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Floristic study on the algae of Siahdarvishan River in Guilan Province, North Iran

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ABSTRACT
In the present study the freshwater algae of Siahdarvishan River were sampled on a montly basis from December 2007 through November 2008. Three sampling stations (Gaght roudkhan , Shahkezr dame and Talab laleh) were chosen in the river. Some physical and chemical parameters (water temperature , total hardness , nitrate , nitrite, phosphate and pH) of water samples were measured. A total of 84 species were identified including: Chlorophyta, 36 species; Cyanophyta, 24 species; Bacillariophyta, 20 species; Rhodophyta, 2 species; Euglenophyta and Xanthophyta each with 1 species. Among the families, Oscillatoriaceae with 14 species showed the highest species richness. Taxonomic keys to genera and species are presented to facilitate the identification of algal flora of the region.

Keywords: *Floristic study, algae, Siahdarvishan River.*

INTRODUCTION
Algae play a vital role in all aquatic ecosystems by providing the food and energy base for all organisms living in lakes, ponds, streams and rivers (Addy and Green, 1966).
They have significant impact on determining water pollution and cleaning waste water (Çolak and Kaya, 1988). A floristic study on the fresh water algal flora reveals the species composition and taxonomic diversity of biological communities in an ecosystem (Pfiester *et al*., 1980; Oguni *et al*., 1987; Fumanti *et al*., 1995; Kolayli *et al*., 1998; Sahin and Akar, 2004; El-Awamri *et al*., 2007; Škaloud, 2009; Andrejic *et al*., 2012). In addition, it reflects the seasonal variations (Sen and Sonmez, 2006; Kim *et al*., 2008; Ezekiel *et al*., 2011) , evolutionary processes, ecological functions and stability of aquatic ecosystems (Komulaynen 2009). The most outstanding algal flora studies in Iran are those of Löffler, (1961); Hirano (1973); Moghaddam, (1976) ; Compere, (1981), Nejadsattari *et al*., (2005) ; Zarei-Darki, (2009) ; Noroozi *et al*., (2009). The present study deals with species composition, diversity and distribution of algal flora in Siahdarvishan River.

MATERIALS AND METHODS
The study area
Siahdarvishan River is one of the important rivers entering Anzali wetland, situated at 37° 16' North latitude and 49° 21' East longitude (Abbasii *et al.* 2006) (Fig.1). In order to provide effective sampling, three sampling stations were chosen, (Gaght roudkhan, Shahkezr dame and Talab laleh). Siahdarvishan river is not seasonal and the minimum water flow is seen during summer.

Sampling procedure
The samples were collected on a monthly basis from December 2007 through November 2008, between 10 Am and 13.30 Pm. Phytoplankton samples were collected using a phytoplankton net of 5-10 µm mesh. Algal mat samples were collected using a small flat shovel; immediately

were placed in sterile plastic bags and were stored in the dark until they were transferred to the laboratory. Filamentous algae were collected by forceps from the different zones (e.g. old branches, basins, pools, stones etc). Water samples were taken in 0.5 liter. Polyethylene bottles and fixed immediately with 4% Formalin. Algal flora identification were carried out using available literatures (Anderson, 1966; Gomont, 1972; Kiyanmehr, 1994; Maosen, 1983; Prescott, 1954; Smith, 1920; 1924; West, 1904; Starmach, 1972) and the samples were photographed by an Olympus Bx51 microscope. Water temperature was measured in situ using a mercury thermometer and total hardness(German degree d°), nitrate, nitrite, phosphate and pH of water samples were measured using Aquaquant® test kits based on standard methods(Adams, 2000; Apha, 1986).

RESULTS

Physicochemical factor

Physicochemical parameters in the three sampling stations are presented in Table 1. The pH value varies from 7.5 to 8.0. The minimum (6 d°) and maximum total hardness (7-8 d°) values were respectively recorded from first to third stations. Nitrate (0 mg/l), nitrite (2 mg/l) (Table 1) and Phosphate concentrations (ranged from 0.033 to 0.1 mg/l , not shown in Table 1) were almost identical in three stations. The average of air and surface water temperatures in the three stations were measured. The lowest average of air (10-27 C^o) and water (3-15 C^o) temperatures were recorded in station I, while the highest average of air (12-31 C^o) and water temperatures (8-28 C^o) were reported from the station III (Table 1).

Taxonomical remarks

In this study a total of 84 species of fresh water algae, belonging to 34 families and 51 genera were identified (Fig. 2). Cholorophyta with 20 genera/ 36 species was the most abundant phyllum followed by Cyanophyta (12 genera/ 24 species); Bacillariophyta (13 genera/ 12 species); Rhodophyta (2 genera/ 2 species), Euglenophyta and Xanthophyta (each with 1 genus/ 1 species). While Oscillatoriaceae was the most abundant family with 14 species, then Hydrodictyaceae, Coelastraceae, Scenedesmaceae (5 species), Cladophoraceae Zygnemataceae, Ulothrichaceae, Cymbellaceae, Pleurosigmataceae, Naviculaceae (3 species), Nostocaceae, Coscinodiscaceae, Melosiraceae, Tabellariaceae, Cocconeidaceae (2 species) and Chamaesiphonaceae, Chaetopeltidieae, Chaetophoraceae, Oedogoniaceae, Botryococcaceae, Characieae, Microsporaceae, Cholorococcaceae, Diatomaceae, Fragilariaceae, Catenulaceae, Bacillariaceae, Diploneidaceae, Euglenaceae, Vaucheriaceae, Porphyridiaceae and Helminthocladiea each with 1 species respectively were present in the studied stations (Fig. 2).

