

THE DIATOM FLORA OF JAYAKWADI BIRD SANCTUARY, PAITHAN, 'MAHARASHTRA: GENUS- *NAVICULA*, *CALONEIS* AND *GYROSIGMA*

S.B. ANDHALE and P.B. PAPDIWAL

Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad- 431 004, India.

Diversity of diatoms in the Jayakwadi Bird Sanctuary has been studied for four years (2005-2008) and their taxonomic accounts have been given. Among the diatoms, genera of *Navicula*, *Caloneis* and *Gyrosigma* were observed at the locations Bramhgavan, Dhakephal, Kaigaon and Nathsgar North; during September to March. A detailed systematic account of these 3 genera and 21 species is given in the present communication, as a first phase of ecological studies of the Sanctuary.

Keywords: Diatoms; Diversity; Jayakwadi Bird Sanctuary.

Introduction

In Marathwada region of Maharashtra State, about 50 km away from Aurangabad, a dam is constructed on the river Godavari at Paithan, which is known as Jayakwadi project. Thousands of birds belonging to 215 species; including herbivorous, carnivorous as well as omnivorous birds, visit this water body every year during winter. Therefore, the water body known as 'Nathsgar', has been declared by Govt. of Maharashtra as Bird Sanctuary in 1986. Geographically it is located between 75° 00'00" and 75°15'00"E longitudes and 19°18'33" and 19°33'16"N latitudes. The water body is about 55kms in length and 27 kms in width. Of this area, about 25-28% area is shallow, where the water depth is less than one meter. This region of water body is biologically active, having large number of flora and fauna. Several angiospermic plants and large number of algae are observed in this area, which are primary producers in the water body. The migratory birds' food chain is dependent on this vegetation, which has not been explored so far. Therefore, the study of vegetation of the water body was undertaken during years 2005-2008.

From Marathwada area, studies on algae were carried out earlier by Kamat^{1,2}, Sarode and Kamat³⁻⁵ and Ashtekar⁶. However, the algal flora of Jayakwadi Bird Sanctuary has not been studied so far, and this is the first report. Earlier the authors⁷ have described 16 species of *Pediastrum* belonging to Chlorococcales from this water body.

Diatoms play an important role in aquatic ecosystem. Being primary producers, they are either directly consumed by the larval or adult stages of different aquatic animals or indirectly constitute the bulk of the

food web via zooplankton population. Diatom bloom at the end of growing season, are deposited at bottom of the rivers, lakes or oceans, therefore controlling the recycling of nutrient flux and the biogeochemical cycle. A study of diatom diversity and productivity is an important field of research for documentation of population diversity⁸.

In the present communication, as a first phase of the study of Diatoms ecology, a systematic account of 3 Diatoms genera and 21 species has been given.

Material and Methods

Random sampling technique has been applied in the algal collection procedure. For the present study, 4 locations of the Nathsgar water body viz. Kaigaon, Bramhgavan, Dhakephal and Nathsgar North were selected. Sample collections were made for 3 consecutive years (2005-2008), during the months of November to March. The diatoms occurring as phytoplankton in the water body were by plankton net, as per the method adopted by Narkhede⁹. Twenty liters of surface water were collected (by standing in the back water of the dam at about 100-120 cm depth) by dipping a jug at about 3 cm depths and were filtered through the plankton net and were collected in 1 lit capacity wide mouth bottle. In laboratory, 20 ml of the samples were preserved in 4% formalin for further studies. Morphological studies of the specimens were done by using Olympus Research Microscope and Labomed Microscope (Model no. T250L250) and the photographs were taken using Kodak EazyShare cx 7330 camera. Identification of taxa was done using Rath and Adhikari¹⁰ and Sarode and Kamat¹¹ and other relevant literature.

