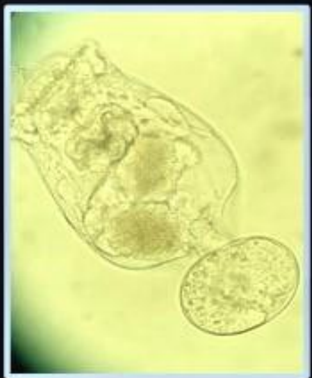




OF THE INLAND WATERS OF BASRAH,
FOLLOWING THE 2003 MARSHLANDS RESTORATION PROJECT

BIODIVERSITY

OF THE INLAND WATERS OF BASRAH

FOLLOWING THE 2003 MARSHLANDS RESTORATION PROJECT

(AN OVERVIEW)

Editor-in-Chief
Dr. Malik H. Ali

Editors
Dr. Salman D. Salman, Dr. Nadir A. Salman
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2021

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Dar Al-Fikr

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Editor-in-Chief
Dr. Malik H. Ali
Marine Science Center, University of Basrah, Basrah- Iraq
https://orcid.org/ 0000-0001-5139-6795

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Cover Designed by:
Assist. Lecturer Zinab J. Auda

Dar Al-Fikr

Iraq, Basrah, Al-Matabah Street, Al-Ali Building
Mobile: 07801019408; 07801831250; 07728324850
Email: univpress2004@yahoo.com

Contributors

Prof.Dr. Abdul Hafith A. Al-Duboon & Lacturer Fadhil J. Farhan……. ……………………………………………………………………………………………Mycoflora

Prof. Dr. Adil Y. Al-Handal……………………………………………………. Diatoms

Prof. Dr. Abdul Ridha A. Al-Mayah, Prof. Dr. Taha Y. Al- Eidani………. ………………………………………………………………………………… Macrophytes

Assist. Prof. Hanaa H. Mohammed, Prof. Dr. Salman D. Salman &

Dr. Mohammed F. Abbas……………………………………………. Zooplankton

Prof. Dr. Malik H. Ali & Prof. Dr. Huda K. Ahmed……………….. Rotifera

Prof. Dr. Malik H. Ali, Prof. Dr. Huda K. Ahmed & Assist. Prof. Hanaa H. Mohammed …………………………………………………………… Crusteasa

Prof.Dr. Ibtisam M. Abdul Sahib………………………………………. Mollusca

Prof. Mustafa A. Al-Mukhtar & Prof. Dr. Thamer S. Ali…………………… ……………………………………………………………………Pisces & Ichthiology

Prof. Dr. Nadir A. Salman……………………………………………………….Birds

Prof. Dr. Nadir A. Salman……………………………Reptiles & Amphibians

Prof. Dr. Nadir A. Salman……………………………………………….Mammals

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PREFACE

Biodiversity is a fascinating subject of the science ecology. The number of species in any habitat is highly related to the thermal zone and the topography of the region. On the other hand, the biodiversity indices are currently used as a practical measure to the health of ecosystems and the impact of ecosystems changes on biological species.

The purpose of this work was mainly an identifying and documentary step for the state of the flora and fauna of the aquatic habitats in Basrah marshes and Shatt al-Arab River system, focusing on the period 2004-2005, Shortly after 12 years of rapid ecological changes due to the crime of the Marshes devastating by the previous Saddam regime.

After the removal of Saddam regime (2003), great international attention has been given to the restoration of the southern Iraqi Marshes for their historical and ecological significance. Marine Science Center of the Basrah University was the major participating Iraqi national institution which play a basic role in various marshes restoretion activities.

Prof. Dr. Malik H. Ali

CONTENTS

CHAPTER ONE

MYCOFLORA

Abdul-Hafiz Al-Duboon[1] and Fadhil J. Farhan[2]

[1]Dept. of Marine Biology, Marine Science Center,
Univ. of Basrah, Iraq.
[2]Dept. of Natural Marine Science, College of Marine Science,
Univ. of Basrah, Iraq.