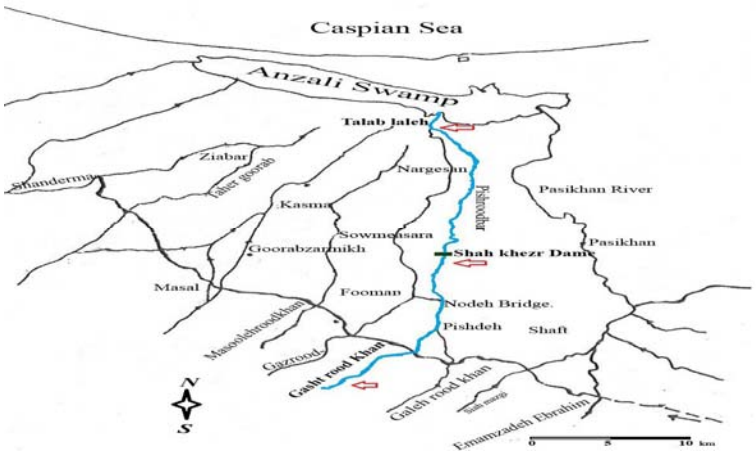

Fig.1. Location of study area

Table 1. Range of physicochemical parameters recorded in the three stations; average of air temperatures (Av. A. Temp, spring (S), summer (Su), autumn(A), winter(W), average of air temperature (Av. A. temp.), average of water temperature (Av. W. temp.), pH, total hardness (German degree d°) (T. H.), nitrate(NO3) and nitrite (NO2).

Stations	Av. A. Temp. C°				Av. W. temp. C°				PH	T. H d°	NO2 mg/l	NO3 mg/l
	S	Su	A	W	S	Su	A	W				
1. Gahtroodkhan	18	27	20	10	10	15	12	3	7.5-8	6	2	0
2. Shahkhezr Dame	20	30	21	12	16	25	14	7.5	7.5-8	6-8	2	0
3. Talab laleh	22	31	23	12	17	28	14	8	7.7-8	7-8	2	0

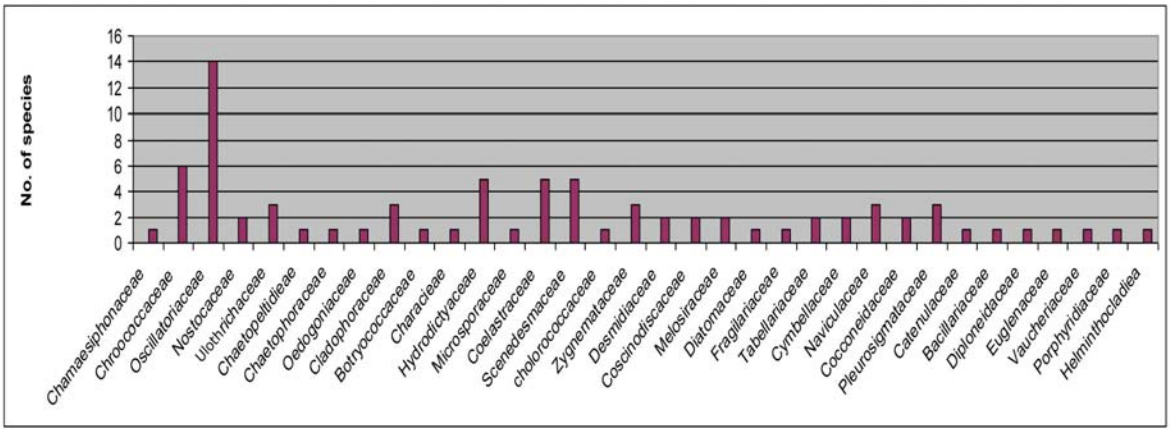

Fig 2. Number of species among the families

DISCUSSION

The taxonomic composition of freshwater algae collected from different stations is presented in Table 2. Out of 84 identified species, 12 were common in the three stations, while 20 species were recorded only from the second (Table 3), 5 species from the first (Table 4) and 4 species from the third stations (Table 5). The second station (Shahkhezr Dame) with 68 species showed the highest species richness, comparing to the first (34 species) and the third stations (24 species) (Fig. 3). This shows that algal population (especially in Shahkhezr Dame station) is greatly influenced by water conditions and physico-chemical parameters. Increase in number of species were also significant during summer in the station I and summer - autumn months in the stations II and III (Table 4 - 5). Based on Devika *et al.* (2006) increase in algal population especially during summer is related to physical parameters (water temperature and transparency) rather than chemical conditions
(which are almost identical in the three stations). On the other hand, low transparency (in the

station III), and heavy flood (in the station I) resulted the decline of algal density and physico-chemical parameters. (Rajagopal, 2010; Pundhir and Rana, 2002). According to several previous studies (Wu and Chou, 1999; Richardson *et al.*, 2000; Izaguirre, 2001 ; Ersanli and Gönülol, 2003; Tyor and Chawla, 2012) the seasonal variations of phytoplankton are related to different environmental factors especially temperature (water and air temperatures) that regulate the growth and distribution of these organisms (Simon and Hildrev, 1998 Thebault and Rabouille, 2003).

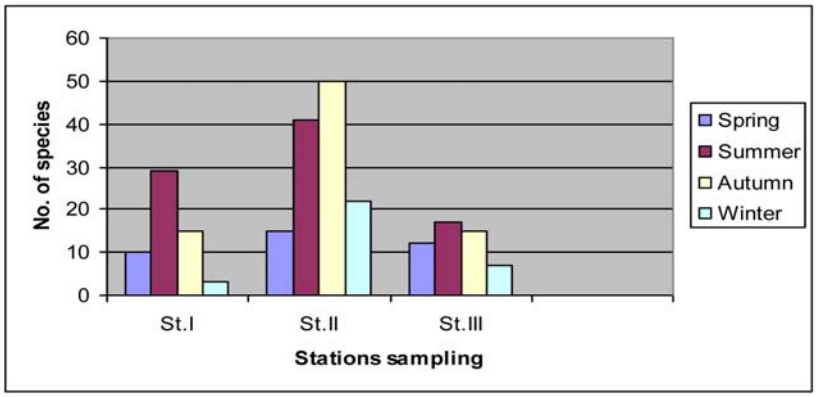

Fig 3. Number of species and seasonal variation in the studied area

Cyanophyta(key to genera)