Systematic enumeration:

Sub-order : Naviculineae

Family : Naviculaceae

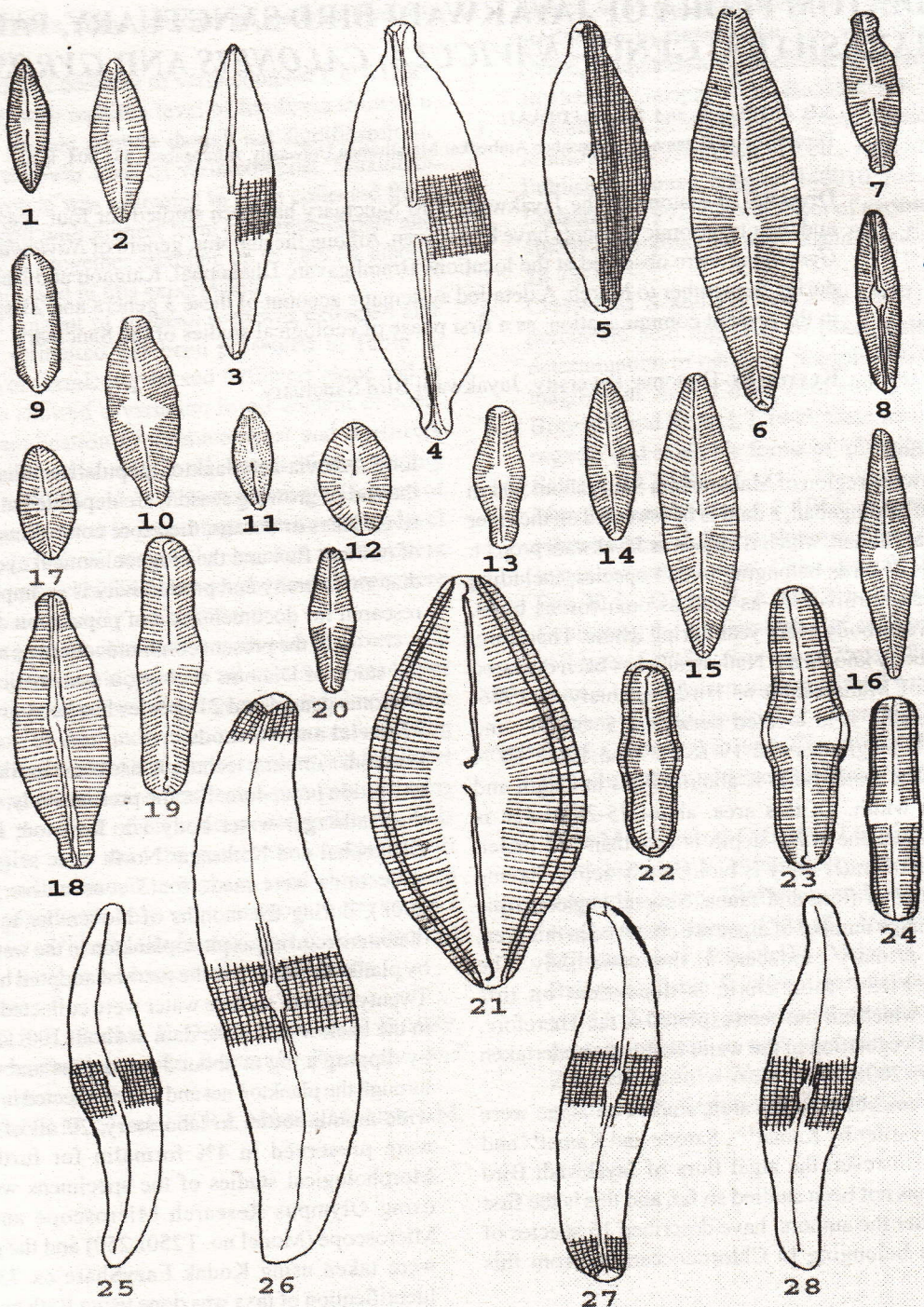


Fig. 1. *Navicula cari* 2. *N. cryptocephala* 3. *N. cuspidata* 4. *N. cuspidata* v. *ambigua* f. *diminuta* 5. *N. cuspidata* f. *brevirostrata* 6. *N. cuspidata* v. *heribaudi* 7. *N. dicephala* v. *sphaerophora* 8. *N. feverborni* 9. *N. iniqua* 10. *N. laterostrata* 11. *Navicula mutica* 12. *N. pupula* v. *elliptica* 13. *N. pupula* v. *rostrata* 14. *N. radiosa* v. *tenella* 15. *N. reinhardtii* f. *gracilior* 16. *N. rhynchocephala* v. *elongata* 17. *N. schonfeldii* 18. *N. varidula* v. *capitata* 19. *Caloneis beccariana* 20. *C. beccariana* v. *hustedtii* 21. *C. permagna* 22. *C. silicula* 23. *C. silicula* v. *intermedia* 24. *C. silicula* v. *tenuis* 25. *Gyrosigma acuminatum* 26. *G. bhusavalensis* 27. *G. khandeshensis* 28. *G. kuetzigii*