Introduction

Wetlands as defined by the Ramsar conversion (Ramsar, Iran, 1971) include a wide variety of habitats such as marshes, peat lands, flood plains, rivers and lakes, and coastal areas such as salt marshes, mangroves, and sea grass beds, but also coral reefs and other marine areas no deeper than six meters and low tide, as well as human made wetlands such as waste water treatment ponds and reservoirs (Ramsar conversion secretariat, 2007). The mesopotamian marshlands are part of a major international river system, the Tigris and Euphrates; one of the great "cradles of civilization" and the largest river system in southwest Asia. The Mesopotamian marshlands, which until recently extended over an area of 15,000-20,000 km^2, have been devastated by the combined impact of massive drainage works implemented in southern Iraq in the late 1980s/ early 1990s and upstream damming. The general and Al-Hamar marshlands have completely collapsed with respectively 97% and 94% of their land cover transformed into bare land and salt crusts, while less than a third of the trans-boundary Hawr Al-Hawizeh/ Al-Azim remains. This remaining area is also under high risk of disappearing due to upstream activities, including the recently inaugurated Karkheh dam in Iran and associated water transfer designs to Kuwait and the planned Ileus dam in Turkey. In the Shatt Al-Arab estuary, decrease in freshwater flows has stimulated seawater instruction and disrupted its complex ecology (Partow, 2001).

After insects, fungi are the second largest group of organisms and according to the five kingdom system of Whittaker and Margulis (1978), fungi are placed in the kingdom Fungi, they have unusually wide morphological diversity and many life strategies which explain their enormous importance in evolution, the ecosystem, human progress, and most of the progresses that take place on the Gaia i.e. the Earth considered as a whole, the atmosphere, the oceans, biota and lithosphere (Hawksworth, 1979). Fungi are primarily terrestrial organisms, although a few are freshwater or marine called aquatic fungi, so aquatic fungi may be defined as, fungi normally completely submerged in large volumes of free water such as streams, rivers, ponds and lakes. Majority of lower Phycomycetes are aquatic in nature while few Ascomycetes and very few Basidiomycetes have been reported in aquatic habitat (Park, 1976). Fungi also form beneficial relationships with other organisms, but many are pathogenic and infect plants and animals. Animals are known to play an important role in the epidemiology of both animal and human mycoses. They can act as a reservoirs or vectors for these diseases (Ainsworth and Austwick, 1973; Rippon, 1982; Connole, 1990).

Because of the changes in the Southern Mesopotamian marshlands ecosystem due to the desiccation of water bodies in the southern marshes through a massive hydro-engineering program by the government from 1991-1995, and rehabilitation of the marshes started at 2003 - 2004, the present study has been carried out to show the diversity, occurrence and frequency of mycoflora in water and sediments of Shatt Al-Arab and southern Iraqi marshes (Basrah and Thi-Qar marshlands).

Materials and Methods

Water and sediment samples were collected from different stations at Shatt Al- Arab (Al-Sindibad Island, beginning and middle of Al-Baghdadia, Al-Bargah, Al-Kirmashia (Khwesa), and southern Iraqi mrashes(Lissan Ojayradah, Hor Majnon, Al-Udhaim, Abu Ziriq, Al-Soudah North, Al- Soudah South, Al-Baithah, Umm Al- Warid, and Umm Al-Niaj) (Fig. 1), at the period from January-2005 to , May-2007. Each sample was transferred to the laboratory and processed.

Water samples

1-For the isolation of the true aquatic fungi

Water samples were taken in 250 ml bottles from the surface (usually 10-20 cm below the surface), water samples were shaken and small volume (about 25 ml) from each sample was poured in 10 cm Petri dishes (in duplicates). Few previously sterilized and spilt sesame seeds were placed in each Petri dishes as bait. The Petri dishes were kept at 18 - 22°C then sesame seeds were examined after every 24 hrs for 5-7 days for any fungal growth that might have appeared (Rattan *et al.*, 1978; Al-Rekabi *et al.*,1996). The colonized baits were then washed with sterilized distilled water and transferred to fresh Petri dishes containing sterilized distilled water to which an antibiotic, chloramphenicol (250 mg/L) had been added. These colonized baits were incubated at room temprature (22°C) and the developing colonies were examined regularly and identified.

