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DIVERSITY OF ALGAE AND CYANOPROKARYOTA IN SOUTHERN AFRICAN DRAKENSBERG (WITH SPECIAL ATTENTION TO DESMIDS)

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Abstract

We studied the diversity of algae (desmids and diatoms) and cyanoprokaryota in freshwater and aerophytic biotopes in the Drakensberg (South Africa and Kingdom of Lesotho). Diversity, species composition and distribution of the taxa, their ecological characteristics, level of endemism and perspectives of taxonomical studies are being discussed.

Special attention was paid to the study of desmids which are poorly investigated in the Drakensberg. Our work on the mountain tarns around the Giant's Cup area (UKhahlamba-Drakensberg National Park) revealed a total of 86 species from 18 genera of saccoderm and placoderm desmids (87 intraspecific taxa). Desmids belonging to the families Mesotaeniaceae (3 species), Gonatozygaceae (2), Closteriaceae (9) and Desmidiaceae (72 species, 73 intraspecific taxa) were identified. Most diverse families are: Gonatozygaceae (2), Closteriaceae (9) and Desmidiaceae (72 species, 73 intraspecific taxa). As the result of our studies 1 genus (*Teilingia* Bourr.) and 28 species (3 species and 2 varieties from them will be described as new for science) were recorded in Southern Africa for the first time.

Our data revealed a high algal diversity in the Drakensberg and confirmed that the Drakensberg (together with the Cape region, Waterberg, Caprivi Strip, Swaziland, Karoo and Namib deserts) is one of the most diverse algal areas in Southern Africa.

Introduction

Drakensberg Mountains (DM) (Africa's highest mountain range south of Kilimanjaro) extend from the north of Hoedspruit in the RSA's Northern Province

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1,000 kilometers south to the mountain Kingdom of Lesotho, where a series of spectacular peaks, some 240 kilometers long, creates the western border of KwaZulu-Natal. This border is known as uKhahlamba (or “barrier of spears”) to the Zulus. Later they were renamed “Dragon Mountains” by the Trekkers seeking to cross them - a massive basaltic cap set on a broad base of sedimentary rocks belonging to the Stormberg series of 150 million years age. The highest peak is Thabana Ntlenyana (3,482 meters). DM are home for the world's second-highest waterfall, the Tugela Falls, with a total drop of 947 m. Part of the chain forms the watershed between the rivers flowing west to the Atlantic and those flowing east and south to the Indian Ocean. The Orange and Tugela rivers rise in the Montaux-Sources. Van Reenen's and Laingsnek are the main passes. DM are home to forest, scrub, fynbos, savannah, mountain grassland and heath plant families, including a large number of species listed in the Red Data Book of threatened plants, with 119 species listed as globally endangered (**Golding, 2002**).

Unfortunately the diversity of algae in such a diverse ecosystem as the DM is studied insufficiently regarding particular groups such as cyanoprokaryota, desmids and diatoms. There are no data on algae and cyanoprokaryota of certain ecological groups, such as terrestrial and aerophytic algae. Our work will complement some of the data about the diversity and ecology of these organisms in the DM.

Materials and methods

Algal samples were examined using a Zeiss microscope. Diatom material was cleaned using a saturated solution of KMnO_4 and cleared using concentrated HCl (for details see **Taylor *et al.*, 2005**). Cleaned material was mounted on glass slides using Pleurax (r.i. 1.73) and examined using a Nikon 80i equipped with DIC optics and photographs were taken using a Nikon DS-U2 5 mp digital camera. Sub-samples in which diatom species were most abundant were mounted on aluminum stubs, coated with gold palladium and examined using a FEI 200 QUANTA ESEM at the North-West University (Potchefstroom Campus), Potchefstroom.

Results and Discussion

As preliminary results on algal diversity of DM we will present some data on the distribution of certain groups as well as algal characteristics of some regions in the studied areas.

Cyanoprokaryota:

Certain data on the diversity of cyanoprokaryotes in Clarens Sandstone cliffs of DM were reported in a few works (**Büdel and Wessels, 1991; Büdel et al., 1993; Wessels and Büdel, 1995; Büdel, 1999**). *Nostoc microscopicum*, *Chroococcus*, *Gloeocapsa*, *Nostoc* sp. and *Oscillatoria* were found. All these organisms are closely related to honeycombed weathering structures and the only source of water was strongly alkaline (pH 9) seepage water from the wall and ceiling. Also cyanoprokaryote species of *Chamaesiphon*, *Scytonema* and *Tolypothrix* as well as green algae were found in Moses Cave. *Chrococccidiopsis* species dominated in the cryptoendolithic community.

