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CONIDIAL DISTRIBUTION OF FRESHWATER HYPHOMYCETES OF AN IRANIAN RIVER: ZAYANDE-ROUD

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Abstract

There is no published report regarding Iran's aquatic hyphomycetes. In an attempt to identify species of aquatic hyphomycetes in a river in central Iran (Zayande-Roud River), conidial frequency and distribution were determined by filtration. Water samples were collected monthly from two stations 55 km apart and filtered through millipore filters (5 um pore sizes). This was carried out for seven months starting in March 1990. Species identified are as follows: *Alatospora acuminata, Anguillospora* sp. 1; *Clavariopsis aquatica, Lunulospora curvula, Tetracladium marchalianum, Tricladium* sp. and *Vargamyces aquaticus*. Except for *T. marchalianum*, which was not present on filter papers after March, all other species were present at least till May with *Anguillospora* sp. 1 and *V. aquaticus* being recorded in August. Conidial frequency declined steadily from March through September. This might relate to declining organic resources available in the river.

Introduction

Organic matters of plant origin entered into streams provide a substantial source of fixed carbon available to fungi and other heterotrophs. Aquatic hyphomycetes colonize submerged organic matters, degrade them, and contribute to energy recycling in the stream's ecosystem. Although frequent reports of aquatic hyphomycetes from different countries are known [1-13], no report has been published regarding these fungi in Iran. This study was undertaken to survey and determine conidial frequency and distribution of species of hyphomycetes in a river in central Iran.

Materials and Methods

Description of the Sampling Area

Two stations were selected at a distance of 55 kilometers extending from the west to the east of the city of Isfahan in central Iran. Locations of these stations were: Station PK (Pole-Kaleh) 55 km to the west and station PB (Pole-Bozorgmehr) inside the city of Isfahan. The respective altitudes of these stations were 1725 and 1573 meters above sea level. Vegetation around the stations included various herbs and different planted tree species. There were six dominant plant species in station PK of which four tree species were in common with station PB. The density of trees was higher in station PK and reduced downstream as one moved toward the city. Tree species occurring in station PK were: *Elaeagnus angustifolia* L.; *Morus alba* L.; *Platanus orientalis* L.; *Populus alba* L.; *Salix babylonica* L.; and *Populus euphratica* Olive. The last four species of trees also grew in station PB.

Water discharge rate was 33 m^3 per second in station PK and reduced to 20 m^3 per second in station PB.

Keywords: Freshwater fungi; Hyphomycetes; Iranian fungi

Sampling

Water samples were taken to the laboratory of the Water Treatment Facilities of Isfahan to determine water quality in each station.

Water was filtered through millipore filters (5 um pore sizes) placed on a filtering unit as described by Iqbal and Webster [5]. In each station, five replicates of 750 ml water was filtered every month for seven months (March through September). Filter papers containing conidia were fixed in lactophenol cotton-blue in the field to be examined later in the laboratory.

Results

Temperature, pH and other chemical properties of the water samples are presented in Table 1. There was a 3°C temperature difference between annual maximum temperature of stations (18 and 21°C, respectively), while minimum annual temperature in both stations was 1°C. In stations PK and PB, pH was nearly the same. Except for dissolved oxygen concentration which was greater in station PK, all other chemical parameters of water were greater in station PB (Table 1).

The following seven species of freshwater hyphomycetes were identified on filter papers: *Alatospora acuminata* Ingold; *Anguillospora* sp. 1; *Clavariopsis aquatica* de Wilde; *Lunulospora curvula* Ingold; *Tetracladium marchalianum* de Wilde; *Tricladium* sp; and *Vargamyces aquaticus* (Dod.) Toth (Table 2).

Table 1. Physical and chemical properties of water in the Zayande-Roud River at two stations: Pole-Kaleh (PK) and Pole-bozorgmehr (PB)

Parameter	PK	PB
Temperature (C)	18 (1) *	21(1)
PH	8.05	7.97
Dissolved oxygen (mg/1)	9.3	6.6
Ca^{++} (mg/1)	140.0	215.0
SO_4^{--} (mg/1)	44.4	82.3
Cl^- (mg/1)	14.2	49.7
NO_2^- (mg/1)	0.18	0.46
NO_3^- (mg/1)	6.19	12.39

* Numbers in parentheses are minimum annual temperature.