1) *Navicula cari* Ehr. (Pl. 1, Fig. 1), Sarode and Kamat, 1984, p 104, pl 11, f 245 Valves 17.5-20 μ long, 4.2-4.5 μ broad, narrowly lanceolate with almost acute rounded ends; raphe thin and straight with curved terminal fissures; axial area narrow, linear, central area large, striae 18 in 10 μ , radial in the middle and convergent at the ends.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date: JB-5/2 (06-11-05), JB-69/3 (01-12-07), JK-234/3 (19-02-06), JNN- 312 (22-01-06)

2) *N. cryptocephala* Kuetz. (Pl. 1, Fig.2) Sarode and Kamat, 1984, p 106, pl 12, f 254 Valves 22-35.5 μ long 8.5-9.2 μ broad, lanceolate with produced, rounded ends; raphe thin and straight; axial area narrow; central area slightly extended transversely, small; striae 10-12 in 10 μ , radial in the middle and slightly convergent at the ends.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-10/2(6-11-05), JB-71/2(1-12-07), JK-236/3 (19-3-06), JNN-314/2(26-2-06)

3) *N. cuspidata* Kuetz. (Pl. 1, Fig. 3) Sarode and Kamat, 1984, p 107, pl 12, f 258 Valves 65-110 μ long, 14.6-20 μ broad, rhombic lanceolate with acutely rounded ends; raphe thin and straight with hooked unilaterally bent central pores and large terminal fissures; axial area narrow, linear, central area very small, striae transverse, 14-16 in 10 μ , parallel, slightly convergent at the ends. Longitudinal striae about 25 in 10 μ .

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-14/3 (4-12-05), JB-74/3 (06-01-08), JK-239/3 (19-11-06), JNN- 317/2 (26-02-06)

4) *N. cuspidata* Kuetz. v. *ambigua* (Ehr.) Cleve f. *diminuta*. A.Cl. (Pl. 1, Fig. 4) Sarode and Kamat, 1984, p 108, pl 12, f 261 Valves 60-85 μ long, 16.1-20.5 μ broad, broadly lanceolate with constricted, rounded ends; raphe thin and straight with unilaterally bent central pores; axial area narrow, transverse striae 14-16 in 10 μ , longitudinal striae 20-22 in 10 μ , fine.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-17/2 (4-12-05), JB-75/2 (06-01-08), JK-241/2 (19-11-06), JNN- 321/3(26-02-06)

5) *N. cuspidata* Kuetz. f. *brevirostrata* Gandhi. (Pl. 1, Fig. 5) Sarode and Kamat, 1984, p 107, pl 12, f 259 Valves 55.8-65.5 μ long, 17-27 μ broad, elliptic lanceolate with constricted shortly rostrate, subtruncate ends; raphe thin and straight with central pores hook like; axial area very narrow, linear central area very small, transverse striae 14-16 in 10 μ , longitudinal striae 24-26 in 10 μ , fine.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-21/4 (01-01-06), JB-176/1 (03-02-08), JK-244/2 (17-12-06), JNN- 326/5(26-11-06)

6) *N. cuspidata* Kuetz. v. *heribaudi* Peragallo (Pl. 1, Fig.

6) Sarode and Kamat, 1984, p 109, pl 12, f 263 Valves 106.4-173.9 μ long, 24.9-35.4 μ broad, rhombic lanceolate with narrowly attenuated ends; raphe thin and straight with unilaterally bent central pores; axial area narrow, central area slightly widened, transverse striae 18-20 in 10 μ , strongly radial, longitudinal striae more numerous and faint, indistinct.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-32/2 (05-02-06), JB-183 (02-03-08), JK-246/2 (17-12-06), JNN- 330/3(24-12-06)

7) *N. dicephala* (Ehr.) W. Smith v. *sphaerophora* A. Cl. (Pl. 1, Fig. 7) Sarode and Kamat, 1984, p 110, pl 13, f 268 Valves 20-25 μ long, 7-8 μ broad, linear or linear elliptical with constricted, capitate, rounded ends; raphe thin and straight; axial area narrow, linear; central area fairly large, somewhat roundish, striae 14-15 in 10 μ , radial throughout and curved.

Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North

Coll. No. and Date : JB-34/1 (05-03-06), JD-201/4 (13-11-05), JK-247/2 (20-01-07), JNN- 334/2(24-12-06)

8) *N. feverborni* (Feverb.) Hustedt (Pl. 1, Fig. 8) Sarode and Kamat, 1984, p 111, pl 13, f 271 Valves 35.5-41 μ long; 6.5-7.5 μ broad, linear lanceolate with broadly rounded ends; raphe thin and straight, axial area very narrow; central area small, unilateral, striae 14 in 10 μ , strong and strongly radial.

Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North

Coll. No. and Date : JB-35/5 (05-03-06), JD-206/2 (11-12-05), JK-248/2 (20-01-07), JNN- 336/3(24-12-06)

9) *N. iniqua* Krasske (Pl. 1, fig.9) Sarode and Kamat, 1984, p 113, pl 13, f 280 Valves 16-18 μ long, 4.5-7.6 μ broad, linear with somewhat sinuous, wedge shaped and acutely rounded ends, raphe thin and straight; axial area broad central area rounded, striae 18-20 in 10 μ , radial.

Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North

Coll. No. and Date : JB-43/4 (5-11-06), JD-208/1 (11-12-05), JK-253/6 (17-2-07) JNN-339/3 (27-1-07)

10) *N. laterostrata* Hustedt (Pl. 1, Fig. 10) Sarode and Kamat, 1984, p 113, pl 13, f 281 Valves 18.5-28.5 μ long, 6.6-9.5 μ broad, elliptic lanceolate with broadly rounded and more or less capitate ends; raphe thin and straight; axial area very narrow ; central area large, rhombic to rounded; striae 14-16 in 10 μ in the middle and up to 20 in 10 μ at the ends, delicate and radial.

Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North

Coll. No. and Date : JB-45/4 (03-12-06), JD-209/4 (08-

- 01-05), JK-254/1 (17-03-07), JNN- 340/2 (27-01-07)
- 11) *N. mutica* Kuetz (Pl. 1, Fig. 11) Sarode and Kamat, 1984, p 115, pl 13, f 286 Valves 13.5-20.8 μ long, 5.6-6.5 broad, elliptic lanceolate with very slightly constricted, broadly rounded ends; raphe thin and straight, axial area narrow; central area large, striae 20-24 in 10 μ , radial, clearly punctuate and somewhat closer at the ends.
Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North
Coll. No. and Date : JB-47/1 (03-12-06), JD-211/1 (08-01-06), JK-260/4(17-11-07), JNN- 342/2 (27-01-07)
- 12) *N. pupula* Kuetz v. *elliptica* Hustedt. (Pl. 1, Fig. 12) Sarode and Kamat, 1984, p 118, pl 13, f 297 Valves 12.5-16 μ long, 6.2-6.8 broad, broadly elliptic lanceolate with rounded ends; raphe thin and straight, axial area narrow; linear, central area rectangular, large, striae 22-24 in 10 μ , fine, radial, curved, long and short striae alternating in the middle.
Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North
Coll. No. and Date: JB-48/3 (06-01-07), JD-215/3 (12-02-06), JK-265/4(15-12-07) JNN- 345/2 (27-01-07)
- 13) *N. pupula* Kuetz v. *rostrata* Hustedt. (Pl. 1, Fig. 13) Sarode and Kamat, 1984, p 119, pl 13, f 299 Valves 15-32 μ long, 6.6-8.5 broad, elliptic with narrowed constricted rostrate ends; raphe thin and straight; polar areas distinct; axial area very narrow; central area large rectangular, striae 20-22 in 10 μ , radial and fine.
Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North
Coll. No. and Date: JB-51/3 (06-01-07), JD-216/3 (12-03-06), JK-273/4(20-1-08), JNN- 347/2(24-02-07)
- 14) *N. radiosa* Kuetz v. *tenella* Hustedt. (Pl. 1, Fig. 14) Sarode and Kamat, 1984, p 120, pl 14, f 306 Valves 27.5-34 μ long, 5.6-6.5 μ broad, narrowly lanceolate and gradually tapering to somewhat acutely rounded ends, raphe thin and straight; axial area narrow, central area large, rounded, striae 14-16 in 10 μ , radial in the middle.
Locality : Bramhgavan, Dhakephal, Kaigaon, Nathsagar North
Coll. No. and Date : JB-54/1 (3-2-07), JD-217/2 (12-3-06), JK-274/2 (17-2-08), JNN- 248/2 (24-2-07)
- 15) *N. reinhardtii* Grun. f. *gracilior* Grun. (Pl. 1, Fig. 15) Sarode and Kamat, 1984, p 121, pl 14, f 307 Valves 54.9-64 μ long, 9-12 μ broad, elliptic lanceolate with broadly rounded ends, raphe somewhat thick and straight with distinct central pores; axial area narrow; central area large, striae 9-10 in 10 μ , radial throughout.
Locality : Bramhgavan, Kaigaon, Nathsagar North
Coll. No. and Date : JB-58/1 (03-03-07), JK-216/2 (20-11-05), JK-279/4 (16-03-08), JNN- 349/2 (24-02-07)
- 16) *N. rhynchocephala* Kuetz. v. *elongata* Mayer. (Pl. 1, Fig. 16) Sarode and Kamat, 1984, p 121, pl 14, f 310 Valves 45.1-55 μ long, 7-8 μ broad, oblong, slender, with slightly dilated capitate ends; raphe thin and straight, axial area narrow, linear, central area rounded, striae 14-16 in 10 μ , denser towards the ends.
Locality : Bramhgavan, Kaigaon, Nathsagar North
Coll. No. and Date: JB-60/4 (03-03-07), JK-221/3 (20-11-05), JNN-300/2 (27-11-05), JNN- 351/5 (24-02-07)
- 17) *N. schonfeldii* Hustedt. (Pl. 1, Fig. 17) Sarode and Kamat, 1984, p 123, pl 14, f 316 Valves 15.8-21 μ long, 6.8-7.2 μ broad, elliptical or elliptical lanceolate with rounded ends; raphe thin and straight; axial area very narrow; central area rectangular; striae 14-15 in 10 μ , radial, short and long striae alternating in the middle.
Locality : Bramhgavan, Kaigaon, Nathsagar North
Coll. No. and Date : JB-63/4 (03-11-07), JK-223/3 (18-02-05), JK-301 (27-11-05), JNN- 352/5 (24-03-07)
- 18) *N. varidula* Kuetz. v. *capitata* Mayer (Pl.1, Fig. 18) Sarode and Kamat, 1984, p 328, pl 14, f 331 Valves 28.8-41 μ long, 7.5-8.5 μ broad, linear elliptical with somewhat produced, capitate rounded ends; raphe thin and straight; axial area narrow, linear; central area moderately wide, quadrate; striae 10-12 in 10 μ , distinctly lineate, radial in the middle and convergent at the ends.
Locality : Bramhgavan, Kaigaon, Nathsagar North
Coll. No. and Date : JB-67/3 (03-01-07), JK-233/1 (19-02-06), JNN-310/4 (22-01-06), JNN- 365/3 (12-12-07)
- 19) *Caloneis beccariana* Grun. (Pl. 1, Fig. 19) Sarode and Kamat, 1984, p 72, pl 8, f 162 Valves 30-51 μ long, 7.1-9 μ broad, lanceolate to linear lanceolate, somewhat inflated in the middle, broadly rounded ends; axial area fairly wide; central area quite large and reaching the margins, sometimes more widened on one side than the other; striae 21-23 in 10 μ , conspicuously radial but clearly convergent at the ends, crossed by a fine longitudinal line near the margin.
Locality : Bramhgavan
Coll. No. and Date: JB-60/5 (03-03-07)
- 20) *C. beccariana* Grun. v. *hustedtii* Gandhi (Pl. 1, Fig. 20) Sarode and Kamat, 1984, p 72, pl 8, f 163 Valves 26.5-30 μ long; 7.1-7.8 μ broad, lanceolate to linear lanceolate, slightly inflated in the middle, with broadly rounded ends; axial area moderate; central area quite large and reaching the margins; striae 22-24 in 10 μ , slightly radial, crossed by a fine longitudinal line near the margin.
Locality : Bramhgavan
Coll. No. and Date: JB-60/5 (03-03-07)
- 21) *C. permagna* (Bail.) Cleve (Pl. 1, Fig. 21) Sarode