Our results had shown a rich cyanoprokaryotic diversity in Northern DM. The species include *Chlorogloea microcystoides*, *Nostoc microscopicum*, *Microcystis aeruginosa*, *Microcystis* cf. *incerta*, *Oscillatoria limosa*, and members of following genera - *Calothrix*, *Chroococcus*, *Cyanobacterium*, *Gloeocapsa*, *Gomphosphaeria*, *Leptolyngbya*, *Nostoc*, *Merismopedia*, *Phormidium*, *Pseudanabaena*, *Stanieria*, *Synechococcus*, *Synechocystis* etc.

Desmids:

Desmids of Southern Africa were studied by numerous phycologists such as L. Rabenhorst (**Rabenhorst, 1855**), P.F. Reinsch (**Reinsch, 1878**), F.E. Fritsch and colleagues (**Fritsch, 1911-1918; Fritsch and Rich, 1924, 1925, 1930, 1938; Fritsch and Stephens, 1921**), G.S. West (**West, 1911-1918**), J.W. Bews (**Bews, 1916**), W.J. Hodgetts (**Hodgetts, 1926**), G. Huber-Pestalozzi (**Huber-Pestalozzi, 1929, 1930**), G. Nygaard (**Nygaard, 1932**), F. Rich (**Rich 1932, 1940**), J.F.M. Schuurman (**Schuurman 1932**), B.J. Chohnoky (**Chohnoky 1954a,b, 1955**), M.I. Claassen (**Claassen 1961, 1976, 1977, 1982, 1985; Claassen, Eicker 1985**), R. Grönblad and H.T. Croasdale (**Grönblad and Croasdale 1971**), D.B. Williamson (**Williamson 1994, 1995, 1996, 1999, 2000**), D.C.J. Wessels and B. Büdel (**Wessels and Büdel 1995**), P.F.M. Coesel and A. van Geest (**Coesel and van Geest 2008**).

According to the published data (1855-2008) 547 species of saccoderm and placoderm desmids (864 intraspecific taxa including type taxa) were recorded in Southern Africa (**Levanets et al. 2010**). From these 302 taxa were described as new for science (both from water bodies and aerophytic biotopes), including 109 species, 1 subspecies, 162 varieties, 28 forms, 1 new name and 1 new combination.

Not all ecological regions were, however, studied sufficiently, and the most perspective territories for floristical and taxonomical studies of desmids according to our experience are: subtropical regions (Kruger National Park, Swaziland, Caprivi Strip), Okavango Delta, Karoo and Namib deserts and especially

mountain countries – Western and Eastern Cape, Cederberg, Waterberg, Kingdom of Lesotho and Drakensberg.

As part of performing of our project, devoted to floristical and taxonomical studies of Southern African desmids, we visited Cobham Nature Reserve (part of Drakensberg-uKhahlamba National Park) in June 2008 and collected algological samples in mountain tarns that were extremely difficult to access.

Established in 2000, the Drakensberg-uKhahlamba National Park is located in the west of the KwaZulu Natal Province on the Kingdom of Lesotho's border (S 29°23', E29°32'). It is 243 hectares in size, stretching 150 kilometres from Royal Natal National Park in the north to Cobham Forest Station in the south. It is a mixed cultural and natural heritage site and the fourth site in South Africa to be granted a World Heritage status. Africa's highest mountain range south of Kilimanjaro is situated there, as well as the largest and most concentrated series of rock art paintings in Africa, made by the San people over a period of 4000 years. Both the Zulu name, *uKhahlamba* (barrier of spears) and the Afrikaans name *Drakensberg* (dragon mountain) fit the formidable horizon created by the range - a massive basaltic cap set on a broad base of sedimentary rocks belonging to the Stormberg series of 150 million years ago. The mountains are South Africa's main watershed.

The site's diversity of habitats protects a high level of endemic and globally threatened species, especially birds and plants. Ninety eight of the 2153 plant species in the park are endemic or near-endemic (**Golding, 2002**). These include the extremely rare *Protea nubigena* Rourke, a plant found on a high ridge in the Royal Natal section of the park. Part of the reason for the Drakensberg's rich biodiversity is its extremes of altitude, ranging from 1000 to 3500 meters above sea level.

