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## Monthly and vertical fluctuations of aquatic fungi at different depths in Aswan High Dam Lake, Egypt

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Seventeen aquatic fungi were identified in water samples collected from Aswan High Dam lake (AHDL) during the period November 1992 to October 1993. Monthly and vertical (from surface to 20 m depth) samples were taken to determine fluctuations of these fungi in the lake (10 km south of Aswan High Dam). The physicochemical characteristics of the collected water samples were also taken. The fungal population showed marked vertical variations during the period of study. Surface water samples yielded the highest number of aquatic fungal genera and species (8 genera, 13 species), while water samples collected from near the bottom (16-20 m deep) were poor (3-4 genera or species). This reduction in fungal taxa, correlated markedly with the reduction in the amount of dissolved oxygen and organic matter. The most common genera were *Achlya*, *Aqualinderella*, *Pythium* and *Saprolegnia* (moderate occurrences), whereas *Allomyces*, *Aphanomyces*, *Dictyuchus* and *Pythiopsis* were of rare occurrence and irregularly distributed in vertical strata.

**Key words:** aquatic phycocomycetes, freshwater fungi.

### Introduction

Zoosporic fungi from different water habitats have been studied in many parts of the world by numerous researchers (Ziegler, 1958; Suzuki, 1960; Roberts, 1963; Srivastava, 1967; Alabi, 1971a,b, 1973, 1974; Hunter, 1975; Hasiya and Batra, 1978; El-Hissy, 1994). In Egypt, zoosporic fungi have been isolated and studied from waters of the River Nile, Ibrahimia canal, in some ponds and irrigation canals (El-Hissy, 1974; El-Hissy *et al.*, 1982; El-Nagdy and Abdel-Hafez, 1990; El-Nagdy and Khallil, 1991; Khallil *et al.*, 1991). The terrestrial fungal flora of Aswan High Dam Lake (AHDL) have been studied by El-Hissy *et al.* (1990) and Moharram *et al.* (1990). The present work aims to study the vertical and monthly fluctuations of zoosporic fungi in Khore Manam (AHDL).

## **Materials and methods**

### ***Collection of water samples***

A water sampler (Reversing Nensen Bottle) was used for the collection of the monthly water samples from the various vertical strata of Khor Manam. Samples were collected from the surface, 1, 2, 4, 6, 8, 10, 12, 16 and 20 m deep and kept in sterile (10 km south of Aswan High Dame Lake) bottles (500 mL capacity which contain number of sterile sesame seeds) and transferred to the laboratory in less than two hours (Fig. 1).

### ***Physico-chemical analysis of the collected water samples***

Water temperature and pH values were measured in the field. Other physico-chemical characteristics such as total soluble salts (T.S.S.), organic matter and dissolved oxygen were determined in the laboratory as previously described by (El-Hissy *et al.*, 1990).

### ***Determination of zoosporic fungi***

For the recovery of aquatic fungi, the water samples inside bottles containing sesame seeds were poured into Petri-dishes (12 cm diam.). These plates (4 plates) were left overnight at room temperature to allow colonization of seeds by aquatic fungi (El-Hissy and Khallil, 1989). After 24 hours the colonized sesame seeds were transferred into other sterile Petri-dishes which contained sterilized lake or distilled water and crystalline penicillin (to inhibit bacterial growth) (Roberts, 1963), and incubated at  $22 \pm 2$  C for 6 weeks. The colonized seeds examined weekly and identified.

## **Results and discussion**

### ***Changes in the physico-chemical characteristics***

Water temperature exhibits regular monthly variations and ranged from 15.6 to 27.6 C at the surface and from 15.1 to 26.5 C at 20 m depth (Fig. 2). The minimum temperatures were recorded in February, 1993 at the surface, while the maximum was recorded in August, 1993. During the whole sampling period, also the temperature regularly decreased with depth and this is in agreement with that obtained by Ahmed *et al.* (1989), Shoreit *et al.* (1989) and Moharram *et al.* (1990) working on the water from AHDL.

