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Research Article

Relationship of pollution with distribution of Mermaid's tresses (*Spirogyra*) in different localities of river Kabul

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Abstract

The current research work focused on the distribution of *Spirogyra* in different localities of river Kabul in relation to pollution. Species' diversity was determined from water polluted due to all the three types of water pollution i.e. domestic, industrial and agricultural pollution. In all the sets of collected samples from the research sites a total of 37 species of *Spirogyra* belonging to class Chlorophyta were recorded. Of them 30 species were collected from unpolluted, 36 from slightly polluted and 4 from highly polluted waters. The chemical analysis of collected water samples from three selected sites showed high concentration of $CaCO_3$ (245mg/L) at highly polluted site Main Gujar; 188 mg/L and 164 mg/L at Khazana and Shah Alam respectively.

Keywords: Algae; Mermaid Tresses; Pollution; River Kabul; *Spirogyra*

Introduction

The River Kabul is actually the River Chitral that emerges from Chitral flows into Afghanistan and comes back to Peshawar **[1]**. It enters in to Pakistan through Shalman, then reaches to Warsak Dam while then it divides into several branches which flow in several sites of Peshawar valley for irrigating a major area. There are three branches of River Kabul, one is Shah Alam, second is Naguman and third one is Adezai. **[2]** Described that Naguman and Adezai branches are unpolluted. Mainly the unpolluted water is present in Serdaryab, Naguman and Shah Alam up to Muhajer Camp. Khazana has slightly while at Main Gujar water is highly polluted. The River is used for waste material dumping and therefore is very polluted and turbid **[3]**. Algae are very diverse group almost found in every habitat from marine ecosystem to fresh water bodies, brackish water and moist habitat. Algae have a great importance to life on earth **[4, 5]**. Micro-algae are the first precursor in the food chain for the aquatic animals and hence play an excellent role of primary producers in aquatic habitats. Algae have both the beneficial and harmful impacts **[6]**. They cause troubles by trapping

into the propeller of boats and produce eutrophication [7]. In spite the negative impacts algae also use in the water cleaning and determination of pollution [8]. Freshwater algae are widely used in ecological assessment and monitoring of water quality [9]. Green algae are one of the most diverse groups of Protista [10, 11], which shows diverse morphological structures i.e. unicellular, flagellated, un-flagellated, colonial, coccoid, branched or unbranched filamentous with approximately six hundred (600) genera and ten thousand (10,000) species. They are cosmopolitan and found almost in every habitat from poles regions to deep seas, freshwater ponds, pools as well as in terrestrials regions [10]. Freshwater algae are very diverse organisms that occupied all natural environments where the water and light are present. Algae of aquatic habitats have a definite answer to changes in the water properties and, thus, are widely used as bio-indicators of water quality and ecosystem status [12, 13, 14]. The algae is living organisms and are having a short span of life, its flora will also increase day by day such in ditches and/or moorland, Zygnemataceae algae, particularly *Spirogyra*, is the example of floating algae and 47 species were recorded in ditches and pools [15]. Sixty (60) species of the genus *Spirogyra* were recorded in the United Kingdom, specifically Netherlands [16]. After all it has been observed the there is always greater number of the algal species where there is low pollution at site of the rivers, ponds and sea. Such as in hard water ditches, *Spirogyra* forms a abundantly diversified species with approx 20 species per each site. While at very low basic and very week acidic sites, the number of algal species per each site is significantly decreasing, whereas under highly acidic (pH < 5), the *Spirogyra* does not exists and is replaced by some other algae like, (*Mougeotia, Zygnema, Klebsormidium, Microspora* etc). In spite of *Spirogyra* most of the algal species have wide range of existences; like in different environmental conditions twenty two (22) species were existed in the above said habitats, however, majority of the species are not existed in that conditions [17].