1- Cells solitary or small colony never contain more than a few cells……..……...2

- Cell arranged in to colony or filament . ..….4

2- Cell spherical or hemispherical.……. ……3

- Cells erect, subcylindrical clubs, straight or curved;epiphytic;…....…...1. *Chamaesiphon*

3-Cell enclosed within transparent layered sheath.…..……...….....2. *Chroococcus*

-Cell without a gelatinous sheath, not spherical or hemispherical-cells solitary or in pairs……..……..…….3.*Synechocystis*

4-Thalus colony …….…...…..5

-Thallus filamentous……...…….....……...8

5- Cells globose, or hemispherical……..…...6- Cells elongate cylinders, forming large colonies; have no individual sheaths ……4. *Aphanothece*

- Cells forming irregularly globular or oval colonies ……7

7-Cells very numerous and crowded within the colonial mucilage……...…...6. *Microcystis*

- Cells distributed throughout the colonial mucilage..……...7. *Aphanocapsa*

8-heterocysts present. ……..……9

-heterocysts absent…..... ……...….…...10

9- Trichomes not parallel, or if so, forming indefinitely shaped flakes, composed of bead-like or barrel-shaped cell ..8.. *Anabaena*

-Trichomes parallel, forming a free-floating flake or bundle……..9. *Aphanizomenon*

10- Trichomes with sheath…….....11

-Trichomes without a sheath; solitary, not lying in parallel bundles, sometimes tapered slightly at the anterior end, or with the apical cell swollen (capitate) .....…10. *Oscillatoria*

11- Trichomes with a thin sheath; blue or black-green in color and slimy or slippery to touch…….…..……11. *Phormidium*

-Sheath colorless or yellowish, extending beyond the end of the trichome..12. *Lyngbya*

***Oscillatoria* (key to species)**

1- Trichomes straight, or slightly curved with calyptra……..2

-Trichomes straight or slightly curved, without calyptra…….……5

2- Trichomes not constricted at the junction.. 3

- Trichomes constricted at the junction….....4

3-Trichome straight, slightly tapered toward both ends, 3.5-5 µm wide; with granules along the cross wall, with conical shape calyptra ……*O. agardhii* (Gomont).

-Trichomes straight, 2-5.5 µm broad; granulated; terminal cell broad……. *O. prolifica* N.

4- Trichomes straight, bent or some time twisted in apical region; cells 6-8 µm in width with granules along the cross wall, terminal cell curve.….*O. anguina* (Bory).

- Trichomes, 2.5-5 µm broad....*O. amoema* N.5- Trichomes straight or slightly curved, not constricted at the junction, cells 3.5-5 µm in width with granules along the cross wall, …*O. granulata* Gardner.

-Trichomes straight or slightly curved, constricted at the junction……...……..….6

6-Cells 4-6 µm in width with granules along the cross wall.……..….*O. formosa* Bory.

-Cell 2.5-8 µm in in length, with granules along the cross wall, ……..……..…....*O. tenuis Ag.*

***Phormidium* (key to species)**

-Trichomes straight or slightly curved 4.5-12 µm in width, not constricted d at the junction, with granules along the cross wall; terminal cell not attenuated or rounded, without calyptra ……..*P. retzii* N.

-Trichomes straight or slightly curved, 4-7 µm in width, not constricted at the junction; with granules along the cross wall, with diffluent sheath; apical cells not attenuated and often calyptrate….……*P. ambiguum* Gom.

***Lyngbya* (key to species)**

1- Trichomes 4- 5.5 µm in width, straight or curved; not constricted at the junction, cells without granules along the cross wall…….. ..……*L. aerugineo-coerulea* (Kutz.) Gom.

-Trichomes more than 7 µm in diameter, straight…….2

2- Trichomes 7- 10 µm in diameter; not constricted at the junction and not attenuated; cells with or without granules along the cross walls……..L. *martensiana* Menegh .

- Trichomes 14- 19.5 µm in width, not constricted at the junction, cells with or without granules along the cross walls ……....…..*L. hieormymusii* Lemm.

Cholorophyta (key to genera)

1-Thallus not filamentous, solitary or a colony of 2 or more cells……..…..2

-Thallus a filament with or without branches ……..……...11

2- Thallus composed of solitary cell; bearing an unbranched hair with a basal sheath ……..…….…...…… 1. *Chaetosphaeridium*

-Thallus with solitary cells; without hair……..3

3-Solitary cells, not adjoined to form colonies, not constricted or constricted in the midregion……..……..……....4

- Solitary cells adjoined to form colonies…... 6

4-Solitary cells constricted in the midregion, margin without spines…… …2. *Cosmarium*

- Solitary cells, not constricted, crescent or sickle shaped, with pointed or narrowly rounded and tapering apices…….5

5- Cell with 2 axial chloroplasts bearing longitudinal ridges, a chlorcplast in either horn of the cell; pyrenoids conspicuous, usually in an axial row……3. *Closterium*

-Cell with one chloroplasts or with parietal chloroplasts not arranged as above, cells only slightly crescent-shaped, attached by a slender stipe to other algae …4. *Characium*

6-Colonies with definite patterns, definitely arranged and definite in number or forming, nets and plates..…..……...……..…7

-Colonies with indefinite patterns, irregularly shaped; compounded by interconnecting strands of tough mucilage between clusters of cells……..……...…5. *Botryococcus*

7- Cells cylindrical, l attached by 2 others at the end walls, repeatedly to form a network. ……...…6. *Hydrodidtyon*