Dominated by Hodgson's Peaks which enclose Giants Cup, Cobham Nature Reserve is a 52.000 hectare section of the uKhahlamba Drakensberg Park in the southern mountains adjacent to Himeville Village (situated approximately 150 km from Pietermaritzburg). Cobham is dominated by vast expanses of *Themeda triandra* Forsk. and *Festuca* spp. (*F. caprina* Nees, *F. costata* Nees) grasslands. The grasslands are interspersed with rocky outcrops/boulders, streams and rivers and indigenous forests.

The reserve was established in 1959 by the Department of Forestry, and has been administered by KZN Wildlife (formerly the Natal Parks Board) since 1988. Vergelegen is managed as part of Cobham. It is the closest hiking route (via Mkhomazi pass) to the highest peak in the Drakensberg, Thabana Ntlenyana (the beautiful little mountain) which is situated in Lesotho. At 3482 m, Thabana Ntlenyana is the highest peak south of Kilimanjaro. The area has large numbers

of small upland lakes or tarns and there is an area in Cobham called the Lake District.

Samples were collected from tarns with acidic water situated on the plateau of Siphongweni Mt., and plateaus of near mountains (Kwesamakhehlababili, Ndolvini, Little Bamboo Mts.) which surround the Pholena River.

In total 86 species from 18 genera of saccoderm and placoderm desmids (87 intraspecific taxa) were found in samples studied. Desmids belonging to the families *Mesotaeniaceae* (3 species), *Gonatozygaceae* (2), *Closteriaceae* (9) and *Desmidiaceae* (72 species, 73 intraspecific taxa) were identified. Most diverse genera are: *Cosmarium* Corda ex Ralfs (25 species, 26 intraspecific taxa), *Staurastrum* Meyen ex Ralfs (16), *Closterium* Nitzsch (9) and *Euastrum* Ehr. ex Ralfs (7). As a result of our studies 1 new genus (*Teilingia* Bourr.) and 28 new species (3 species and 2 varieties from them will be described as new for science) were recorded in Southern Africa for the first time. Short descriptions of new records are presented here.

Closterium angustatum Kütz. Cells slightly curved, in the middle with parallel margins, to the ends slightly narrowed. Cell ends slightly capitate. Cell wall with girdle bands, brownish, costate. Length 240-270 μm , breadth 20 μm , length/breadth 12-13.5.

Cl. calosporum Wittr. Cells strongly arched. Cell wall without girdles, colourless, smooth. Distinct terminal pore. Length 80-84 μm , breadth 8 μm , length/breadth 10-10.5.

Cl. cf. infractum Messikommer. Cell wall colourless and smooth. Length 27-30 μm , breadth 10-12 μm , length/width 2.5-2.7.

Actinotaenium cucurbita (Ralfs) Teiling. Cells cylindrical to ellipsoid with a median constriction. Apices rounded. Chloroplast stelloid. Length 28-30 μm , breadth 13 μm , length/breadth 2.1-2.2.

Pleurotaenium verrucosum (Bailey) Lund. Cells straight, apex truncate. Length 400-570 μm , breadth at the base 43 μm , breadth of apex 24-30 μm .

Haplotaenium rectum (Delponte) Bando. Cells elongate cylindrical with truncately rounded apices. Semicells with a slight, but distinct basal inflation. Apices smooth-walled. Length 250-280 μm , breadth 20 μm , length/breadth 12.5-14.

Triploceras gracile Bail. var. *aculeatum* Nordst. Cells of of medium size, cylindrical, elongate, with slight median constriction and a somewhat forked apex ending in 2-4 lobes or processes which are tipped with 2-4 stout spines or teeth; walls of semicells having 8-18 whorls of slight elevations or projections bearing mostly broad-based spines or verrucae, finely punctate between; chloroplast with

longitudinal bands radiating from a central axis, and with an axile row of pyrenoids. Cells 220-620 x 21-50 μm , at apex 28-40 μm . Zygospores were not observed.

Euastrum sinuosum (Lenorm.) Arch. var. *germanicum* (Racib.) Krieg. A variety with 3-5 central pores, usually in a triangular pattern; polar lobe typically extended and well set-off from the rest of the semicell. Cells 60-72 x 34-44 μm , 10-18 μm at isthmus, 18-22 μm at apex, 20-32 μm thick.

Cosmarium freemanii W. et G.S. West. Two varieties were discovered which will be described later as a new for science.