Species were more abundant at station PK than station PB throughout the study period (Fig. 1). The number of species declined steadily in station PK (from seven species in March to one species in September). The monthly abundance of species at station PB, however, increased to

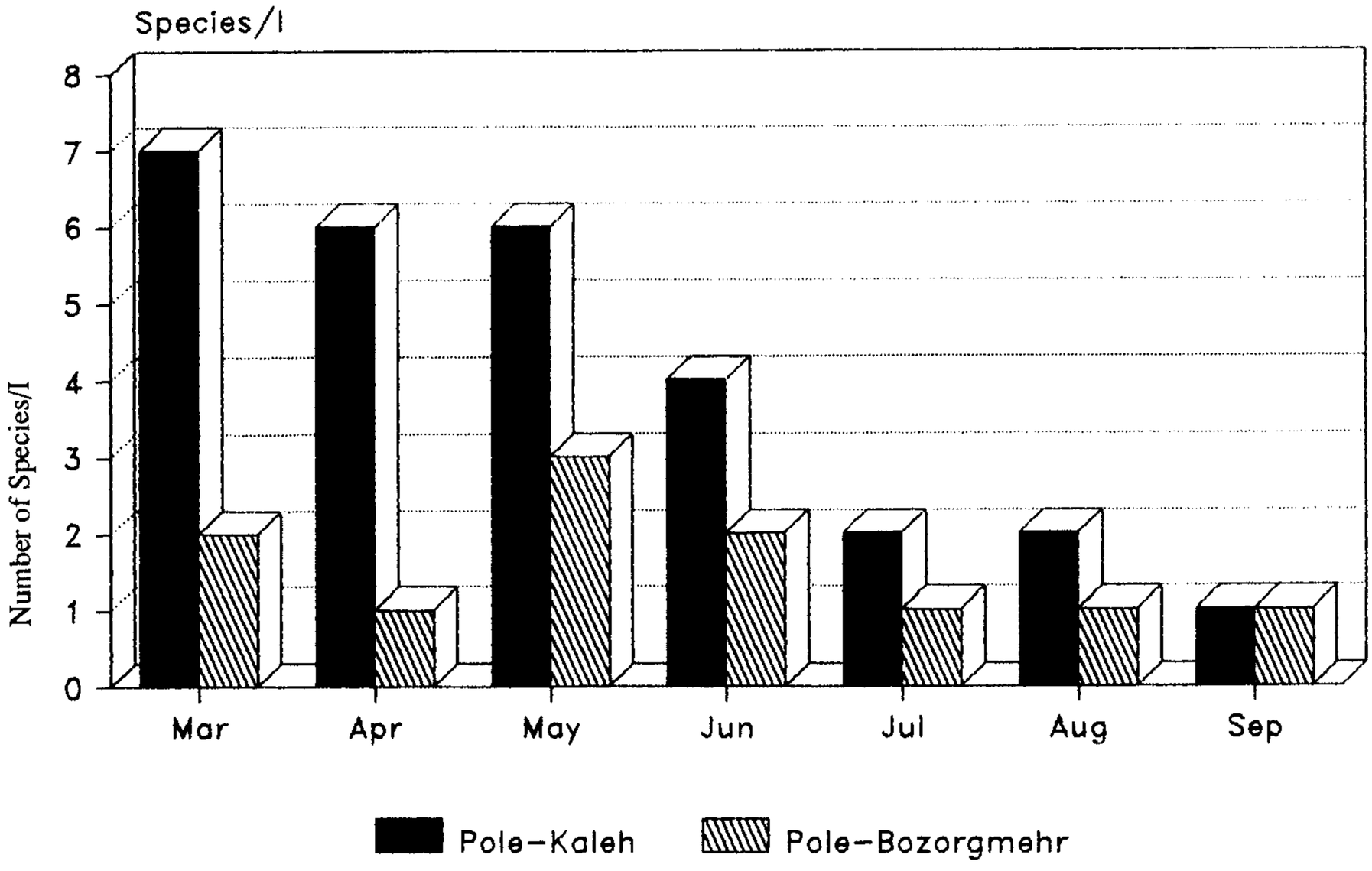

Figure 1. Richness of species at PK and PB in different months

Table 2. Presence (12) or absence (–) of aquatic hyphomycetes species in the Zayande-Roud River at stations Pole-Kaleh (1) and Pole Bozorgmehr (2), from March to September