-Cells arranged otherwise, definite in number ……..…….……..…....8

8- Colonies not bearing long or short needle-like spines, cell forming somewhat angular or oval plates ……..……9

-Colonies bearing long or short spines …..10

9-Cells forming oval colony, trapezoidal, outer free walls deeply incised……..7.*Pediastrum*

-Cells forming quadrate plates, the outer walls entire (not incised)……...……8. *Crucigenia*

10- Cells arranged side by side in one or two alternating rows; spines short, arising from the poles of the cells only....……..9. *Scenedesmus*

-Cells forming oval colony, bearing long needle-like spines ….……10. *Golenkinia*

11- Filament without branches……...12

- Filament with branches…..……..…..17

12- Chloroplasts extend only part way around the cell, filament not showing a basal-distal differentiation……11. *Hormidium*

- Chloroplasts are not about one-half the cell in length…….13

13- Chloroplast a parietal band or ring which encircles the cell or nearly so; apical cell not tapering……12. *Ulothrix*

- Chloroplast otherwise……..……..…….14

14- Chloroplasts spiraled, conjugation by the formation of tubes from one or both cells, either between cells of two different filaments (scalariform conjugation), or between adjacent cells n the same filament (lateral conjugation…….....13. *Spirogyra*

- Chloroplasts network, perforated, padded sheet, branched, beaded ribbon shape …..15

15-Chloroplast a perforated, padded sheet, branched, beaded ribbon; cell wall forms H-shaped pieces…….……14. *Microspora*

- Chloroplast a parietal network, axial plate or band shape …...……16

16-Chloroplast an axial plate or band shape …..….....15. *Mougeotia*

-Chloroplast a parietal network; cells cylindrical, with at least 1 ring-like scar at the anterior end just below the cross wall …..... 16. *Oedogonium*

17- Multicellular hairs resulting from the apical tapering of branches, filaments of cells in 1 series throughout…....…..17. *Stigeoclonium*

-Ends of branches not tapering to form hairs...18

18- Branching habit has been reduced; cells cylindrical…….....18. *Rhizoclonium*

- The habit of branching is variable according to habitat, branching open and spreading; cells cylindrical…..……..19. *Cladophora*

***Cosmarium* (key to species)**

- Semicells ovate-pyramidate froma broad, flat base, basal angles rounded, sides convex, apex rather narrowly truncate or subtruncate, apical angles rounded. Chloroplasts axile, with two pyrenoids in each semicell……. *C. botrytis* Menegh.

- Semicells compressed or rounded when seen from the top or side, not with radiating arms, margin of cell without spines..….. ……*C. panamenes* Presc.

***Closterium* (key to species)**

1-Cells of 247-1000 µm long, 46.5-120 µm broad……..….. …….....*C. lunula* (Mull).

-Cells less than 1000 µm long, ……..….2

2-Inner margin tumid, cells of 221-370 µm long; inner margin tumid……..… ……..*C. moniliferum* Ehr.

-Inner margin not tumid; cells of 250-790 µm long, elongated, attenuated curved, rarely straight, with a single chloroplast in each semicell……*C. acerosum* (Schr.).

***Pediastrum* (key to species)**

1- Colony of upto 16 cells with two projections on margin …….....2

-Colony of more than 16 cells…...….....……3

2-Colony 12-16 cells, 40 µm in diameter, projections side by side in front view of cell …… *P. boryanum* (Menegh).

-Colony of 12-14 cells, 8-32 µm in diameter; cells covered with short, linear, concentrically arranged granules; 12-22 µm broad; 13-24 µm long……..... *P. duplex* var. *rolundatum* Lucks.

3-Colony of 8-16 or 32-64 cells, with openings between cells. Cell wall smooth; cells 32 µm in diameter ……*P.biradiatum* Meyen.

-Colony of -16-32 cells, 80-150 µm in diameter, oval to circular, with 8 interior and 4-6 straight sides; marginal cells with two lobes; cell wall covered with a

network of very fine ridges; cells 10-15 µm diameter .*P. sculptatum* G. M. Smith.

***Scenedesmus* (key to species)**

1-Walls smooth, lateral ridges, terminal teeth or spines…..……..……2

-Wall with terminal teeth, or spines; 8-42 µm in diameter and 3-15 long, oblong-elliptical, arranged in one row or alternate. …….*S. quadricauda* Breb.

2- Cells ovoid to cylindrical, with rounded ends; colony of 4 cells, 5-8 µm in diameter and 3-10 long, arranged in one row …..……..……*S.bijuga* (TurP.)

- Cells acicular to broadly elliptic…….....3

3- Colony with erect cells(2-4); with pointed ends; 5-30 µm in diameter and 2.5-10 long, ……....….*S. obliquus* (TurP.)

-Colony with erect or unerect cells……..……4

4- Median cells erect, terminal cells lunate; 5-25 µm in diameter and 3-9 long, oblong-elliptical, arranged in one row……. ……*S. dimorphus* (TarP).

- Colony of 4-8 crescent- shaped cells; 5-20 µm in diameter and 2.5-11…….*S. incrassatulus* var. *mononae* G. M. Smith.

***Spirogyra* (key to species)**

-Cells cylindrical, 40-85 µm in diameter, 115-200 µm long……*S. rhizobrachalis* Jao.

-Cells of 30-35 µm in diameter, 50-200 µm long; chloroplast single making up to 5.5 turns; end wall plane……..*S. borgeana* Transeau.

***Cladophora* (key to species)**

-Attached or free floating; branch obliquely and rarely lateral; terminal cell 25-50 µm in diameter……...*C. glumerata* (L.) utz .

-Free floating, lying loosely about the substratum; branch pseudochotomously, growing mainly intercalary; terminal cell 16-28 µm in diameter ……*C. fracta* (Muller ex Vahi)Kutz.

