



**FIRST REPORT OF FRESHWATER MICROALGAE FROM RUVUMA RIVER,
SONGEA, TANZANIA, EAST AFRICA**

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ABSTRACT

The present work deals with the 24 fresh water algal samples and description of 46 taxa of biodiversity of fresh water algae from Ruvuma river, Songea, Tanzania, East Africa. Collection of 24 fresh water algal samples were carried out during September 2015 to December 2015. Samples were examined in the laboratory and identified. The following micro algae were present Actinastrum (1), Pediastrum (3), Desmodesmus (1), Scenedesmus (2), Spirogyra (3), Penium (1), Closterium (3), Cosmarium (5), Euastrum (1), Staurastrum (1), Melosira (1), Synedra (2), Fragilaria (1), Nitzschia (1), Caloneis (1), Stauronesis (1), Navicula (2), Gomphonema (3), Euglena (2), Phacus (2), Trachelomonas (3), Chroococcus (1), Gomphosphaeria (1), Oscillatoria (3), Anabaena (1) were first time recorded and report. Algae are described with photographs.

KEYWORDS: Biodiversity, Bacillariophyceae, Chlorophyceae, Cyanophyceae, Fresh water algae.

INTRODUCTION

Ruvuma River is the among of the largest river in Tanzania specifically found in Songea district-Ruvuma region. This river cross between two countries Tanzania and Mozambique. Algae are the most abundant predominant members in Ruvuma River and the water quality is assessed by the physico-chemical and biological parameters. Studies on taxonomy of algae also began in the early part of the last century and monographs on different groups of algae were published Carmichael et al., (1997), Carpenter, E.J. & Carmichael, W.W. (1995), Carpenter, E.J. (1983), Cocquyt C et al., (1993), Digital Image Collection of Desmids (2013), Johnstone R and Olafsson E. (1995), Lugomela, C. (1996), Machiwa JF (2003), Scott, W.E. (1991), Williamson D. B., Marazzi L. (2013), Yoo, R.S (1995).

In the present study, sample collected from various environmental conditions from different sites base on accessibility, include Sinai village in Lilambo ward, London village and Subira village. More than 46 micro algal strains were identified from 24 sites of Ruvuma River, Songea between September 2015 to December 2015, all the 46 micro algae new reported first from Songea, Tanzania with special reference to biodiversity.

MATERIALS AND METHODS

The study area Ruvuma River is the among of the largest river in Tanzania specifically found in Songea district-Ruvuma region. This river cross between two countries

Tanzania and Mozambique. Random sampling method has been applied in the algal collection procedure. Sample collections were carried out during the month of September 2015 to December 2015. The different types of algal forms were collected from Ruvuma River only. The soil is protective and climates are the best situated for different class of algae. On initial examination of the living samples, the coarser material was removed by filtration through a mesh net. The algal samples were preserved in 4% formalin (aqueous solution of formaldehyde). The microalgae were used different stains glycerin was used for mounting the materials. The sentric organism has been photographed using the OLYMPUS CH20i microscope with attached SONY camera.

RESULTS AND DISCUSSION

In the present study a total of 24 samples were collected from different sites of Ruvuma River. The fresh water micro algae from the areas of Ruvuma River were totally 46 micro algae new reported first from Songea, Tanzania. Description of each species and systematic enumeration is presented.

Chlorophyceae

Actinastrum hantzschii Lagerheim (Plate-1, Fig.1)

Coenobia 4-8 celled, 50 µm in diameter, radially arranged from a common centre; cells spindle-shaped, middle of the cell slightly broad, apices attenuated,

slightly rounded; chloroplast single, parietal without pyrenoid; cells 3.2-4 µm broad and 16-19 µm long.

Pediastrum duplex Meyen (Plate-1, Fig.2)

Colonies 16-32 celled, inner cell quadrate to angular, inner side of the marginal cell concave, outside produced into a short truncate process, cells 15.0 µm in diameter, 16 cell colonies up to 90 µm in diameter.