The pH showed slight and irregular variations both vertically or monthly. The lowest pH (5.9) was measured at 20 m depth and the highest (9.5) at the surface, 1 and 2 m. The relatively high values of pH in surface waters during the whole period of study might be due to the photosynthetic activity of phytoplankton (El-Wakeel and Wahby, 1970). The decreases in pH in bottom water could be due to the decomposition of descending plankton and organic

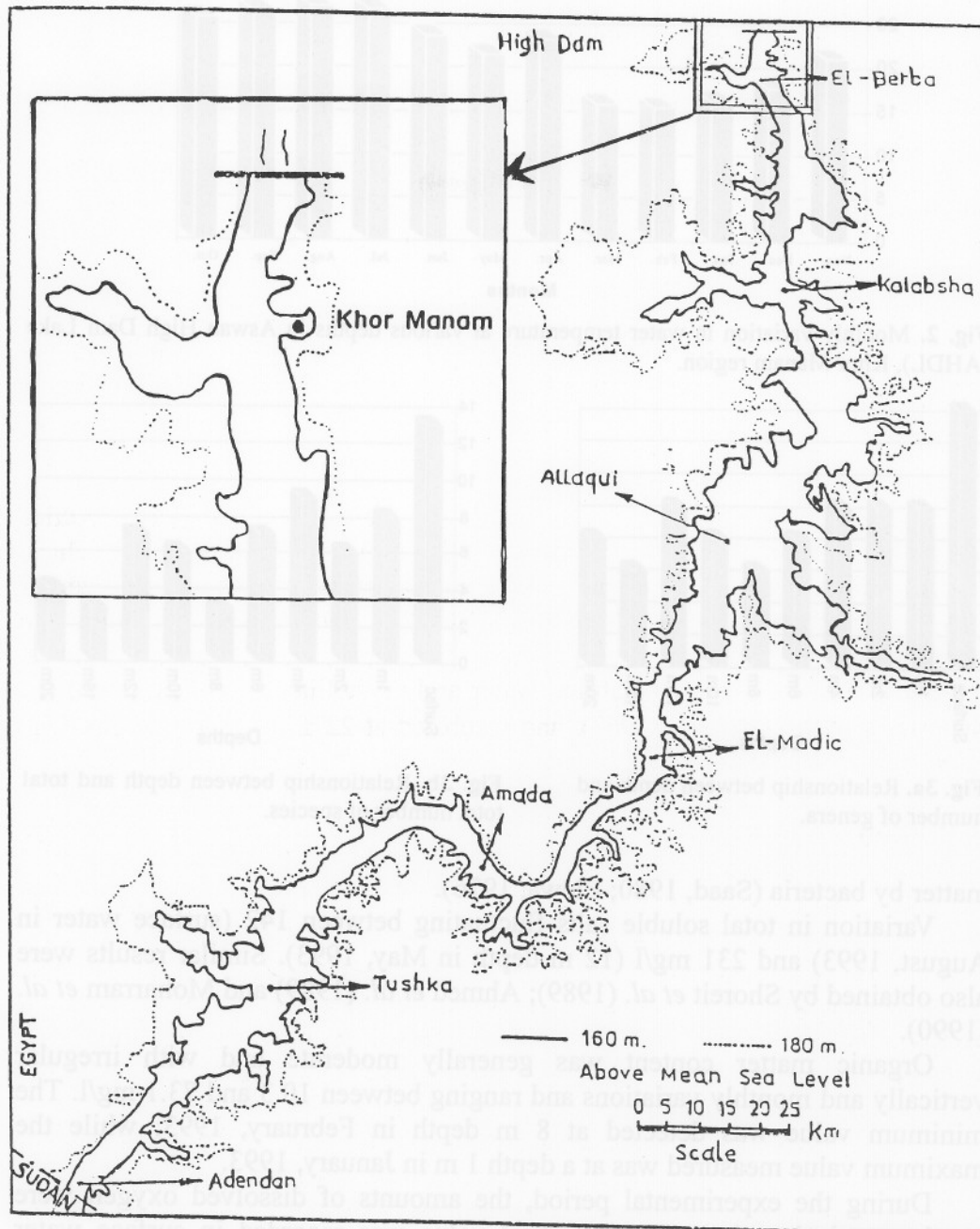
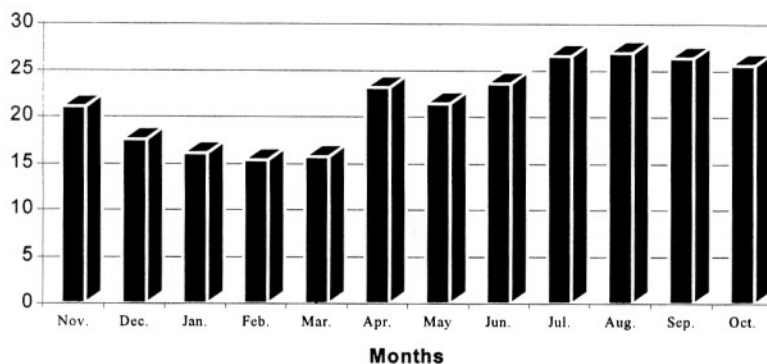
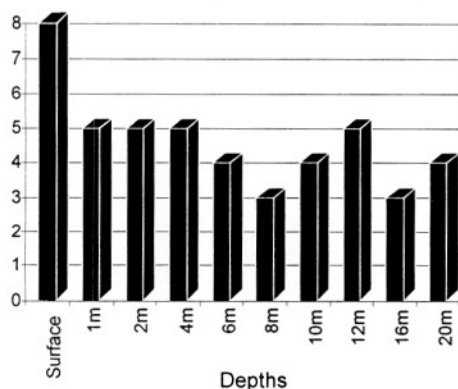