Bacillariophyta (key to genera)

1- Raphe or pseudoraphe absent ;valves with radial ornamentation ……..... 2

- Raphe or pseudoraphe present; valves with transverse / longitudinal ornamentation ……..….....4

2- Frustules attached to form long chain or filament…..……..…1. *Melosira*

-Frustules solitary but may form short chains.....3

3-Valve margin with costae but central area not sharply distinct from margin; valves with radial rows of punctae in multiseriate rows, each row gradually or abruptly becoming uniseriate toward the center; marginal spines always present ..…… ……..…….....2. *Stephanodiscus*

-Valve margin with costae and ornamentation in central area different from margin ……..……..…3. *Cyclotella*

4-Raphe present on at least one valve; very short or rudimentary …..……..…….8

- Raphe absent, pseudoraphe present on both valves..... 5

5- Frustules with thick longitudinal septae, parallel to the valve face…...4. *Tabellaria*

-Frustules without septae…...……..6

6- Valves with thickened costae, symmetrical about the transapical plane……5. *Diatoma*

-Valves without thickened costae, symmetrical about the transapical plane…… ..7

7-Frustules forming long ribbon-like chains, rarely solitary…….……6. *Fragilaria*

- Frustules solitary, or forming stellate colonies; striae often appearing as costae …...…….……7. *Synedr*a

8- Raphe evident on at lease one valve ..……9

- Raphe not evident, concealed in a keel; frustules usually solitary or forming irregular ribbonlike chains or stellate colonies……...…8. *Nitzschia*

9- Valves not similarly ornamented, raphe on one valve, opposing valve with pseudoraphe, or with rudimentary raphe near valve ……..……..….10

--Valves with similar ornamentation, raphe on both valves……...…..11

10-Valves elliptical, never linear.9.*Cocconeis*

-Valves elliptical-lanceolat…..10. *Encyonema*

11- Valves elliptical……12

-Valves not elliptical, asymmetrical about the transapical plane, with completely developed raphe, opposing valve with rudimentary raphe near valve pole ……..……11. *Rhoicosphenia*

12-Valves symmetrical about the transapical plane, asymmetrical about the apical plane……...……...13

- Valves asymmetrical about both the apical and apical plane ……...……...14
13- Valve faces not parallel,both valves faces can be seen in girdle view.....12. *Amphora*
-Valve faces parallel.…….....13. *Cymbella*
14-Valves and raphe sigmoid……...…….14
-Valves and raphe not sigmoid, central area not extending to the margins of the valve, striae present along lateral margins of the central area.....14. *Navicula*
15 -Valves with transverse and longitudinal striae…….....15. *Gyrosigma*
Valves with transverse and oblique striae ……. 16. *Pleurosigma*

***Melosira* (key to species)**

-Valves length less than 20 µm;……..2
-Valves 9-13 µm long, no visible ornamentation…….*M. varians C. A. Ag*
-Valves 5-18 µm long…..*M. undulata* (Eh r.).

***Tabellaria* (key to species)**

-Cells 12-50 µm in diameter, 5-16 µm wide ..……*T. flocculosa* (Roth) Kutz.
- Cells 30-140 long, 3-9 µm wide; intercalary bands per cell……*T. fenestrata* (Lyngb.) Kuetz.

***Cymbella* (key to species)**

- Cells 20-70 µm long, 7-17 µm wide, venteral median striae ending in an isolated prominent puncta…….. *C. affinis* Kutzing.
-Cells 10-40 µm long, 2-12µm wide….. ……..*C. ventricosa* Kutz.

***Navicula* (key to species)**

1- cells upto 28 µm long, 5-8 µm wide; may be found in chains *N. confervacea* (Ehr.)
-Cell over 28 µm long…….…..2
2-Cell 20-40 µm long, 5-7 µm wide …… …….. *N. cryptocephala* (Kutz).
-Cells 36-80 µm long, 6-10 µm wide … …….....….*N. gracilis* (Ehr.).