Pediastrum tetras (Ehrenberg) Ralfs (Plate-1, Fig.3)

Colonies 4-8 celled, lobes adjacent to incision more or less deeply concave, diameter of colonies 20-22 µm and cells 12-14 µm in diameter.

Pediastrum tetras (Ehrenberg) Ralfs Var. apiculatum Fritsch (Plate-1, Fig.4)

Colonies 4 celled, cells without intercellular spaces. Marginal cells divided into two lobes by a deep linear to cuneate incision on the outer side reaching to the middle of the cell. Each lobe truncate, divided into two lobes. Inner cells 4 sided with a single linear incision. Colonies 24.6 µm in diameter and cells 14-17.6 µm in diameter.

Desmodesmus abundans (Kirchner) Hegewald (Plate-1, Fig.5)

Colonies of 2-4 cells arranging linearly; cell body ovoid or ellipsoidal in shape; outer cells with long spines at both ends and short spines at outer side; inner cells have a short spine at both ends. Cell size 9-20x3-5µm.

Scenedesmus armatus forma bicaudatus Hortobagyi (Plate-1, Fig.6)

Colonies four to eight celled. Cells with prominent longitudinal ribs which are smooth or rugged. Terminal cells with a long spine from the outer edge of one of their poles, the spines of the two terminal cells alternating with each other. The other pole of the terminal cells and poles of internal cells short spine from their poles. Cells 4.4-5.6 µ broad, 12-19.5 µ long. Long spines 12.3-16.5 µ long. Short spines 1.8-2.5 µ long.

Scenedesmus bijugatus (Turpin) Kuetzing (Plate-1, Fig.7)

Colonies flat or slightly curved, of 2-4-8 cells arranged in a single linear series. Cells oblong-ellipsoid to ovoid with the ends broadly rounded. Cells 3.5 – 7 µ broad, 7-23µ long.

Spirogyra distenta Transeau (Plate-1, Fig.8)

Vegetative cells 45-52 µm broad, 65-85 µm long, each cell with 2 chloroplasts, making 1-5-3 turns; conjugation scalariform, tubes formed by both gametangia.

Spirogyra ellipsozona Transeau (Plate-1, Fig.9)

Filaments cylindrical cells, 125-150 µm in diameter, 125-160 µm long, chloroplast 3-8 narrow bands, making ½ to 5 turns. Fertile cells cylindrical.

Spirogyra gratiana Transeau (Plate-1, Fig.10)

Filaments of elongate-cylindrical cells, 26-32 µm in diameter, 120-140 µm long, chloroplast (2)-3-(4). Conjugation lateral or scalariform by tubes from both gametangia; fertile cells cylindrical or merely enlarged. Zygospores ellipsoid or cylindrical-ellipsoid; median spore wall smooth and yellow.

Penium cylindrus (Ehrenberg) Breb. & Ralfs (Plate-1, Fig.11)

Cells short and cylindrical, about 4 times longer than broad, with a slight median constriction; semi-cell with parallel sides, broadening slightly towards a truncate apex; cell wall reddish brown in colour.

Closterium lineatum Ehr. (Plate-1, Fig.12)

Cells long and narrow, 26-28 times longer than broad, faintly curved with middle portion almost straight, outer margin moderately curved inner margin parallel to outer poles and broadly tumid in the middle, cell gradually attenuated towards broad and truncately rounded apices. Long cell, 480-520 µm, lat.cell, 18.0-22.0 µm.

Closterium ehrenbergii Menegh (Plate-1, Fig.13)

Cells large, 6-8 times longer than broad, moderately curved, outer margin 92-110 degrees of arc, inflated in the middle, cell gradually attenuate towards obtusely rounded apices; Long cell 312-320 µm, lat.cell.40-60 µm, lat.apex 5.0-7.0 µm.

Closterium moniliferum (Bory) Ehr. (Plate-1, Fig.14)

Cells stout, 6-7 times longer than broad, moderately curved, outer margin 120-130 degree of arc, inner margin inflated in the middle. Long.cell 208-225 µm, lat.cell 33.0-37.0 µm.