C. incertum Schmidle var. *borgei* Krieg. et Gerloff. Cells rectangular, compressed. Sinus narrowly linear on apex, open on end. Semicells nearly square, with prominent, flat or concave apex and more or less concave sides, upper angles rounded, lower angles nearly straight. Cell wall smooth. Zygospores were not observed. Cell length 26-29 μm , breadth 16-18 μm , isthmus 3-7 μm .

C. jugatum Coesel. Cells as long as broad. Sinus shallow, widely open from an obtuse-angled apex. Semicells in frontal view oval-cuneate with a retuse apex. Semicells in apical view oval in outline. Cell wall smooth. Cell length 6-7 μm , breadth 6-7 μm .

C. ordinatum (Børgesen) W. et G.S. West. Cells slightly longer than broad with a deep, acute-angled, open sinus. Semicells subsemicircular. Cell wall beset with verrucae. Verrucae on the frontal side arranged in groups (of 2 to 4 warts) in some six longitudinal rows. Apical view ellipsoid, with projecting verrucae along the greater part of the outline. Cell length 20-25 μm , breadth 18-24 μm .

C. cf. quadrogranulatum W. et G.S. West. Cells longer than broad. Sinus deep, closed from the apex to above half-way, then much dilating. Semicells rounded hexagonal. Cell wall with a minute granule on each of the four lateral angles. Apical view broadly elliptic to rounded rhomboid. It is a poorly known species, originally described from Madagascar. Cell length 16-22 μm , breadth 13-17 μm .

Xanthidium bifidum (Bréb.) Deflandre. Cells about as long as broad with a moderately deep, open sinus. Semicells cup- to bowl-shaped with slightly concave to straight apex and convex to straight lateral sides. Apical angles broadly truncate, bifurcate. Cell length inclusive of spines 10-15 μm , breadth 10-15 μm .

Cells 2-radiate, about as long as broad with a moderately deep, widely open sinus. Semicells triangular with slightly convex sides and a minute spine at the apical angles. Cell length 20-24 μm , breadth (without spines) 20-23 μm . Spines about 1 μm .

Std. extensus (Borge) Teil. Cells biradiate, without spines slightly longer than broad, with a deep, widely open sinus. Semicells obversely trapeziform mutually separated by a cylindrically elongate isthmus, with divergent spines at the apical angles. Cell length without spines 16-28 μm , breadth 13-20 μm . Spines about 7-14 μm .

Staurastrum arctiscon (Ehr.) Lund. Cells about as long as broad, deeply constricted. Sinus widely open with subacute apex. Semicells broadly elliptic to oval in outline, the lateral sides produced into arm-like processes which are almost as long as the body of the semicell is broad. Processes tipped with 2-3 spines. Apex of semicell with a series of similar processes, ascending obliquely. Cell wall of the processes with concentric series of granulations/denticulations, cell wall of the semicell body smooth. Semicells in apical view almost circular with two whorls of radiating processes: a marginal series of 9 processes and an intramarginal series of 6 processes. Cell length 98-130 μm , breadth 90-120 μm .

St. boreale W. et G.S. West. Cells slightly broader than long, deeply constricted. Sinus widely open and acute-angled. Semicells cup-shaped, the apical angles produced to form rather short to moderately long, parallel or slightly divergent processes tipped by short spines. Cell wall furnished with acute granules or denticulations arranged in concentric series around the processes and continuing onto part of the semicell body, those at the apex being emarginate. Semicells at the base with a supraisthmal whorl of granules. Semicells in apical view 3-radiate with about straight sides, the angles attenuated into processes; the inner series of verrucae/denticulation on the semicell body emarginate, often also along each of the sides a number of emarginate verrucae. Cell length 25-28 μm , breadth 35-45 μm .

St. brachiatum Ralfs. Cells about as long as broad, deeply constricted. Sinus widely open, more or less rectangular. Semicells obversely triangular with almost straight lateral sides and almost straight to concave apex. Semicell body at the apical angles gradually passing into divergent, arm-like processes which are 2-3(5)-fid at the end, resulting in shorter or longer, usually blunt, terminal teeth. Cell wall smooth. Semicells in apical view 3-4-angular with strongly concave sides, sometimes with a slight median inflation. Cell length 28-38 μm , breadth 26-52 μm .