Table 2. The taxonomic composition of taxa found in the studied are

Phylum	Family	Genus	Species
Cyanophyta	1. Chamaesiphonaceae	1. *Chamaesiphon*	1. *C. incrustans* Grunow
	2. Chroococcaceae	2. *Aphanocapsa*	2. *A. grevillei* (Hass.) Rabenh.
		3. *Aphanothece*	3. *A. saxicola* Nag
		4. *Chroococcus*	4. *C. limnetieus* Lemm.
		5. *Merismopedia*	5. *M. elegans* A. Braun
		6. *Microcystis*	6. *M. aeruginosa* (Kutz.)
		7. *Synechocystis*	7. *S. aquatilis* Sauv.
	3. Oscillatoriaceae	8. *Lyngbya*	8. *L. martensiana* Menegh. 9. *L. hieormymusii* Lemm. 10. *L. aerugineo-coerulea*(Kutz.) Gom
		9. *Oscillatoria*	11. *O. granulata* Gardner 12. *O. formosa* Bory 13. *O. anguina* (Bory) 14. *O. formosa* Bory 15. *O. agardhii* (Gomont) 16. *O. tenuis* Agardh 17. *O. limnetica* Lemmermann. 18. *O. sp.* 19. *O. prolifica* N. 20. *O. amoema* (Kutzing) Gomont.
		10. *Phormidium*	21. *P. retzii* N. 22. *P. ambiguum* Gom.
	4. Nostocaceae	11. *Anabaena*	23. *A. affinis* Lemm.
		12. *Aphanizomenon*	24. *A. flos-aque (* L.) Ralfs.
Chlorophyta	5. Ulothrichaceae	13. *Ulothrix*	25. *U. zonata* (Weber & Mohr) Kuetz. 26. *U. tenerrima*
		14. *Hormidium*	27. *H.sp*
	6. Chaetopeltidieae	15. *Chaetosphaeridium*	28. *C. globosum* (Nordst.)nKlebahn
	7. Chaetophoraceae	16. *Stigeoclonium*	29. *St. flagelliferum Kuetz*
	8. Cladophoraceae	17. *Cladophora*	30. *glumerata* (L.)Kutz 31. *C. fracta* (Müll. ex Vahl.) Kützing
		18. *Rhizoclonium*	32. *R. hieroglyphicum* (Ag.) Kuetz
	9. Oedogoniaceae	19. *Oedogonium*	33. *O. sp*
	10. Botryococcaceae	20. *Botryococcus*	34. *B. brounii* Kutz.
	11. Characieae	21. *Characium*	35. *C. subulatum* A. Br.
	12. Hydrodictyaceae	22. *Pediastrum*	36. *P. boryanum* Menegh. 37. *P. duplex var. rolundatum* 38. *P. biradiatum* Meyen. 39. *P. sculptatum* G. M. Smith
		23. *Hydrodictyon*	40. *H. reticulatum* (L.) Lagerheim
	13. Microsporaceae	24. *Microspora*	41. *M. Loeigrenii* (Nordst.) Lag.
	14. Coelastraceae	25. *Coelastrum*	42. *C. acerosum* (Schr.) 43. *C. monlliferum* Ehr 44. *C. lunula*(Mull) 45. *C. cynthia* De Not. 46. *C. parvulum* Nag
	15. Scenedesmaceae	26. *Crucigenia*	47. *Cr. rectangularis* (A. Braun) Gay.
		27. *Senedesmus*	48. *S. bijuga* (Turp.) 49. *S. dimorphus*(Tarp.) 50. *S. quadricauda* Breb. 51. S. *obliquus* (Turp.) 52. S. *incrassatulus* var. mononae G. M. Smith.
	16. cholorococcaceae	28. *Golenkinia*	53. *G. paucispina* W.G.S.
	17. Zygnemataceae	29. *Mougeotia*	54. *M. punctata*

Phylum	Family	Genus	Species
		30. *Spirogyra*	55. *S. rhizobrachalis* Jao.
			56. *S. borgeana* Transeau
	18. Desmidiaceae	31. *Cosmarium*	57. C. *panamenes* Presc.
			58. C. *botrytis* Menegh
Bacillariophyta	19. Coscinodiscaceae	32. *Stephanodiscus*	59. *S. hantzchii* Grun
		33. *Cyclotella*	60. *C. comta* (Ehr.)
	20. Melosiraceae	34. *Melosira*	61. *M. granulata* (Ehr.)Ralfs
			62. *M. varians* C. A.Ag
	21. Diatomaceae	35. *Diatoma*	63. *D. vulgare*
	22. Fragilariaceae	36. *Fragilaria*	64. *F. capucina* Desm.
		37. *Synedra*	65. *S. ulna* (Nitsch.) Ehr.
	23. Tabellariaceae	38. *Tabellaria*	66. *T. flocculosa* (Roth)Kutz.
			67. *T. fenestrata* (Lyngb.) Kuetz
	24. Cymbellaceae	39. *Cymbella*	68. *C. affinis* Kutzig
			69. *C. cistula* (Hemp.)
	25. Naviculaceae	40. *Navicula*	70. *N. gracilis* (Ehr.)
			71. *N. cryptocephala* (Kutz.)
			72. *N. confervacea* (Ehr.)
	26. Cocconeidaceae	41. *Cocconeis*	73. *C. placentula* Ehrenb.
		42. *Encyonema*	74. *E. caespitosum* Kütz
	27. Pleurosigmataceae	43. *Gyrasigma*	75. *G. attennatum*(Kutz.)
			76. *G. scalproides*
		44. *Pleurosigma*	77. *P. delicatum.*
	28. Catenulaceae	45. *Amphora*	78. *A. ovalis* (Kützing) Kützing
	29. Bacillariaceae	46. *Nitzchia*	79. *N. paradoxa* Gmelin.
	30. Diploneidaceae	47. *Rhoicosphenia*	80. *R. curvata*
Euglenophyta	31. Euglenaceae	48. *Phacus*	81. *P. curvicauda* Swir
Xanthophyta	32. Vaucheriaceae	49. *Vaucheria*	82. *V. geminata* (Vauch.)
Rhodophyta	33. Porphyridiaceae	50. *Porphyridium*	83. *P. cruentum* Naeg.
	34. Helminthocladiea	51. *Chantransia*	84. *C. pygymaea* Kutz.

Table. 3 List of taxa recorded at shakhezr dome
(Abbreviations; S: spring; Su: summer; A: Autumn ; W: Winter)

phyllm	Family	Genus	Species	S	SU	F	W
Cyanophyta	Chamaesiphonaceae	*Chamaesiphon*	*C. incrustans* Grunow			*	*
	Chroococcaceae	*Aphanothece*	*A. saxicola* Nag		*	*	
	Chroococcaceae	*Chroococcus*	*C. limnetieus* Lemm		*		
	Chroococcaceae	*Merismopedia*	*M. elegans* A.Braun		*		
	Chroococcaceae	*Microcystis*	*M. aeruginosa* Kuetz.	*		*	*
	Oscillatoriaceae	*Lyngbya*	*L. hieormymusii* Lemm.	*		*	*
			L. martensiana Menegh.	*			*
	Oscillatoriaceae	*Oscillatoria*	*O. anguina* (Bory)	*	*		
			O. formosa Bory	*	*	*	
			O. agardhii (Gomont)		*	*	
			O. tenuis Agardh			*	
			O. limnetica Lemmermann.	*	*	*	
			O. sp.			*	
			O. prolifica N.			*	
			O. amoema (Kutzing) Gomont.			*	
	Oscillatoriaceae	*Phormidium*	*rmidium retzii* N.	*	*		*
			mbiguum Gom.			*	
	Nostocaceae	*Aphanizomenon*	*A. flos-aque* (L.) Ralfs	*			*
Chlorophyta	Ulothrichaceae	*Ulothrix*	*U. zonata* (W e b e r & Mohr) Kuetz.			*	*
	Chaetophoraceae	*Stigeoclonium*	*St. flagelliferum Kuetz*		*		
	Chroococcaceae	*Golenkinia*	*G. paucispina* W. G.S. West	*	*	*	
	Cladophoraceae	*Cladophora*	*C. glumerata* (L.)Kutz		*	*	*
			C. fracta (Müll. ex Vahl.) Kützing				
	Cladophoraceae	*Rhizoclonium*	*R. hieroglyphicum* (Ag.) Kuetz		*	*	