Cosmarium subprotumidum Nordst (Plate-1, Fig.15)

Cell small, a little longer than broad, semicells, sides with 3 faintly bigranulate crenations and apex with 3 or 4 slight undulations, centre with a tumour above the isthmus, long cell 32.0 µm lat.cell 24.0 µm, lat.isthmus 6.0 µm.

Cosmarium nitidulum De Not. (Plate-1, Fig.16)

Cells longer than broad, deeply constricted, semicells truncate-subsemi-circular, tapering evenly from rounded basal angles to flattened apex with straight margin; long cell 33.0-36.0 µm, lat.cell 24.0-26.0 µm, lat.isthmus 6.0-8.0 µm.

Cosmarium holmiense var. integrum P. Lundell (Plate-1, Fig.17)

Unicellular; cells solitary, 30 µm long, 13-14 µm wide with length breadth ratio 2.4; cells are usually longer than their breadth with a median constriction; This specimen is slightly elongated than *Cosmarium*; anterior and posterior margins are broad, both sides convex, one chloroplast per semi-cell.

Cosmarium hammeri var. homalodermum Nordstedt (Plate-1, Fig.18)

Cells of medium size, longer than broad, sub-hexagonal, deeply constricted, sinus narrowly linear with slightly dilated apex; long.cell 52.0-54 μm , lat.cell 32.0-40.0 μm lat.isthmus 12.0 μm .

Cosmarium lundellii Delp. Var. circulare (Reinsch) Krieg., (Plate-1, Fig.19)

Cells of medium size, a little longer than broad, deeply constricted, sinus linear and open, semicells sub-semicircular. Cell 51 μm long and 40 μm broad. Isthmus 14 μm .

Euastrum denticulatum F.Gay (Plate-1, Fig.20)

Cells 14-25 μm broad, 17-30 μm long, with 3 angular lobes and closed isthmus; semicells subquadrate with

basal lobes rounded and angular, corners pointed, 3 to 4 evenly spaced protrusions on lateral walls narrowing halfway to a deep, comparatively broad, rectangular upper lobe; upper lobe with pointed angles and a shallow, open median incision; semicell face view with distinctive granulated central protrusion, some-times with 2 small granules beneath protrusion and also emarginated granules decorating basal and upper angles.

Staurastrum tetracerum Ralfs (Plate-1, Fig.21)

Cell body short, radiate in shape; apical view of the cell, triangular, polygonal, ellipsoidal or spindle-shaped; zygospores formed outside of mother cells. cell body 19 μm long (excluding arms), 33 μm long (including arms), 40 μm wide (including arms).