St. hystix Ralfs. Cells slightly longer than broad to about as long as broad, deeply constricted. Sinus rather widely open from an acute apex. Semicells oblong-oval with a concave to almost straight apex. Each of the lateral lobes provided with some stout, often curved, terminal spines and a circle of similar spines just proximal of it. Cell wall otherwise smooth. Semicells in apical view 3-4-angular with concave to almost straight sides and broadly rounded angles;

spines confined to the region of the angles. Cell length 30-35 μm , breadth 26-33 μm .

St. micron W. et G.S. West. Cells about as broad as long or a little broader than long, deeply constricted. Sinus V-shaped. Semicell body bowl-shaped, the apical angles produced to form rather short, stout, diverging processes. Processes slightly dilated at the apex, tipped with 3-4 minute spines, towards the semicell body furnished with a number of concentric series of granules/dentations. Semicells in apical view (2-)3(-4) radiate with concave to straight sides, the angles attenuated into short processes. Cell length 14-24 μm , breadth 14-26 μm .

St. smithii Teiling. Cells slightly broader than long, very deeply constricted and strongly twisted at the isthmus. Sinus widely open with obtuse apex. Semicell body in outline cup-shaped with concave apex, the apical angles gradually attenuated to form long, divergent processes. Processes tipped with some three minute spines and towards the semicell body furnished with a spiralling series of undulations/denticulations. Semicell body smooth-walled. Semicells in apical view 2-radiate with straight or slightly convex sides, the poles attenuated into processes. Cell length 36-48 μm , breadth 48-62 μm .

Desmidium pseudostreptonema W. et G.S. West. Cells near to elliptic, deeply constricted. Sinus narrow, nearly linear or gradually get narrow to the apex, open. Semicells narrowly elongated, with prominent apex and 2 short sprouts and prominent sides. In apical view 3-angular, rectangular or 2-lobbed with small narrowings near each angle. One star-like chloroplast in each semicell, with one pyrenoid. Cell length 18-20 μm , breadth 31-36m, isthmus 14-28 μm .

Teilingia excavata (Ralfs) Bourr. Cells slightly longer than broad with a shallow, obtuse-angled, widely open sinus. Semicells oval-elliptic in outline, in apical view oval. Cell wall, apart from the four apical granules, smooth. Cell length 7-12 μm , breadth 16-10 μm .

T. granulata (J. Roy et Bisset) Bourr. Cells about as long as broad. with a moderately deep, widely open sinus. Semicells oval in outline, in apical view oval-elliptic. Cell wall ornamentation in the form of distant granules or blunt teeth; in frontal view usually 2 at the apical margin, 3 marginal and 1 or 2 intramarginal on each lateral side. Cell length 7-12 μm , breadth 8-14 μm . Zygosporangia were not observed.

Dominant desmid species in samples from Cobham Nature Reserve tarns consisted of *Actinotaenium cucurbitinum* (Bisset) Teiling, *Euastrum denticulatum* (Kirchn.) Gay, *Cosmarium moniliforme* (Turp.) Ralfs, *Staurodesmus extensus* (Borge) Teil., *Staurastrum brachiatum*, *S. gracile* Ralfs, *S. paradoxum* Ralfs, *S. tetracerum* Ralfs. Filamentous desmids like *Sphaeroszma vertebratum* (Bréb.)

Ralfs and *Spondylosium planum* (Wolle) W. et G.S. West play an important role in the structure of dominant complex as well.

In conclusion we can note that our preliminary results as well as a variety of ecological conditions and microhabitats in Drakensberg gave us an impression of a rich and diverse desmid flora, a study which we will continue in future.

Diatoms:

In the past research on the diatom flora of DM has been limited to the Tugela River and its tributaries (**Cholnoky 1957**). This work centered mainly on small rivers and streams at high altitudes near the source of the Tugela River on the Mont-aux-Sources plateau. B.J Cholnoky found the following taxa to be abundant across most of the study sites: *Achnanthes exigua* var. *heterovalvata* Krasske, *A. lanceolata* (Bréb.) Grun, *Amphipleura pellucida* Kg., *Cymbella amphicephala* var. *hercynica* (A.S.) Cl., *C. oliffii* Cholnoky, *Eunotia polgdentula* Brun., *E. tschirchiana* O. M., *Fragilaria ungeriana* Grun., *Neidium affine* var. *amphirrhynchus* (E.) Cl., *Nitzschia accommodata* Hustedt, *N. interrupta* (Reicheldt) Hustedt, *N. perminuta* Grun. and *Tabellaria flocculosa* (Roth) Kg.