2-For the isolation of fungi other than the true aquatic fungi

One hundred ml of each water sample was filtered by using sterilized millipore filter papers (0.45 µm) then the millipore filter paper was placed on the surface of Potato Dextrose Agar (PDA) with chloramphenicol (250 mg/L) in Petri dishes and kept at room temperature until fungal colonies were appeared.

Sediments samples

Sediment samples were collected at a depth of 0.5 - 2 meter under the water surface, then brought to the laboratory and processed. Ten grams from each sample of sediment were mixed with 100 ml of sterilized distilled water in 250 ml conical flask by shaking gently to obtain a dilution of 1:10. Then 1 ml from this dilution was transferred to 9 ml of sterilized distilled water to obtain the dilution, 1:100 and by the same way the dilution of 1:1000 was obtained. Later, I ml from each dilution were transferred to a 10 cm Petri dishes containing unsolidified PDA + chloramphenicol (at about 45°C), rotated gently for mixing and left at room temperature to solidify then incubated at room temperature until fungal growth developed (Warcup,1950).

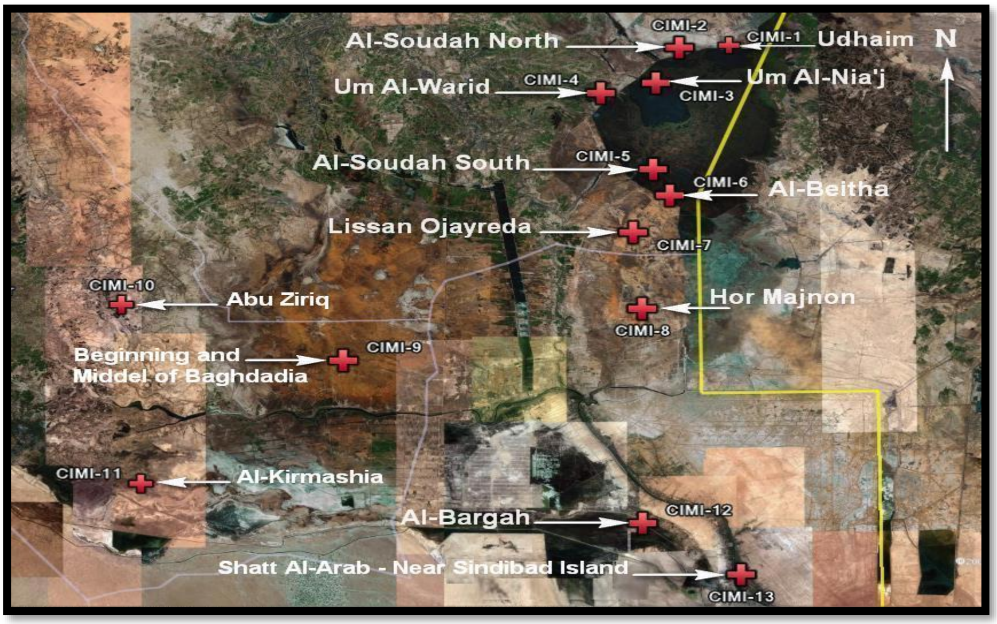

Fig.1. The map of sampling stations (www.googlearth.com)

The isolated colonies were examined and identified using the criteria of: Ellis,1971; Dick, 1973; Johnson,1974; Ellis, 1976; Frey *et.al.*, 1979; Domish *et al.*, 1980; Von Arx, 1981; Kregen-Van Rij, 1984; de Hoog & Guaro, 1995; and Klich,2002.

Percentage of occurrence and frequency for the genera and species of the isolated fungi were calculated as following:

$$\textit{Occurrence } \%(\mathrm{O}) = \frac{\textit{Number of samples from which the fungal genus or species were isolated}}{\textit{Total number of samples}} \times 100$$

$$\textit{Frequency } \%(\mathrm{F}) = \frac{\textit{Number of colonies of the isolated genus or species}}{\textit{Total number of colonies}} \times 100$$