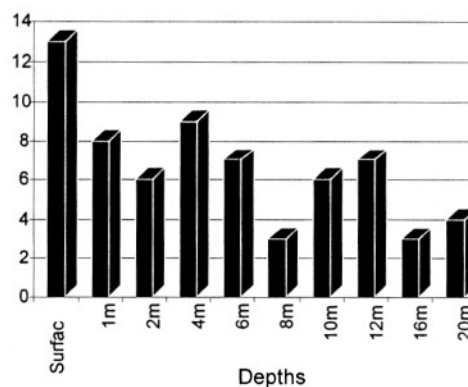
Fig. 1. Map of Aswan High Dam Lake and the study areas at Khor Manam region.



**Fig. 2.** Monthly variation in water temperature at various depths in Aswan High Dam Lake (AHDL), Khor Manam region.



**Fig. 3a.** Relationship between depth and number of genera.



**Fig. 3b.** Relationship between depth and total number of species.

matter by bacteria (Saad, 1980; Elewa, 1976).

Variation in total soluble salts fluctuating between 142 (surface water in August, 1993) and 231 mg/l (12 m depth in May, 1993). Similar results were also obtained by Shoreit *et al.* (1989); Ahmed *et al.* (1989) and Moharram *et al.* (1990).

Organic matter content was generally moderate and with irregular vertically and monthly variations and ranging between 10.3 and 73.1 mg/l. The minimum value was detected at 8 m depth in February, 1993; while the maximum value measured was at a depth 1 m in January, 1993.

During the experimental period, the amounts of dissolved oxygen were regular vertical variations, the highest value was recorded in surface water samples and the lowest at the 20 m deep. The maximum value of dissolved oxygen 10.5 mg/l was recorded in March 1993; while the minimum 3.4 mg/l

**Table 1.** Frequency of occurrence of aquatic fungi (out of 120 water samples) recovered monthly from different depths in Aswan High Dam lake (Khor Manam region).