and Kamat, 1984, p 72, pl 8, f 164 Frustules large and robust; valves 70-132 μ long, 27.4-41 μ broad, rhombic lanceolate with somewhat produced, broadly rounded ends; raphe thick and straight; central pores large, unilaterally bent, terminal fissures broadly curved and clear; axial area large, moderately lanceolate; central area large, circular and somewhat unilateral; striae 13-14 in 10 μ , radial in the middle and convergent at the ends; crossed by two longitudinal lines slightly away from the margin.

Locality : Dhakephal

Coll. No. and Date : JD-203/2 (13-11-05)

22) *C. silicula* (Ehr.) Cleve (Pl. 1, Fig. 22) Sarode and Kamat, 1984, p 74, pl 8, f 168 Valves 35-53.5 μ long, 6.5-8 μ broad, linear to lanceolate with triundulate margins and broadly wedge shaped ends, raphe thin and straight, axial area moderate, linear lanceolate; central area large; striae 20-22 in 10 μ , slightly radial throughout, crossed by a fine longitudinal line near the margin.

Locality : Dhakephal

Coll. No. and Date: JD-211/3 (08-01-05)

23) *C. silicula* (Ehr.) Cleve v. *intermedia* Mayer. (Pl. 1, Fig. 23) Sarode and Kamat, 1984, p 75, pl 8, f 172 Valves 56.1-65 μ long, 11.5-12 μ broad; linear, feebly undulate, slightly inflated in the middle and near the ends; ends somewhat cuneate rounded; raphe thin and straight with central pores distinct and curved terminal fissures; axial area broadly lanceolate; central area reaching the sides; striae 24-26 in 10 μ , slightly radial in the middle and perpendicular to the middle line towards the ends.

Locality : Dhakephal

Coll. No. and Date : JD-203/2 (13-11-05)

24) *C. silicula* (Ehr.) Cleve v. *tenuis* (Hustedt.) Mayer (Pl. 1, Fig. 24) Sarode and Kamat, 1984, p 76, pl 8, f 175 Valves 50.5-51 μ long, 9-9.5 μ broad, linear, very slightly gibbous in the middle with broadly rounded ends; raphe thin and straight; axial area moderate; central area large, reaching the margins; striae 26 in 10 μ , fine radial, crossed by a fine longitudinal line near the margin.

Locality : Dhakephal

Coll. No. and Date : JD-211/3 (08-01-05)

25) *Gyrosigma acuminatum* (Kuetz.) Rabh. (Pl. 1, Fig. 25) Sarode and Kamat, 1984, p 67, pl 7, f 145 Frustules solitary; valves 99-106.5 μ long, 10-12.8 μ broad, sigmoid, lanceolate in outline, gradually tapering from the middle towards the ends; ends broadly rounded; raphe sigmoid and central; axial area narrow; central area small and elliptical; striae 18 in 10 μ ; transverse and longitudinal striae at equal distances from one another.

Locality : Bramhgavan, Kaigaon, Nathsagar North

Coll. No. and Date : JB-43/3 (03-12-06), JK-238/3 (19-

03-06), JNN—368/5 (12-12-07)

26) *G. bhusavalensis* Sarode and Kamat (Pl. 1, Fig. 26) Sarode and Kamat, 1984, p 67, pl 7, f 153 Valves 115-127.8 μ long, 16.2-23.5 μ broad, slightly sigmoid, linear, attenuated towards the poles with obliquely rounded ends; raphe central and sigmoid; axial area very narrow; central area small elliptical; transverse striae 14-15 in 10 μ , coarse, longitudinal striae 17-18 in 10 μ , distinct.