Result

Fifty-five different fungal species belonged to eighteen genera of true aquatic fungi, and terrestrial fungi instead of sterile mycelia and unidentified yeasts, were isolated from water and sediments from different locations of Shatt Al-Arab and Southern Iraqi Marshlands (Table (1-13)). Most of the isolated fungi belonged to fungi imperfecti and many of these are known as opportunistic human pathogens, or true pathogens for animals and plants. The mostly occurred species in water samples were represented by; *Penicillium* sp.1, *Aspergillus niger* and *Alternaria alternat*a with a percentage of occurrence reached 100%, 92.31%, and 84.62% respectively, while the mostly occurred species in sediment samples were represented by; *Aspergillus terreus***,** *Penicillium* sp., and *Microascus* sp**.** with a percentage of 76.92%, 76.92%, and 61.54% respectively. The highly frequented species were in water samples represented by; *Penicillium* sp.1, *Aspergillus* sp. and *Acremonium* sp. with a percentage of 25.44%, 11.59%, and 9.98% respectively, while the mostly frequented species in sediment samples were represented by; *Alternaria alternat*a**,** *Cladosporium herbarum*, and *Cladosporium oxysporum* with a percentage of 11.11%, 6.08%, and 5.51% respectively (Table (14)).

Table 1: Fungal species which isolated from water and sediment samples of Al-Udhaim (CIMI- 1) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	*Achlya oblongata*	*Acremonium alabamense* (200), *Alternaria alternata* (200), Aspergillus *flavus* (100), *Penicillium* sp.1 (900), *Penicillium* sp.2 (100).	*Alternaria alternate* (20) *Aspergillus flavus* (200) *Aspergillus terreus* (200) *Cladosporium cladosporoides* (300) *Cladophialophora boppii* (150) *Penicillium* sp. (400) *Trichoderma* sp. (100) White Sterile Mycelia (10)
S.2	Nile	*Acremonium* sp.1 (100), *Acremonium* sp.2 (400), *Alternaria alternate* (500), Penicillium sp. (1000).	*Alternaria alternate* (100) *Aspergillus flavus* (10) *Cladosporium herbarum* (20) *Cladosporium cladosporoides* (600) *Microascus* sp. (10) *Penicillium* sp. (10) Yeasts (30) White Sterile Mycelia (10)
S.3	*Achlya oblongata*	*Acremonium alabamense* (100), *Alternaria* sp. (300), *Fusarium oxysporum* (400), *Penicillium* sp. (1200), *Rhizopus microsporus* (100), *Rhizopus stolonifer* (100), Yellow Sterile Mycelia (400).	*Aspergillus* sp. (10) *Cladosporium cladosporoides* (600) *Fusarium oxysporum* (100) *Penicillium* sp. (100) Yeasts (200)

Table 2: Fungal species which isolated from water and sediment samples of Al- Soudah North (CIMI-2) Southern Iraqi Marshlands.

Sits	**Water samples**		**Sediment samples (No. of colonies/1 gm)**
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	Nile	*Acremonium alabamense* (500), *Aspergillus niger (*200), *Penicillium* sp. (1400)	-
S.2	Nile	*Aspergillus niger (*200), *Fusarium oxysporum* (100), *Fusarium* sp. (400), *Penicillium* sp. (800). Yellow Sterile Mycelia (100).	-
S.3	Nile	*Aspergillus niger (*200), *Aspergillus flavus* (300) *Acremonium* sp.1 (500), *Acremonium* sp.2 (200), *Penicillium* sp. (600)	-

Table 3: Fungal species which isolated from water and sediment samples of Umm Al-Niaaj (CIMI-3) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	*Dictyuchus pseudodictyon*	*Acremonium alabamense* (500) *Aspergillus niger (*200) Yellow Sterile Mycelia (100).	*Acremonium alabamense* (10) *Aspergillus niger (*100), *Cladophialophora* sp. (100) *Fusarium oxysporum* (10) *Microascus* sp. (100) *Penicillium* sp. (200), Yeasts (300)
S.2	Nile	*Acremonium alabamense* (300) *Aspergillus niger* (100) *Penicillium* sp. (800) Yellow Sterile Mycelia (100).	*Acremonium alabamense* (90) *Acremonium* sp. (50) *Aspergillus terreus* (10) *Aspergillus flavus* (100) *Cladosporium cladosporoides* (1000) *Cladosporium herbarum* (500) *Exophiala jeanselme* (300) *Fusarium oxysporum*. (10), *Microascus* sp. (900) *Penicillium* sp. (30). White Sterile Mycelia (20). Yellow Sterile Mycelia (400).
S.3	Nile	*Alternaria alternata*. (100) *Acremonium alabamense* (900) *Microascus* sp. (100) *Penicillium* sp. (300)	*Acremonium* sp. (10) *Alternaria canicola* (10), *Cladosporium cladosporoides* (200) *Exophiala* sp. (40), *Microascus* sp. (400) *Penicillium* sp. (20). White Sterile Mycelia (80). Yellow Sterile Mycelia (400).