Fungi	NCI <sup>1</sup>	Total percentage	OR <sup>2</sup>
<i>Achlya dubia</i> Coker	1	0.83	R
<i>A. proliferoides</i> C.G.Nees	5	4.16	R
<i>Achlya</i> sp.	11	9.16	R
<i>Allomyces anomalus</i> Emerson	4	3.33	R
<i>A. moniliformis</i> Coker and Braxton	2	1.66	R
<i>Aphanomyces scaber</i> de Bary	1	0.83	R
<i>Aqualinderella fermentans</i> Emerson and Weston	42	35.0	M
<i>Dictyuchus sterilis</i> Coker	5	4.16	R
<i>Pythiopsis cymosa</i> de Bary	6	5.00	R
<i>P. humpheryana</i> Coker	1	0.83	R
<i>Pythium deparyanum</i> Heese	3	2.50	R
<i>P. pulchrum</i> Minden	5	4.16	R
<i>P. rostratum</i> Butler	4	3.33	R
<i>P. thalassium</i> Atkins	2	1.66	R
<i>P. ultimum</i> Trow	3	2.50	R
<i>P. vexans</i> de Bary	3	2.50	R
<i>Saprolegnia ferax</i> (Gruith) Thuret	9	7.50	R
<i>S. hupogyna</i> (Pringsheim) de Bary	5	4.16	R
<i>Saprolegnia</i> sp.	18	15.0	L
<i>Flagellospora penicilloides</i> Ingold	13	10.83	R

<sup>1</sup> NCI = Number of cases of isolation;

<sup>2</sup> Occurrence remarks (OR): M = moderate occurrence (30-59 cases); L = low occurrence (15-29 cases); R = rare occurrence (<15 cases).

was measured at the depth of 20 m in January, 1993. Similar results were reported by Shoreit *et al.* (1989) and Moharram *et al.* (1990) working on the water of Aswan High Dam Lake.

#### ***Aquatic fungi recovered on sesame seeds***

Seventeen of aquatic fungi were identified which belong to 8 genera while 2 species were unidentified (Table 1).

Surface water samples yielded the highest number of aquatic fungi (8 genera, 13 species), while only a few species were collected near the bottom (16, 20 m deep, 3-4 genera and species each) (Figs. 3a,b). The reduction in the number of genera and species near to the bottom correlated markedly with the reduction in the amounts of dissolved oxygen and organic matter content (Fig. 4).

*Aqualinderella fermentans* was the most common species (42 samples; 35% water samples). This species was collected with variation of occurrence