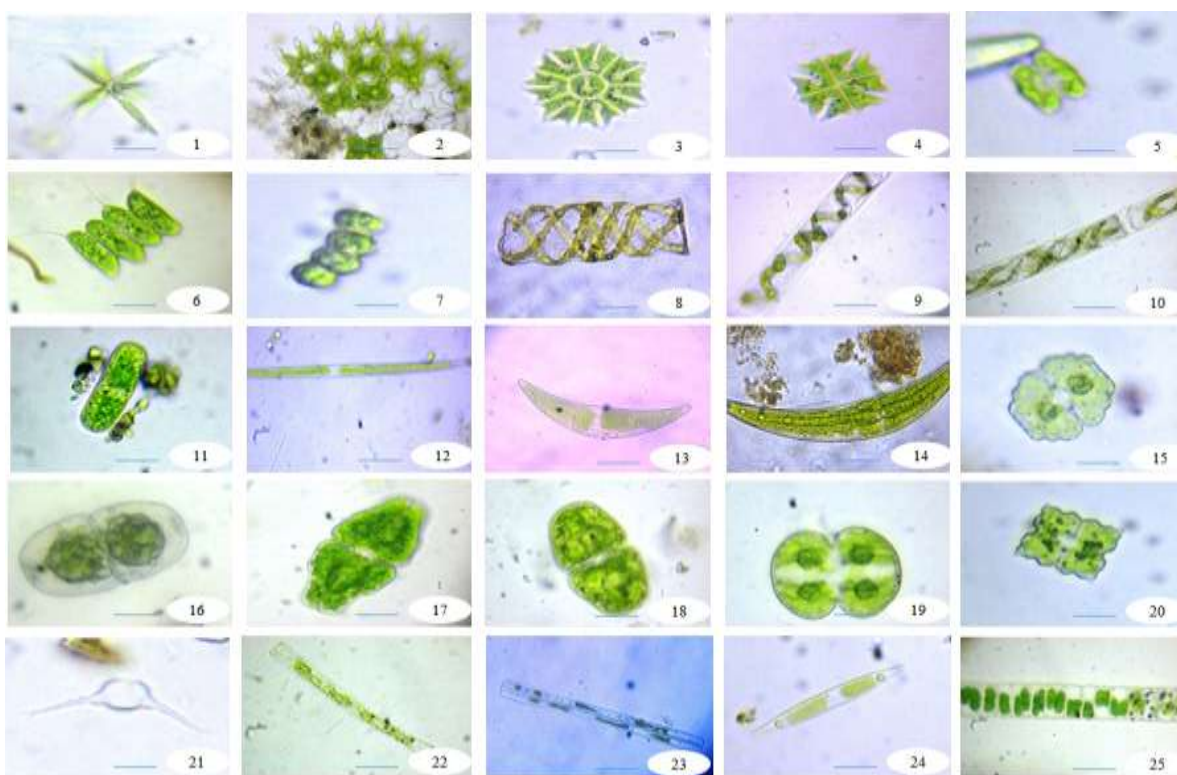


Plate - 1: 1. *Actinastrum hantzschii* Lagerheim, 2. *Pediastrum duplex* Meyen, 3. *Pediastrum tetras* (Ehrenberg) Ralfs, 4. *Pediastrum tetras* (Ehrenberg) Ralfs Var. *apiculatum* Fritsch, 5. *Desmodesmus abundans* (Kirchner) Hegewald, 6. *Scenedesmus armatus* forma *bicaudatus* Hortobagyi, 7. *Scenedesmus bijugatus* (Turpin) Kuetzing, 8. *Spirogyra distenta* Transeau, 9. *Spirogyra ellipsospora* Transeau, 10. *Spirogyra gratiana* Transeau, 11. *Penium cylindrus* (Ehrenberg) Breb. & Ralfs, 12. *Closterium lineatum* Ehr., 13. *Closterium ehrenbergii* Menegh, 14. *Closterium moniliferum* (Bory) Ehr., 15. *Cosmarium subprotumidum* Nordst, 16. *Cosmarium nitidulum* De Not., 17. *Cosmarium holmiense* var. *integrum* P. Lundell, 18. *Cosmarium hammeri* var. *homalodermum* Nordstedt, 19. *Cosmarium lundellii* Delp. Var. *circulare* (Reinsch) Krieg., 20. *Euastrum denticulatum* F.Gay, 21. *Staurastrum tetracerum* Ralfs, 22. *Melosira islandica* O. Muller subspecies *Helvetica* O. Muller, 23. *Synedra ulna* (Nitzsch) Ehrenberg var. *oxyrh.* (Kuetzing) Van Heurck, 24. *Synedra rumpens* Kuetz, 25. *Fragilaria vaucheriae* (Kutz.). (Scale bar; Figs 1 – 25 = 1-45 μm).

Bacillariophyceae

***Melosira islandica* O. Muller subspecies *Helvetica* O. Muller** (Plate-1, Fig.22)

Frustules cylindrical, united in chains, valves thin with parallel margins, ring like neck, wall clearly punctuate, 24.5-27.2 μm long and 4.5-5 μm broad.

***Synedra ulna* (Nitzsch) Ehrenberg var. *oxyrh.* (Kuetzing) Van Heurck** (Plate-1, Fig.23)

Valve linear to slightly lanceolate, long, straight, end narrow, roundly capitate, striation parallel through out the valve, slightly radiate at the apices, striae 10-14 in 10

μm area, many times longer than broad, 54-64.6 μm long and 7.5-10 μm broad.

