucida* (Kützing) Hassall, *Carrodorus pellucida* (Kützing) Kuntze, *Berkeleya pellucida* (Kützing) Giffen	*	tol		1.3	1.3	3		
Amphora ovalis var. *affinis* (Kützing) van Heurck								
	**	hal				3		
Amphora ovalis Kützing var. *gracilis* (Ehrenberg) Van Heurck				1.6				
Amphora ovalis var. *libyca* (Ehrenberg) Cleve, *Clevamphora ovalis* var. *libyca* (Ehrenberg) Mereschkowsky	**	tol			1.6	3	3.5	5
	V	ae	0.1	1		3		
Frustulia ovalis Kutzing, *Clevamphora ovalis* (Kützing) Mereschkowsky	**	tol	1.65	1.7	1.5	2	3.3	2

Taxa	Station
Amphora pediculus (Kützing) Grunow	N01, N02, N05, N06, N08, N15, N17, N18, N18, N21, N22, NP01, NP07, NP12, NP18, NP19, NP21, NP22, NP26, NP27, NP29, NP30, NP31, NP33, NP34, NP35, NP36, NP39, NP42, NP43, NP45, NP46, NP47, NP48, NP49, NP50, NP51, NP52, NP53, NP61, PJ02, PJ04, UJ07, M01, M02a, M02b, M02c, T08, T10, C02, C04, C05, C07, C10, C12, C16, C17, C21, C22, C23
Amphora sp.	N03, N17, NP01, NP07, NP24, C12, C10, C16, C18, NP33, NP34, NP46, NP56, NP61
Aneumastus	
Aneumastus stroesei (Østrup) D.G.Mann	N05, N06, NP32
Aneumastus tuscula (Ehrenberg) D.G.Mann & A.J.Stickle	N01, N07, N22, NP15, NP16, NP18, NP21, NP22, NP30, NP43, NP45, NP46, C05, C16, M02, M02d
Anomoeoneis	
Anomoeoneis exilis Kützing Cleve f. *lanceolata (*A.Mayer) Hustedt	PJ03
Anomoeoneis sphaerophora (Kützing) Pfitzer var. *elliptica* O. Müller	NP47, M02

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Amphora ovalis Kützing var. *pediculus* (Kützing) Van Heurck, *Cymbella pediculus* Kützing, *Cymbella cespitosa* var. *pediculus* (Kützing) Brun, *Amphora ovalis* var. *pediculus* (Kützing) Van Heurck, *Encyonema pediculus* (Kützing) H.Peragallo, *Clevamphora ovalis* var. *pediculus* (Kützing) Mereschkowsky	**	tol		1.5	2.1	2	2.8	2
Navicula pseudotuscula Hustedt, *Navicula stroesei* (Østrup) A. Cleve, *Navicula tuscula* var. *stroesei* Østrup	3	oc			1.3	1		
Navicula tuscula (Ehrenberg) Grunow, *Stauroptera tuscula* (Ehrenberg) Ehrenberg, *Schizonema tuscula* (Ehrenberg) Kützing, *Clevia tuscula* (Ehrenberg) Mereschowsky	*			1.5	1.1	1		
Anomoeoneis exilis Kützing Cleve								
Navicula sphaerphora (Kützing), *Navicula amphisbaena* var. *sphaerophora* (Kutzing) Rabenhorst								

Taxa	Station
Anomoeoneis sphaerophora Pfitzer	N08, PJ02, M02, M02b, C18
Asterionella	
Asterionella formosa Hassall	N09, N16, N17, N22, PJ02, UJ01, UJ02, UJ03, UJ04, UJ05, UJ06, UJ07, M02b, T11, C23, C24
Asterionella sp.	JU07
Aulacoseira	
Aulacoseira crenulata (Ehrenberg) Thwaites	C14
Aulacoseira distans (Ehrenberg) Simonsen	NP31, C14
Aulacoseira elegans (Mukhina) Simonsen	PJ02
Aulacoseira granulata (Ehrenberg) Simonsen	N15, N22, NP31, NP35, PJ04, C04, C24
Aulacoseira islandica (Otto Müller) Simonsen	NP07