Materials and methods

To assess the *Spirogyra* diversity and ecology of the Kabul River, three research sites were selected in the Peshawar Valley. The sites included highly polluted (a), slightly polluted (b) and unpolluted (c) (Figure 1). Sampling was carried out during the autumn and spring seasons in 2017-2018. At each site, samples were collected from different habitats containing *Spirogyra*. The samples were brought into the laboratory, Department of Botany, Islamia College, Peshawar, in standard specimen bottles. The isolates were immediately preserved with neutral Lugol's Iodine solution, 0.5 ml per 100 ml water sample, and stored for a short time (Edler and Elbrächter 2010). The Lugol's iodine was prepared by dissolving 150 g potassium iodide and 50 g iodine in 980 ml distilled water, and then adding 20 ml of glacial acetic acid. Water Quality Index (WQI) was used to classify the class and status of river. The 100-point index is divided into several ranges corresponding to the general descriptive terms. Physicochemical properties of the water from the sampling sites were measured using HANNA HI98190 portable meter and HANNA HI98703 meter in the laboratory.

Results and discussion

The current research work was carried out to find the diversity and distribution of the genus *Spirogyra* in different habitats of river Kabul. Out of all the filamentous green algae the genus found at all the three sites of river Kabul was *Spirogyra*. It was the most common genus of Chlorophyta found. A total of 37 species of *Spirogyra* were collected from 3 selected water sites of river Kabul (Table 1 & Figure 2). From the collected samples of water 30 species of *Spirogyra*

were found at unpolluted site of Shah Alam, 4 species at highly polluted site of gujar and 32 species at slightly polluted site of Khazana (Table 2).

Table 1. Occurrence of *Spirogyra* in the three (3) sites selected with water quality differences (Unpolluted, slightly polluted and highly polluted waters)

S. No.	Species	Sites		
		a	***b***	***c***
1	*S. affinis*	+	-	+
2	*S. circumlineata*	+	-	+
3	*S. communis*	+	-	-
4	*S. condensata*	+	-	+
5	*S. conllinsii*	+	-	+
6	*S. crassa*	-	+	+
7	*S. daedaleoides*	+	-	+
8	*S. deciminia*	+	-	+
9	*S. denticulata*	-	+	+
10	*S. dubia*	+	+	+
11	*S. elongata*	+	-	+
12	*S. fallax*	-	-	+
13	*S. farlowii*	-	-	+
14	*S. fluviatilis*	+	-	+
15	*S. grevilleana*	+	-	+
16	*S. fuellebornei*	+	-	+
17	*S. gratiana*	+	+	+
18	*S. juergensii*	+	-	+
19	*S. jugalis*	+	-	+
20	*S. longata*	+	-	+
21	*S. majuscula*	+	-	+
22	*S. micropunctata*	+	-	+
23	*S. mirabilis*	+	-	-
24	*S. nitida*	+	-	+
25	*S. orientalis*	+	-	-
26	*S. occidentalis*	+	-	+
27	*S. pratensis*	+	-	+
28	*S. proticalis.*	+	-	+
29	*S. rectangularis*	+	-	+
30	*S. parvula*	+	-	+
31	*S. spreeiana*	+	-	+
32	*S. scrobiculata.*	+	-	+
33	*S. stictica*	+	-	-
34	*S. subsalsa*	-	-	+
35	*S. varians*	-	-	+
36	*S. teodoresci*	-	-	+
37	*S. weberii*	-	-	+

Table 2. Percentage of occurrence of the species of *Spirogyra* at three selected sites

S. No.	Selected Sites	No. of Species	Percentages
1	Unpolluted	30	81.1
2	Slightly polluted	32	86.48
3	Highly polluted	4	10.81

The chemical analysis of water samples showed that the concentrations of Caco3 at unpolluted, highly polluted and slightly polluted sites were 164, 245 and 188mg/L respectively (Figure 3). *Spirogyra* was also a dominant genus in trems of species recorded by [18-20], stated that chlorophyceae is a major class with species, majority of which belong to genus *Spirogyra* the most common genus, which agree with our findings. Similarly [21-24], also reported *Spirogyra* a leading genus with speices which supports our present data. *Spirogyra* is the most frequent genus of freshwater green algae. The green, unbranched filaments of this genus occur in a wide variety of habitats, including lakes, rivers, streams, and temporary ponds [25-27].