phyllm	Family	Genus	Species	S	SU	F	W
	Oedogoniaceae	*Oedogonium*	*O.* sp.	*	*		*
	Botryococcaceae	*Botryococcus*	*B. brounii* Kutz.		*		
	Characieae	*Characium*	*C. subulatum A. Br.*		*	*	
	Hydrodictyaceae	*Pediastrum*	*P. boryanum* Menegh.		*	*	
			P. duplex var. rolundatum		*	*	
			P. biradiatum Meyen.				
			P. sculptatum G. M. Smith				
	Hydrodictyaceae	*Hydrodictyon*	*H. reticulatum* (L.) Lagerheim		*	*	
	Microsporaceae	*Microspora*	*M. Loeigrenii* (Nordst.) Lag.		*	*	
	Coelastraceae	*Coelastrum*	*C. acerosum* (Schr.)		*	*	
			C. monlliferum Ehr		*	*	
			C. lunula(Mull)		*		*
	Scenedesmaceae	*Crucigenia*	*Cr. rectangularis* (A. Braun) Gay.			*	
	Scenedesmaceae	*Scenedesmus*	*S. bijuga* (Turp.)		*		
			S. dimorphus(Tarp.)		*	*	
			S. quadricauda Breb.		*		*
			S. *obliquus* (Turp.)		*	*	
			S. *incrassatulus* var. *mononae* G. M. Smith.			*	
	Zygnemataceae	*Mougeotia*	*M. punctata* Wittrock			*	*
	Zygnemataceae	*Spirogyra*	*S. rhizobrachalis* Jao.		*	*	*
			S. borgeana Transeau		*	*	
	Desmidiaceae	*Cosmarium*	C. *panamenes* Presc.		*		
			C. *botrytis* Menegh			*	
	Coscinodiscaceae	*Stephanodiscus*	*S. hantzchii* Grun		*	*	
		Cyclotella	*C. comta* (Ehr.)			*	
Bacillariophyta	Melosiraceae	*Melosira*	*M. granulata* (Ehr.)Ralfs		*	*	*
			M. varians C. A.Ag	*	*	*	*
	Diatomaceae	*Diatoma*	*D. vulgare*			*	*
	Fragilariaceae	*Fragilaria*	*F. capucina* Desm.		*	*	
	Fragilariaceae	*Synedra*	*S. ulna* (Nitsch.) Ehr.		*	*	*
	Tabellariaceae	*Tabellaria*	*T, flocculosa* (Roth)Kutz.		*	*	*
			T. fenestrata (Lyngb.) Kuetz		*	*	
	Cymbellaceae	*Cymbella*	*C. affinis*			*	
			C. cistula (Hemp.)			*	
	Naviculaceae	*Navicula*	*N. gracilis* (Ehr.)			*	*
			N. cryptocephala (Kutz.)	*	*	*	
			N. confervacea (Ehr.)		*	*	*
	Cocconeidaceae	*Cocconeis*	*C. placentula* Ehrenb.			*	
	Pleurosigmataceae	*Gyrasigma*	*G. attennatum*(Kutz.)	*	*	*	
			*G. scalproides (*Rabenhorst) Cleve		*		
	Catenulaceae	*Amphora*	*A. coffeaeformis* (C.Agardh) Kützing		*	*	*
	Bacillariaceae	*Nitzschia*	*N. paradoxa* Gmelin.			*	
	Diploneidaceae	*Rhoicosphenia*	*R. curvata* (Kützing) Grunow	*			
Xanthophyta	Vaucheriaceae	*Vaucheria*	*V. geminata* (Vauch.)	*	*	*	*
Euglenophyta	Euglenaceae	*Phacus*	*P. caudatus* Hubner.		*		

Table. 4 List of taxa recorded at Gashtroodkhan
(Abbreviations; S: spring; Su: summer; A: Autumn ; W: Winter)

phylum	Family	Genus	Species	S	SU	F	W
Cyanophyta	Chamaesiphonaceae	*Chamaesiphon*	*C. incrustans* Grunow		*	*	
	Chroococcaceae	*Aphanocapsa*	*A. Grevillei* (Hass.) Rabenh.		*		
	Chroococcaceae	*Aphanothece*	*A. saxicola* Nag		*		*
	Chroococcaceae	*Chroococcus*	*C. limnetieus* Lemm.		*		
	Chroococcaceae	*Microcystis*	*M. aeruginosa* (Kutz.)	*		*	