Locality : Bramhgavan, Kaigaon

Coll. No. and Date: JB-48/4 (06-01-07), JK-265/5 (15-12-07)

27) *G. khandeshensis* Sarode and Kamat (Pl. 1, Fig. 27) Sarode and Kamat, 1984, p 67, pl 17, f 154 Frustules free floating, solitary; valves 91-100.8 μ long, 13.6-18 μ broad, slightly sigmoid, linear lanceolate with broadly rounded ends; raphe central, slightly sigmoid, axial area narrow; central area small and elliptical; transverse striae 22-24 in 10 μ , slightly radial, fine but distinct; longitudinal striae 18-20 in 10 μ , fine.

Locality : Bramhgavan, Nathsagar North

Coll. No. and Date : JB-183/4 (02-03-08); JNN-360/3 (24-11-07).

28) *G. kuetzigii* (Grun.) Cleve (Pl. 1, Fig. 28) Sarode and Kamat, 1984, p 68, pl 7, f 149 Valves 85.4-93 μ long, 12.8-14.4 μ broad, slightly sigmoid, lanceolate with rounded ends; raphe in the centre, slightly sigmoid; axial area narrow, linear, central area small; transverse striae 24 in 10 μ , coarse; longitudinal striae 26 in 10 μ , fine.

Locality : Dhakephal

Coll. No. and Date : JD-206/3 (11-12-05)

Discussion

Twenty one taxa, represented by 3 genera have been reported from the study area. Genus *Navicula* is represented by 14 species, genus *Caloneis* by 3 species and genus *Gyrosigma* by 4 species. All these taxa are being reported for the first time from this area.

The migratory birds at the birds sanctuary include herbivorous, carnivorous as well as omnivorous birds, Salim Ali ¹² described that majority of Ducks are chiefly herbivorous. Birds like flemingoes are omnivorous, while birds like Blackwinged Kite, Shikra, Steppe and Eagle are carnivorous. Kamat ¹³ has reported ducks feeding on algae. The carnivorous birds feed on aquatic animals. Species *Cosmarium* and large number of diatoms are observed in the intestines of tadpoles¹⁴ and fishes¹⁵. As the Jayakwadi bird sanctuary is visited by herbivorous, carnivorous as well as omnivorous birds, they are dependant on the food available in the water reservoir. Therefore, the study of flora of the reservoir is felt essential to study the food chain of the migratory birds.

References

1. Kamat N D 1973, Desmids of Marathwada, Maharashtra. *J. Bombay nat. Hist. Soc.* 72 616-618.
2. Kamat ND 1974, Algae of Marathwada, Maharashtra. *Phykos* 13 (1) 22-32
3. Sarode P T and Kamat N D 1979, Diatoms of Marathwada, Maharashtra-I. *Phykos* 18 (1 & 2) 25-32.
4. Sarode P T and Kamat N D 1980, Diatoms of Marathwada, Maharashtra-II. *Phykos* 19 (2) 197-203.
5. Sarode P T and Kamat N D 1983, Diatoms of Marathwada. *Marathwada Univ. J. Sci.* 22 (15) 13-20.
6. Ashtekar P V 1980, *Studies on the freshwater algae of Aurangabad district*. Ph.D. thesis, Marathwada University, Aurangabad.
7. Andhale S B and Papdiwal P B 2008, *Pediastrum*- A little star in the Nathsagar water body. *Bioinfolet* 5 (3A) 181-187.
8. Chowdhury A K and Pal R 2008, Diversity of planktonic diatoms from West Bengal coast with special reference to taxonomic accounts, *Phytomorphology* 58 29-40
9. Narkhede P N 2006, Genus *Nitzschia* and *Surirella* from Hatnur dam, Jalgaon district, Maharashtra. *J. Aqua. Biol.* 21 (2) 19-22.
10. Rath J and Adhikary S P 2005, *Algal flora of Chilika Lake*, Daya Publishing House, Delhi.
11. Sarode P T and Kamat N D 1984, *Fresh water Diatoms of Maharashtra*, Saikripa Prakashan, Aurangabad.
12. Salim Ali 2002, *The Book of Indian Birds*, Bombay Natural History Society, Oxford.
13. Kamat N D 1967, Dispersal of charophytes by the Pintails, *Curr. Sci.* 36 (5) 134.
14. Kamat N D 1962, On the intestinal contents of Tadpoles and algae of small ponds. *Curr. Sci.* 31 300-301.
15. Kamat ND 1969, Algae as food of *Barbus conchoni* Ham. ET. Buch. *Curr. Sci.* 38 (2) 50.