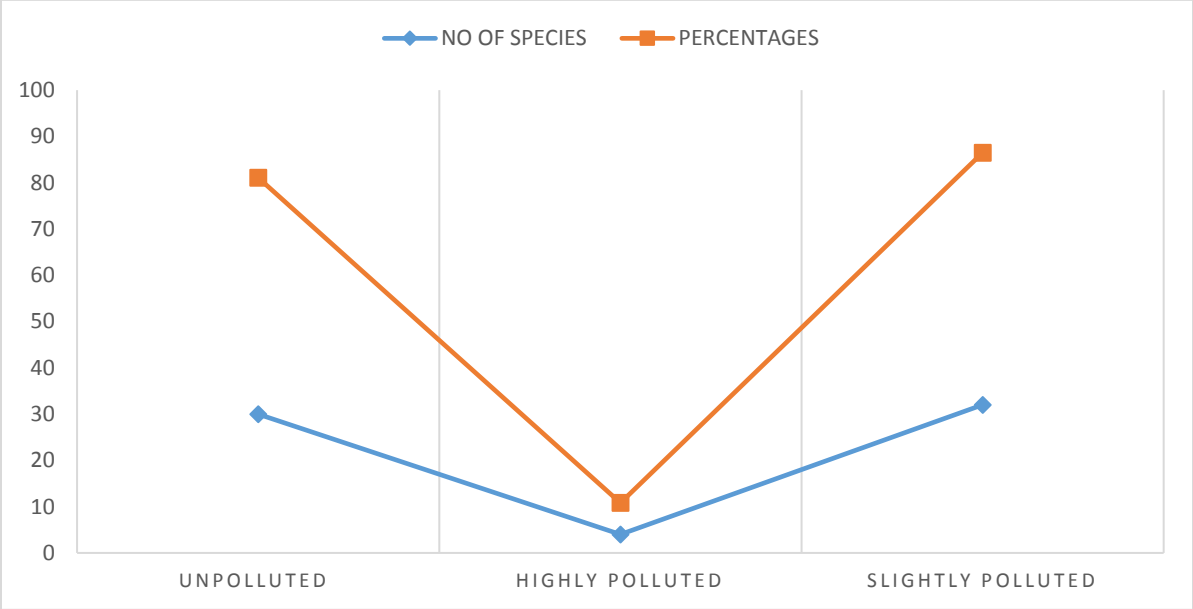
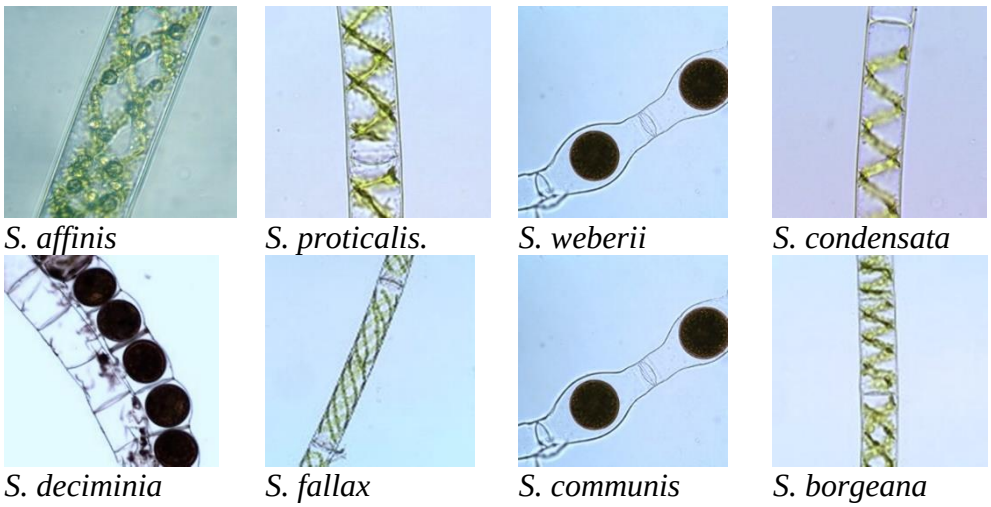