Species described from the region by B.J. Cholnoky include: *Achnanthes rautenbachiae*, *Cymbella anassae*, *C. rautenbachiae*, *C. subventrieosa*, *Diploneis tugelae*, *Frustulia tugelae*, *Gomphonema perminuta*, *Navicula anassae*, *N. artemidis*, *N. cavernae*, *N. natalensis*, *N. rautenbachiae*, *N. zulu*, *Nitzschia anassae*, *N. rautenbachiae*, *Pinnularia anassae*, *Stauroneis dracomontana* and *Surirella anassae*.

More recent work on the mountain tarns around the Giant's Cup area revealed a total of 35 diatom species, comprising 14 genera. The dominants were *Frustulia saxonica* Rab. and *Encyonema gracile* Krammer, while *Gomphonema* sp.1 (aff. *angustatum*) (Kütz.) Rab. and *Nitzschia sinuata* var. *delgonei* (Grun.) Lange-Bertalot, had comparatively low abundances but did show high local occurrences. A number of species were specific to only a limited number of tarns, yet had a relatively high number of individuals, such as *Gomphonema subtile*, *Stauroneis* sp. 2 (aff. *gracilior*) (Rab.) Reichardt and *Pinnularia divergens* W.M. Smith, while others appeared randomly in single wetlands or wetland sub-samples, e.g. *Navicula subhamulata* Grun. and *Staurosirella pinnata* (E.) Williams et Round.

Phytoplankton of Mohale Dam (Lesotho):

Whereas limited knowledge exists on the ecology and algae present in Lesotho's high-altitude Katse Dam, nothing is published about these aspects in

the linked Mohale Dam, completed in 2003. The changes in algal composition and associated environmental variables were investigated since the construction of the Mohale Dam until the present (**Janse van Vuuren et al. 2007**). Monthly sampling in 2003 and 2006 indicated that dissolved inorganic nitrogen concentrations decreased, while dissolved inorganic phosphorus concentration increased 12-fold, resulting in increases in algal concentration and a shift from green algal dominance in 2003 to cyanobacterial dominance in 2006. Multivariate analyses indicated that cyanobacteria were favoured by high temperatures and low DIN:DIP ratios. Although currently non-problematic, the dominance of cyanobacteria may pose future potential problems, especially if further increases in nutrient concentrations occur. Strains of *Microcystis aeruginosa*, currently one of the dominant species, are toxic.

Our data revealed a high algal diversity of DM and confirmed that DM are one of the most diverse algal areas in Southern Africa (together with Cape region, Waterberg, Caprivi Strip, Swaziland, Karoo and Namib deserts).

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تنوع الطحالب وبدائيات النواة السيانوية في جنوب أفريقيا – دركينزبرج (مع الاهتمام بالديزميات)

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تم دراسة تنوع الطحالب من مجموعات الديزميات و الدياتومات و أوليات النواة السيانوية في المياه العذبة والنباتات المائية في دركينزبرج في جنوب أفريقيا و مملكة ليسوتو. تم مناقشة تنوع وتركيب الاجناس و توزيع الانواع المختلفة وخواص بيئها و مستوى تواجدها من الناحية التقسيمية. ركزت الدراسة على الديزميات والتي لم تفحص بدقة في دركينزبرج من قبل، وخاصة في المنطقة الجبلية لبحيرة صغيرة تقع في الحديقة القومية أكاهلمبا- دراكينزبرج. وقد وجد 86 نوع تتبع 18 جنس من الديزميات الساكودرم و البلاكودرم وكذلك (87 صنف من المتداخلات مع الديزميات). أوضحت الدراسة أن الديزميات التي تتبع عائلة ميسوتانيسى (3 انواع)، جاناتوريجيسى (نوعان)، كلوستريبيسى (9 انواع) و ديذميديسى (72 نوع و 73 من الأصناف المتداخله)، وكانوا أيضا العائلات الأكثر تنوعا. ونتيجة لهذه الدراسة وجد جنس واحد (*Teilingia* Bourr.) و 28 نوع منها 3 انواع وصنفان جدد من الناحية العلمية سجلت لأول مرة في جنوب أفريقيا. كما أوضحت النتائج وجود تنوع كبير في انواع الطحالب في منطقة دركينزبرج مع مناطق اخرى كثيرة. والتي أكدت أنها تعتبر واحدة من المناطق الأكثر تنوعا للطحالب في جنوب أفريقيا.