Synedra rumpens Kuetz (Plate-1, Fig.24)

Valves solitary, linear-lanceolate, slightly tapering towards apices; ends faintly undulate produced and rounded; pseudo-raphé narrow; striae fine dense lineate, parallel throughout the valve; length 75 μm , breadth 4 μm .

Fragilaria vaucheriae (Kutz.) (Plate-1, Fig.25)

Frustules typically linked at the valve face to form chains. Valve linear to linear-lanceolate, narrowing towards poles. Striae are parallel becoming slightly radiate towards the poles. Length 28 μm , width 4.2 μm .

Nitzschia palea Kütz. (Plate-2, Fig.26)

Frustule narrowly linear with slightly narrowed truncate ends in the girdle view. Valves linear - sub lanceolate with narrowed, constricted feebly capitate ends. Keel excentric, keel punctae small. Striae fine and almost indistinct. Length 17 to 28 μm , breadth 2.5 to 4, striae 30 to 35 in 10 μm and punctae 12 to 15 in 10 μm .

Caloneis bacillum Grunow Cleve (Plate-2, Fig.27)

Valves linear to linear-lanceolate with rounded ends; straight; axial area distinct, narrow, gradually widening towards the centre of the valve; central area broad reaching the sides; length 22.2 μm ; breadth 5.5 μm .

Stauronesis anceps Ehr. (Plate-2, Fig.28)

Valves solitary, elliptical-lanceolate, gradually attenuated with suddenly constricted broadly produced capitate ends; raphe thin, straight median, slightly curved at apices; striae very fine, lineate, strongly radiate and parallel throughout the valve. Length 48 μm , breadth 8.0 μm .

Navicula perrotettii Grun. (Plate-2, Fig.29)

Valves broadly lanceolate; apices rostrate capitate or slightly rounded; axial area narrow parallel; central area moderately wide and longitudinally elongated; raphe straight with distinct central nodules; striae parallel and convergent towards the poles; areolae rectangular and perpendicular to the raphe creating longitudinal striae parallel to axial area. Long 195 μm , breadth 42-44 μm , transverse Striae 13 in 10 μm , longitudinal Striae 9-10 in 10 μm .

Navicula producta Grun (Plate-2, Fig.30)

Valves linear linear-elliptical with constricted broadly rostrate; subtruncate ends; raphe thin and straight with slightly curved terminal fissures. Striae strong, indistinctly punctuate; length 16-25 μm , breadth 6-8.0 μm .

Gomphonema parvulum (Kütz) Grun (Plate-2, Fig.31)

Valves clavate with more or less broadly rounded apex and gradually attenuated to rarely subcapitate base. Raphe thin and straight. Axial area narrow, central area

more or less large unilaterally dilated with an isolated stigma on the opposite side. Striae radial and coarse. Length 27 to 35 μm , breadth 6.8 to 8.9 μm , striae 7 to 9 in 10 μm .

Gomphonema spaerophorum Ehr. (Plate-2, Fig.32)

Valves linear, club-shaped with strongly constricted, truncately capitate apex and gradually attenuated, slightly curved, raphe thin, straight, median with distinct central nodules; axial area narrow, central area broad, unilateral with an isolated punctate on opposite side; Length, 28 μm ; width 6.5 μm .

Gomphonema gracile Ehrenberg (Plate-2, Fig.33)

Length of cell 46.3 μm , diameter 8.3 μm ; striae 11 /10 μm in the middle part and 13 /10 μm towards the ends; valve linear-lanceolate with blunt round ends; axial area broad, central area with a dot toward one side.

Euglenophyceae

Euglena proxima Dangeard (Plate-2, Fig.34)

Cells metabolic, fusiform, narrowed posteriorly to a blunt tip; periplast spirally striated; chloroplast numerous, irregularly shaped discs; paramylon bodies numerous small rods scattered throughout the cells; cell 20.0 μm in diameter, 36.0 μm long.

Euglena polymorpha Dangeard (Plate-2, Fig.35)

Cells metabolic, ovoid-pyriform to subcylindric, narrowed gradually posteriorly to a short, blunt tip; periplast with spiral striations; chloroplast many and disc-like with lancinate margins, with 1 pyrenoid; cell 10 μm in diameter 36.0 μm long.