Species	Month						
	Mar	Apr	May	Jun	Jul	Aug	Sep
Alatospora acuminata	1	1	1	1	–	–	–
Anguillospora sp. 2	12	12	12	12	12	12	12
Clavariopsis aquatica	1	1	1	–	–	–	–
Lunulospora curvula	1	1	12	1	–	–	–
Tetracladium marchalianum	1	–	–	–	–	–	–
Tricladium sp.	1	1	1	–	–	–	–
Vargamyces aquaticus	12	1	12	12	–	1	–

its maximum in June (3 species) and reduced to one species in September.

Except for *T. marchalianum*, which was not present on filter papers after March, all other species were present till at least May, with *Anguillospora* sp. 1; and *V. aquaticus* being recorded in August (Table 2).

Conidial frequency declined steadily from a total of 68 conidia per liter of water in March to three conidia in September in station PK and even fewer in station PB (Fig. 2).

Discussion

Most of the species reported here have a universal distribution and are reported from different parts of the world. However, the number of hyphomycetes reported from the Zayande-Roud River is comparatively fewer than the number of species reported from other temperate streams. Shearer and Webster [9] reported 60 species of aquatic hyphomycetes from the river Teign, 12 of which had been identified through filtration and 48 of which had been observed on leaves. However, the number of species