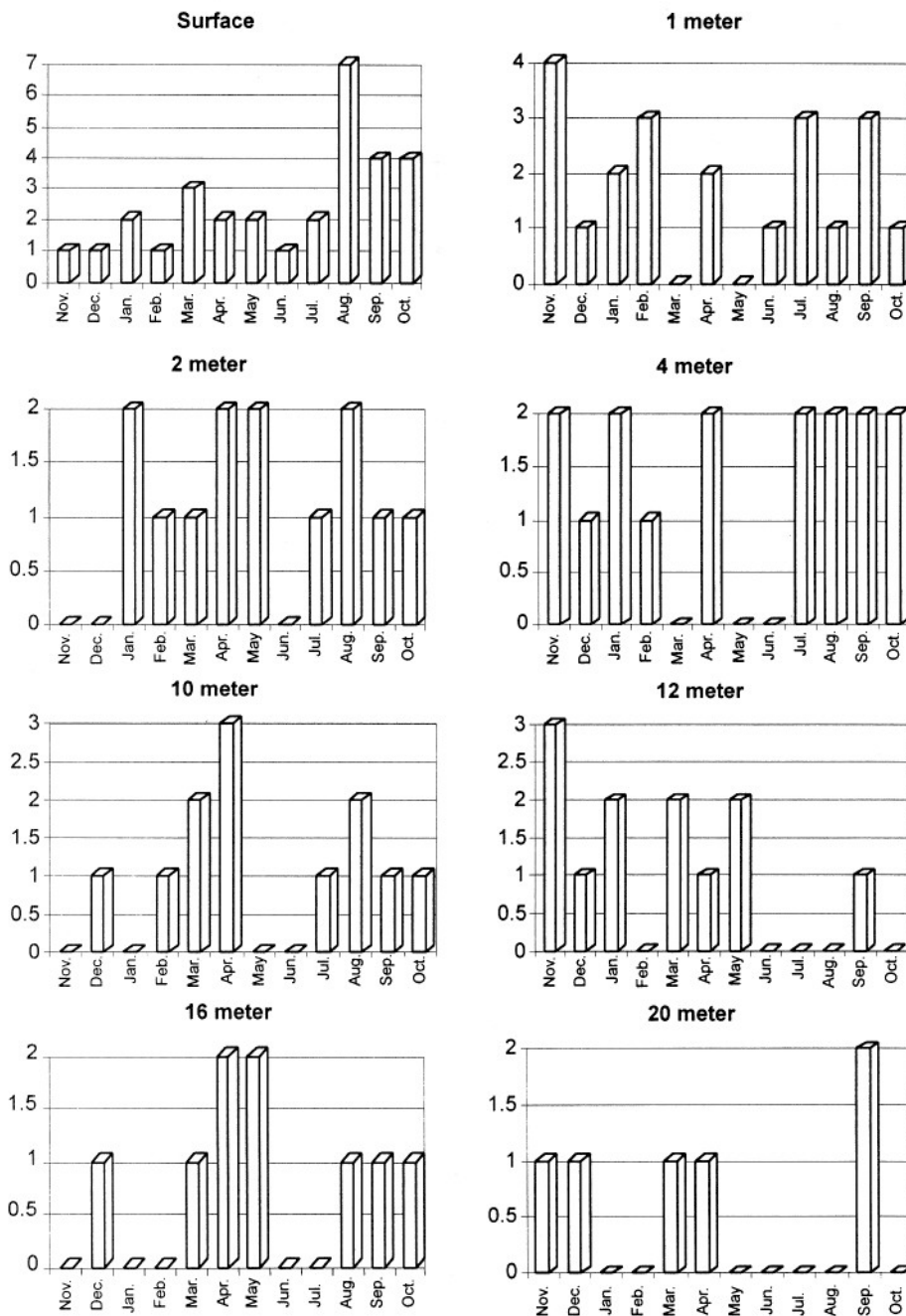


Fig. 4. Monthly occurrence and number of species at various depths.

during the experimental period.

*Saprolegnia* was the second most common aquatic fungal genus (30 samples; 25% water samples). This genus occupied most vertical depths of AHDL but it was more frequent in the upper than lower depths. It was represented by *S. hypogyna* and *S. ferax* in addition to one unidentified species. The broadest spectrum of *Saprolegnia* species was recorded during the low temperature months.

*Pythium* was also of moderate occurrence (18 samples and 15% of water samples). It was recovered from most of the depths (6 species) specially during July-September, 1993 and it was of less frequent in deep than in surface water.

*Achlya* (15 samples and 12.5% water samples) appeared intermittently in six months of the experimental period and it was dominant during November and October, 1993. This genus was represented by *Achlya proliferoides*, *A. dubia* and *Achlya* sp. that were mostly recovered from surface and subsurface water of the lake.

The following genera were of rare occurrence: *Allomyces*, *Aphanomyces*, *Dictynchus*, and *Pythiopsis*. *Pythiopsis* (2 species) was recovered from surfaces, 1 and 2 m depth during the period from June to September, 1993. The other three genera were represented by 2, 1 and 1 species respectively and were irregularly distributed in some depths of the lake.

All aquatic zoosporic fungi identified during this investigation were previously isolated from water sources in Egypt (El-Hissy, 1974; El-Nagdy, 1981; El-Hissy, *et al.*, 1982; Khallil, 1984; El-Nagdy and Abdel-Hafez, 1990; El-Nagdy and Khallil, 1991; Khallil, *et al.*, 1991) and different parts of the world (Höhnk and Bock, 1954; Ziegler, 1958; Suzuki, 1960; Roberts, 1963; Srivastava, 1967; Alabi, 1971a,b, 1973, 1974; Waterhouse, 1972; Hunter, 1975; Hasija and Batra, 1978; Ismail *et al.*, 1979; Khulbe, 1980; Rattan *et al.*, 1980; Misra, 1980; Klich and Tifany, 1985; El-Hissy, 1994).

It is worthy to mention that *Flagellospora penicilloides* (mitosporic fungus) appeared intermittently at most vertical strata of AHDL. This fungal species flourish during October 1993 where it appeared at the depth ranging from 1-10 m below the surface of the lake. It was also recovered with high occurrence from the River Nile in Egypt by Khallil *et al.* (1993).

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