phylum	Family	Genus	Species	S	SU	F	W
	Chroococcaceae	*Synechocystis*	*S. aquatilis* Sauv.		*		
	Oscillatoriaceae	*Lyngbya*	*L. martensiana* Menegh.	*	*	*	
			L. hieormymusii Lemm.	*	*		
			L. aerugineo-coerulea (Kutz.)		*		
	Oscillatoriaceae	*Oscillatoria*	*O. granulata* Gardner	*	*	*	
			O. formosa Bory	*			
	Oscillatoriaceae	*Phormidium*	*P. retzii* N.		*		
	Nostocaceae	*Aphanizomenon*	*A. flos-aque (* L.) Ralfs.	*	*	*	
Chlorophyta	Chaetophoraceae	*Stigeoclonium*	*St. farctum* Berthold		*	*	
	Cladophoraceae	*Cladophora*	*C. glumerata*		*		
			C. fracta (O.F.Müll. ex Vahl.) Kützing			*	
	Characieae	*Characium*	*C. Subulatum* A. Br.			*	
	cholorococcaceae	*Golenkinia*	*G. paucispina* W.G.S.	*	*	*	
	Zygnemataceae	*Spirogyra*	*S. rhizobrachalis* Jao.		*	*	
			S. borgeana Transeau		*		
	Scenedesmaceae	*Closterium*	*C. acerosum* (Schr.)	*	*	*	
			C. monlliferum Ehr		*		
			C. lunula(Mull)		*		
Bacillariophyta	Melosiraceae	*Melosira*	*M. varians C. A.Ag*	*	*	*	
			M. granulata (Ehr.)Ralfs		*		
	Fragilariaceae	*Synedra*	*S. ulna* (Nitsch.) Ehr.	*	*		
	Cymbellaceae	*Amphora*	*A. ovalis* (Kützing) Kützing		*		
	Cocconeidaceae	*Encyonema*	*E. caespitosum* (Kützing) Brun			*	
	Naviculaceae	*Navicula*	*N. cryptocephala* (Kutz.)		*	*	*
	Tabellariaceae	*Tabellaria*	*T. fenestrata* (Lyngb.) Kuetz.		*	*	*
			T. flocculosa (Roth) Kützing		*		
	Diatomaceae	*Diatoma*	*D. vulgare* Bory de Saint-Vincent		*	*	
Xanthophyta	Vaucheriaceae	*Vaucheria*	*V. sessilis* (Vauch.)		*		
Rhodophyta	Porphyridiaceae	*Porphyridium*	*P. cruentum* Naeg.		*		

Table. 5 List of taxa recorded at Talab laleh
(Abbreviations; S: spring; Su: summer; A: Autumn ; W: Winter)

phylum	Family	Genus	Species	S	SU	F	W
Cyanophyta	Chroococcaceae	*Microcystis*	*M. aeruginosa* Kuetz. emend Elenkin	*		*	*
	Nostocaceae	*Anabaena*	*A. affinis* Lemm.	*			
	Oscillatoriaceae	*Lyngbya*	*L. martensiana* Meneh.	*		*	
Chlorophyceae	Ulothrichaceae	*Ulothrix*	*U. zonata* (W e b e r & Mohr) Kuetz.	*		*	*
	Ulothrichaceae				*	*	
	Ulothrichaceae		*U. tenerrima*		*		
		Hormidium	*H. sp.*				
	Chaetopeltidieae	*Chaetosphaeridium*	*C. globosum* (Nordst.)nKlebahn		*	*	*
	Chaetophoraceae	*Stigeoclonium*	*St. flagelliferum Kuetz*		*	*	
	Cladophoraceae	*Cladophora*	*C. glumerata*		*	*	*
	Cladophoraceae	*Rhizoclonium*	*R. hieroglyphicum* (Ag.) Kuetz.		*	*	*
	Microsporaceae	*Microspora*	*M. sp*			*	

phylum	Family	Genus	Species	S	SU	F	W
	Oedogoniaceae	*Oedogonium*	*O. sp*		*	*	
	Botryococcacea	*Botryococcus*	*B. branii* Kützing,	*	*		
	Coelastraceae	*Coelastrum*	*C. acerosum* (Schr.)	*	*		
			C. cynthia De Not.		*		
			C. parvulum Nag.		*		
	Zygnemataceae	*Mougeotia*	*M. genuflexa* (Di1l w.) C. A. Agardh,			*	*
	Zygnemataceae	*Spirogyra*	*S. rhizobrachalis* Jao.	*	*	*	
	Desmidaceae	*Cosmarium*	C. *panamenes* Presc.	*	*		
Bacillariophyta	Melosiraceae	*Melosira*	*M. granulata* (Hhr.)	*	*	*	*
	Fragilariaceae	*Synedra*	*S. ulna*(Nitsch.) Ehr.	*	*		
	Naviculaceae	*Navicula*	*N. cryptocephala* (Kutz.)	*		*	
	Pleurosigmataceae	*Gyrosigma*	*G. attenutum*(Kutz)	*			
	Pleurosigmataceae	*Pleurosigma*	*P. delicatum* Smith		*		
Rhodophyta	Helminthocladiea	*Chantransia*	*C. pygymaea* Kutz.			*	
Euglenophyta	Euglenaceae	*phucus*	*P. curvicauda* Swir		*		

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در تحقیق حاضر جلبک های آب شیرین رودخانه سیاه درویشان طی یک سال (۱۳۸۵ – ۱۳۸۴) در ماه های متوالی نمونه برداری شد. سه ایستگاه نمونه برداری (روستای گشت رودخان، سد شاخزر، تلاب لاله) مشخص شدند. برخی از پارامترهای فیزیکی و شیمیایی (دمای آب، سختی کل (برحسب درجه آلمانی$^{\circ}$d)، میزان نیترات، نیتریت، و فسفات و pH) اندازگیری شد. در مجموع ۳۴ تیره، ۵۱ جنس و ۸۴ گونه از جلبک های آب شیرین مورد شناسایی قرار گرفت که شامل ۳۶ گونه از Cholorophta، ۲۴ گونه از Cyanophyta ، ۲۰ گونه از Rhodophyta، با ۲ گونه از Euglenophyta، و Xanthophyta هر کدام با ۱ گونه می باشد. از میان تیره ها، Oscillatoriaceae با ۱۴ گونه بیشترین غنای گونه ای را دارد. به منظور سهولت شناسایی فلور جلبکی منطقه، کلید های تاکسونومیکی در سطح جنس و گونه ارایه شده است.

*مولف مسئول