Figure 1. Number of species relation to sites chemical profile in the unpolluted, slightly and highly polluted waters



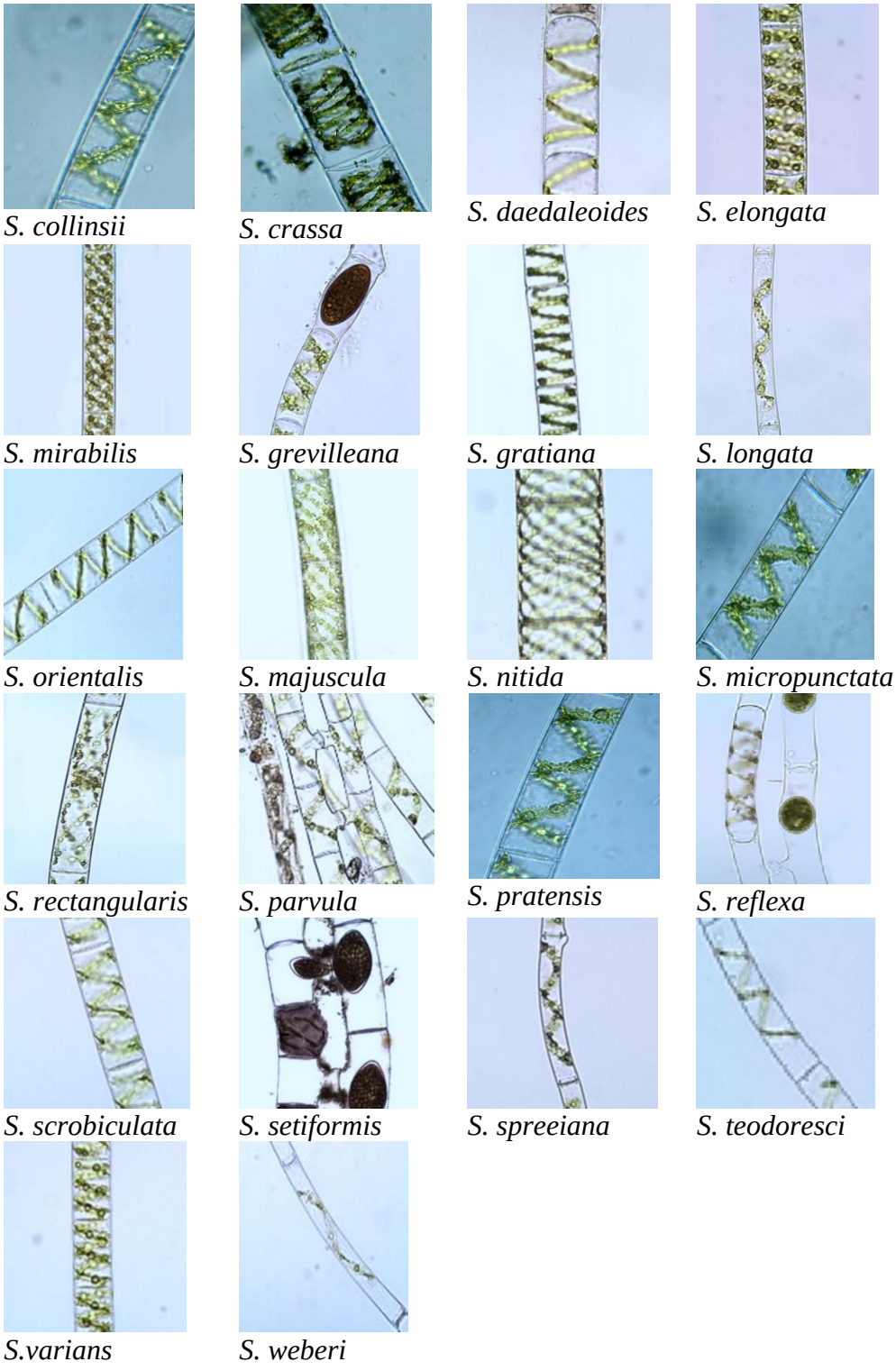


Figure 2. Pictures of the different species of *Spirogyra* identified from the research area

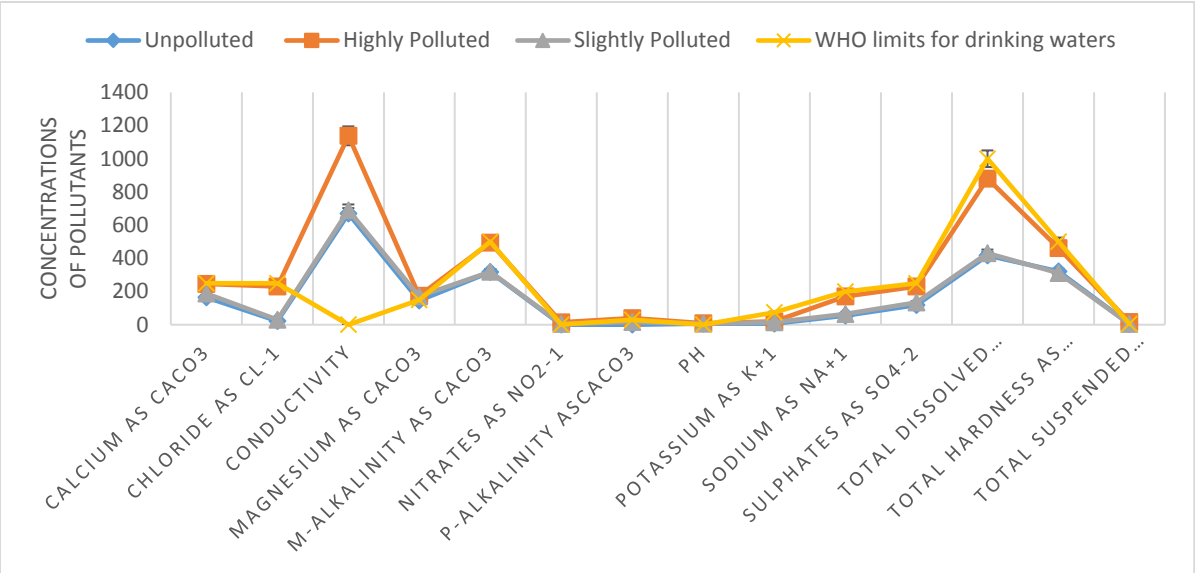


Figure 3. Analysis of the Chemical Components of the selected water samples in comparison to WHO standards

Conclusion

It was concluded in the current research work that *Spirogyra* has a wide distribution in the selected research sites. It is represented by a number of species. Similarly the distribution and diversity of the species in the genus *Spirogyra* in the research area is profundly affected by the habitat pollution levels i.e. unpolluted, slighlty polluted and highly polluted.

Authors' contributions

Conceived and designed the experiments: KRehman, S Wali & I Khuram, Performed the experiments: K Rehman, T Yaseen & L Farooq, Analyzed the data: S Wali, I Khuram, T Yaseen & L Farooq, Contributed materials/ analysis/ tools: K Rehman, S Wali & I Khuram, Wrote the paper: K Rehman, S Wali, I Khuram & L Farooq.

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