Phacus acuminatus Stokes (Plate-2, Fig.36)

Cells suborbicular in outline, broadly rounded posteriorly, with a short, blunt apiculation; periplast longitudinally striated; paramylon bodies 1-2 ring-like discs; cells 42.0 μm in diameter, 50.0 μm long.

Phacus pleuronectes (Plate-2, Fig.37)

Cells suborbicular in outline, broadly rounded posteriorly, with a short, blunt apiculation. cells 45.6-51.4 μm long, 30.1-38.7 μm wide.

Trachelomonas grandis Singh (Plate-2, Fig.38)

Cell wall short irregularly granules; chloroplasts with haplopyrenoids, Lorica Shape large ellipsoidal, Apical pore collar short, narrow. Length 30-43 μm , width 25-32 μm .

Trachelomonas volvocina (Ehrenberg) Ehrenberg. (Plate-2, Fig.39)

Lorica spherical; 16 ± 1.5 μm wide in diameter; walls yellowish, sometimes colourless, smooth; apical pore without a collar; Cell with 2 chloroplasts each with pyrenoid.

Trachelomonas abrupt var. minor Deflandre (Plate-2, Fig.40)

Lorica cylindrical, ca. 11.5 μm wide, ca. 21.0 μm long; covered by short spines and punctate; slightly narrowed at the ends.

Cyanophyceae

Chroococcus schizodermaticus West (Plate-2, Fig.41)

Cells in groups of 2-4 blue green without sheath 5.0-11 μm with sheath 20-42 μm ; sheath yellow to brown.

Gomposphaeria aponina Kütz. (Plate-2, Fig.42)

Cells pyriform or cuneate, cordate at longitudinal cell division, 4-14 μm broad and 8-20 μm long, blue-green to olive-green mostly with a distinct mucilaginous envelope, placed at the ends of regularly dichotomously or trichotomously branched radial mucilaginous stalks; colonies large 50-90 μm diameter.

Oscillatoria princeps Vaucher (Plate-2, Fig.43)

Trichome blue green not constricted at the cross walls not granulated 20-25 μm broad; 1.5-2.0 μm long; end-cells flatly rounded.

Oscillatoria limosa Ag (Palte-2, Fig.44)

Thallus blue-green to brown, straight, 13-16 μm broad; 2-5 μm length, end cell flatly rounded with slightly thickened membrane.

Oscillatoria subbrevis Schmidle (Plate-2, Fig.45)

Trichomes 6-10 μm broad not attenuated at the apices; cells 1-2 μm long, end cell rounded, calyptras absent.

Anabaena azollae Strasb. Loae (Plate-2, Fig.46)

Trichomes straight or coiled, cells subglobose to ellipsoid, heterocyst ovate 6-9.5 μm in diameter.



Plate – 2: 26. *Nitzschia palea* Kütz., 27. *Caloneis bacillum* Grunow Cleve, 28. *Staurodesis anceps* Ehr., 29. *Navicula perrotettii* Grun., 30. *Navicula producta* Grun, 31. *Gomphonema parvulum* (Kütz) Grun, 32. *Gomphonema spaerophorum* Ehr., 33. *Gomphonema gracile* Ehrenberg, 34. *Euglena proxima* Dangeard, 35. *Euglena polymorpha* Dangeard, 36. *Phacus acuminatus* Stokes, 37. *Phacus pleuronectes*, 38. *Trachelomonas grandis* Singh, 39. *Trachelomonas volvocina* (Ehrenberg) Ehrenberg., 40. *Trachelomonas abrupt var. minor* Deflandre, 41. *Chroococcus schizodermaticus* West, 42. *Gomposphaeria aponina* Kütz., 43. *Oscillatoria princeps* Vaucher, 44. *Oscillatoria limosa* Ag, 45. *Oscillatoria subbrevis* Schmidle, 46. *Anabaena azollae* Strasb. Loae. (Scale bar; Figs 1 – 25 = 1-45 μm).

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