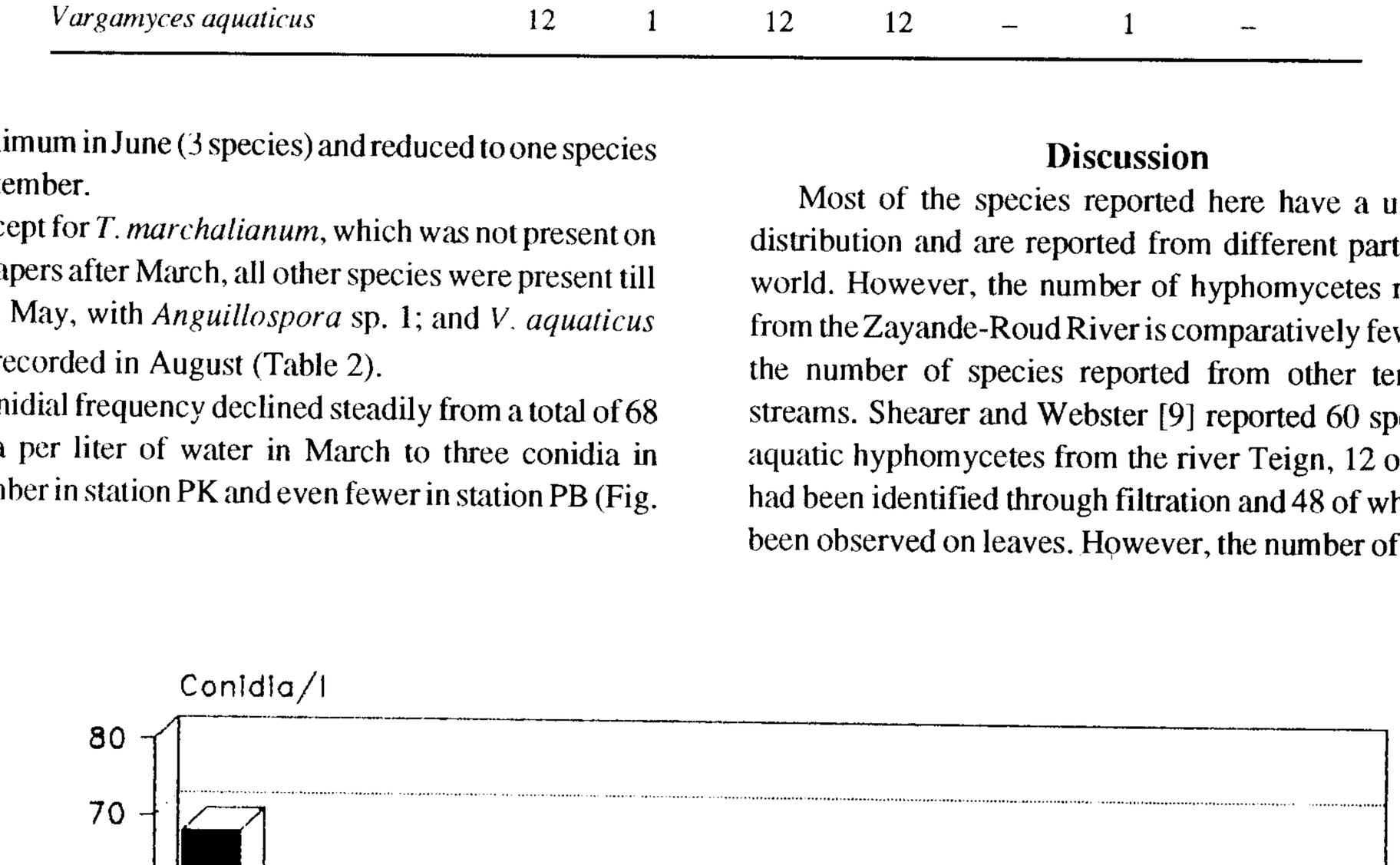

Figure 2. Total conidia/l at stations PK and PB in different months

reported from other rivers is far fewer than the number of species reported from the river Teign. For instance, Ackridge and Koehn [10] reported 13 species of hyphomycetes from the San Marcos River in Texas, and Metwalli and Shearer [14] named 12 species from a stream in Illinois.

Barlocher [15] reported that the number of species declined sharply in streams with a pH greater than 7. Thus, the fact that the number of species in the Zayande-Roud River is relatively low may be due to its basic pH of 8.

The greater number of species in station PK may be attributed to the denser tree cover in this station. Denser vegetation cover in station PK may have also contributed to a greater number of conidia per liter of water in this station. This is in agreement with the findings of Metwalli and Shearer [14] which indicated a greater number of conidia from a wooded area than in a clear-cut part of the stream. Furthermore, temperature may also be important in the degree of sporulation of species identified. Temperature differences between station PK (with an altitude of 1723 m above sea level) and station PB (with an altitude of 1575 m above sea level) is about 3°C which is in the tolerant range of species growth (all species grew at temperatures between 10 to 25°C on corn meal agar in the laboratory).

The minimum temperature of water in stations PK and PB was 18° and 21°C, respectively. Considering the fact that these species sporulate at 17 ± 2°C, a greater number of conidia in station PK is to be expected.

The general trend of monthly decline in the number of conidia observed on the filter papers, as well as the number of species recorded, may be attributed to: (1) a decline in the availability of organic resources, such as fallen leaves in streams; (2) the chemical characteristics of the Zayande-Roud River which make it a hard water river; (3) changes in the chemical properties of the water due to changes in the amount of precipitation or run-offs; (4) the adaptation of species to sporulate at temperatures between 15 to 19°C and (5) the inadequacy of the sampling method which relied solely on recording conidia floating in the water.

It is known that species of aquatic hyphomycetes are generalists [16, 17] and can colonize submerged leaves and twigs. Many of them are substrate selective and prefer one kind of tree leaf over another. However, substrate selectivity does not explain the existing differences in the richness of species between stations. In spite of the fact that there are four dominant tree species common to both stations PK and PB, differences in the monthly abundance of species and differences in fungal community structure may be due to lower dissolved oxygen concentrations and also higher concentrations of chemical ions, such as Ca^{++}, SO_4^{--}, Cl^-, NO_2^- and No_3^- in the latter. This view is supported by findings in a separate sampling of a station 10 km to the east of the city of Isfahan. In this station, where treated city waste-water is routinely released into the Zayande-Roud River, the water quality was poor and contained almost no dissolved oxygen. There were no species of hyphomycetes on filter papers at this station (unpublished data).

Species of freshwater hyphomycetes require well aerated streams throughout the year [18] in order to reach their optimal growth and sporulation. However, many species of aquatic hyphomycetes display seasonal variation in their occurrence. For example, *L. curvula*, is known as a fall species and occurs mostly in the colder months of the year.

Although the possible ecological role of aquatic hyphomycetes has been indicated in many reports [16, 19, 20 - 23] the study of their distribution and factors affecting their occurrence may enable us to deter environmental problems, e. g. water pollution, facing aquatic habitats.

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