Table 4: Fungal species which isolated from water and sediment samples of Umm Al- Warid (CIMI-4) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	*Saprolegnia parasitica*	*Alternaria alternata*. (200), *Aspergillus terreus* (200) *Fusarium oxysporum*. (100) *Fusarium* sp. (200) *Penicillium* sp. (1300)	*Aspergillus niger* (20), *Aspergillus* sp. (10), *Aspergillus terreus* (600) *Penicillium* sp. (800). White Sterile Mycelia (700).
S.2	*Saprolegnia* sp.	*Penicillium* sp. (1300). *Rhizopus* sp. (300) White Sterile Mycelia (200). Yellow Sterile Mycelia (300).	*Acremonium* sp. (100), *Aspergillus terreus* (500) *Exophiala moniliae* (100) *Mucor hiemalis* (100) *Rhizopus* sp. (100) White Sterile Mycelia (700).
S.3	*Saprolegnia parasitica* *Saprolegnia ferax*	*Alternaria alternata*. (300) *Aspergillus niger* (200), *Aspergillus flavus* (100), *Fusarium* sp. (100) *Penicillium* sp. (800) Yellow Sterile Mycelia (400).	*Aspergillus niger* (700), *Penicillium* sp. (1000) Yeasts (1300) White Sterile Mycelia (1000).

Table 5: Fungal species which isolated from water and sediment samples of Al- Soudah South (CIMI-5) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	*Dictyuchus* sp. *Dictyuchus pseudodictyon*	*Alternaria* sp. (100), *Acremonium strictum* (600), *Aspergillus niger (*100), *Penicillium* sp. (900) Yellow Sterile Mycelia (800).	*Alternaria alternata* (10), *Aspergillus terreus (*30) *Aspergillus ochraceus* (10) *Microascus* sp. (110) *Penicillium* sp.1(10) *Penicillium* sp.2(10) White Sterile Mycelia (10).
S.2	*Achlya prolifera*	*Acremonium alabamense* (300), *Aspergillus niger (*200), *Penicillium* sp. (600). White Sterile Mycelia (200). Yellow Sterile Mycelia (400).	*Acremonium alabamense* (30), *Aspergillus flavus (*20), *Cladosporium cladosporoides* (500) *Microascus* sp. (10) *Penicillium* sp. (100) White Sterile Mycelia (30).
S.3	*Saprolegnia parasitica*	*Acremonium alabamense* (500), *Acremonium strictum* (300), *Penicillium* sp. (500) Yellow Sterile Mycelia (200).	*Aspergillus fumigatus (*100) *Acremonium* sp. (100) *Microascus* sp. (400) *Penicillium* sp. (600) Yeasts (300)
S.4	Nile	*Aspergillus niger* (300), *Acremonium* sp. (10) *Microascus* sp. (300)	*Aspergillus fumigatus (*100) *Acremonium* sp. (100) *Microascus* sp. (400) *Penicillium* sp. (600) Yeasts (300)

Table 6: Fungal species which isolated from water and sediment samples of Al-Baithah (CIMI-6) Southern Iraqi Marshlands.

Sits	**Water samples**		**Sediment samples (No. of colonies/1 gm)**
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	*Saprolegnia parasitica*	*Alternaria alternata*. (200), *Acremonium alabamense* (600), *Penicillium* sp. (600) Yellow Sterile Mycelia (200).	*Cladosporium cladosporoides* (100) *Cladosporium herbarum* (200) *Fusarium* sp. (10) *Scytalidium lignicola* (100) White Sterile Mycelia (200).
S.2	*Saprolegnia parasitica*	*Acremonium* sp. (300), *Penicillium* sp. (600). *Rhizopus stolonifer* (100)	*Aspergillus ochraceus (*100), *Cladosporium cladosporoides* (70) *Cladosporium* sp. (200) *Penicillium* sp. (20) Yeasts (2000) White Sterile Mycelia (50).
S.3	*Achlya oblongata*	*Acremonium alabamense* (1000), *Aspergillus niger (*100), Yellow Sterile Mycelia (200).	*Alternaria alternata*. (10) *Aspergillus terreus (*100) *Cladosporium cladosporoides* (200) *Cladosporium herbarum* (1100) *Fusarium oxysporum*. (100) *Microascus* sp. (10) *Penicillium* sp. (30) Yeasts (1000) White Sterile Mycelia (20).