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Anomoeoneis sphaerophora E. Pfitzer	**	eu	1.6	2.7	2.7	1	3.4	3
Asterionella gracillima var. *formosa* (Hasall) Wislouch	**	tol	1.4	1.6	1	2	1.8	
Melosira crenulata Kützing, *Lysigonium crenulatum* (Ehrenberg) Trevisan, *Gaillonella crenulata* Ehrenberg	V	oc				1		
Melosira distans (Ehrenberg) Kützing, *Gaillonella distans* Ehrenberg, *Gaillonella distams* Ehrenberg, *Melosira distans* (Ehrenberg) Kutzing	G	od	0.5	1.3		1	1	4
Melosira elegans V. V. Mukhina								
Melosira granulata (Ehrenberg) Ralfs, *Gaillonella granulata* Ehrenberg, *Melosira punctata* var. *granulata* (Ehrenberg) Cleve & Möller, *Lysigonium granulatum* (Ehrenberg) Kuntze, *Orthoseira granulata* (Ehrenberg) Schonfeldt, *Melosira polymorpha* subsp. *granulata* (Ehrenberg) H.Bethge	**	tol	1.8	2.5		1		
						1		

Taxa	Station
Aulacoseira italica (Ehrenberg) Simonsen	N07, N15, N22, NP31, NP35, NP45
Aulacoseira nivalis (W.Smith) J. English & Potapova	C14, C23
Aulacoseira sp.	NP33, NP48
Brachysira	
Brachysira brebissonii R. Ross	NP31
Brachysira exilis (Kützing) Round & D.G.Mann	NP23, NP31, NP34, NP49, NP51, NP52, NP53, PJ02
Brachysira microcephala (Grunow) Compère	NP48
Caloneis	
Caloneis alpestris (Grunow) Cleve	NP33, NP34, NP42, NP43, NP46, NP49, NP50, PJ02, M02d
Caloneis amphisbaena (Bory) Cleve	N08, PJ02, M02a

Syn	Status	Ecology	S1	S2	S3	T1	T2A	T2B
Melosira italica (Ehrenberg) Kützing, *Gaillonella italica* Ehrenberg, *Aulacoseira italica* f. *italica* (Ehrenberg) N.N.Davydova	V		1.6	1.6		1	1.4	2
Melosira nivalis W. Smith, *Melosira distans* (Ehrenberg) Kützing var. *nivalis* Smith Kirchner	*							
						1		
Anomoeoneis brachysira (Brébisson ex Kützing) Cleve, *Anomoeoneis serians* (Brébisson) Cleve var. *brachysira* (Brébisson) Cleve	*	od	0.2					
Navicula exilis Kützing, *Navicula cryptocephala* Kützing var. *exilis* (Kützing) Grunow, *Colletonema exile* (Kützing) Grunow, *Anomoeoneis exilis* (Kützing) Cleve, *Schizonema exile* (Kützing) Kuntze								
Navicula microcephala Grunow	G	o				3	2	1
Navicula alpestris Grunow, *Schizonema alpestre* (Grunow) Kuntze	G	oc	0.1	1		1		
Navicula amphisbaena Bory de Saint-Vincent, *Caloneis silicula* (Ehrenberg) Cleve var. *peisonis* Hustedt	**	eu	2.35	2.3		1	3.9	2

Web izvori

URL 1. Algebase, http://www.algaebase.org/

URL 2. Hrvatske vode, Metodologija, http://www.voda.hr/hr/metodologije

URL 3. RAMSAR convention: www.ramsar.org/

URL 4. Federalni hidrometeorološki zavod BIH. www.fhmzbih.gov.ba

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