Table 7: Fungal species which isolated from water and sediment samples of Lissan Ojayradah (CIMI-7) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	Nile	*Acremonium* sp. (5000), *Alternaria alternata* (600), *Aspergillus niger* (100), *Fusarium* sp. (200), *Penicillium* sp. (400), Yeasts (1000), Yellow Sterile Mycelia (400).	-
S.2	Nile	*Acremonium alabamense* (400), *Aspergillus niger* (100), *Cladosporium sphaerosperum* (1000), *Penicillium* sp. (6200), *Rhizopus microsporus* var. *oligosporus* (100), Yeasts (1000).	-
S.3	Nile	*Alternaria alternata* (300), *Aspergillus niger* (100), *Cladosporium* sp. (100), *Fusarium* sp. (100), *Penicillium* sp. (100).	-

Table 8: Fungal species which isolated from water and sediment samples of Hor Majnon (CIMI-8) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	*Saprolegnia parasitica*	*Aspergillus niger* (900), *Fusarium* sp. (200), *Penicillium* sp. (1200), Yeasts (400), White Sterile Mycelia (400).	-
S.2	*Saprolegnia parasitica*	*Alternaria alternata* (200), *Aspergillus niger* (100), *Fusarium* sp. (100), Yeasts (1600), White Sterile Mycelia (200).	-
S.3	*Saprolegnia parasitica*	*Alternaria canicola* (100), *Aspergillus niger* (300), *Fusarium* sp. (200), *Paecilomyces* sp. (300), *Penicillium* sp. (3600), White Sterile Mycelia (900).	-

Table 9: Fungal species which isolated from water and sediment samples of Beginning and Middel of Al-Baghdadia (CIMI-9) (Southern Iraqi Marshlands).

Sits	**Water samples**		**Sediment samples (No. of colonies/1 gm)**
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	*Saprolegnia terrestica* *Saprolegnia* sp.	*Acremonium* sp. (1100), *Alternaria alternata* (300), *Aspergillus niger* (100), *Aspergillus* sp. (1900), *Fusarium oxysporum* (400), *Penicillium* sp. (1700), Yeasts (200),	*Aspergillus fumigatus* (3000) *Penicillium* sp. (1000) Black Sterile Mycelia (3000) Brown Sterile Mycelia (5000). White Sterile Mycelia (2000).
S.2	Nile		*Cladosporium oxysporum* (5000) *Penicillium* sp. (2000) Yeasts (1000) Brown Sterile Mycelia (1000). White Sterile Mycelia (4000).
S.3	*Saprolegnia parasitica*	*Acremonium* sp. (100), *Alternaria alternata* (600), *Aspergillus niger* (100), *Aspergillus ochraceus* (300), *Fusarium* sp. (500), *Penicillium* sp. (2000).	*Alternaria alternate* (5000) *Aspergillus terreus* (300) *Cladosporium herbarum* (1000) *Cladosporium* sp. (100) *Fusarium oxysporum* (1000) *M*icroascus sp. (100) White Sterile Mycelia (100).

Table 10: Fungal species which isolated from water and sediment samples of Abu Ziriq (CIMI-10) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	*Saprolegnia ferax*	*Alternaria alternata* (400), *Aspergillus flavus* (100), *Fusarium oxysporum* (500), *Fusarium* sp. (600), *Penicillium* sp. (4000), Yeasts (100).	*Acremonium kilienes* (300) *Aspergillus niger (*1000) *Penicillium* sp. (200) Yeasts (2000) White Sterile Mycelia (300).
S.2	*Saprolegnia ferax*	*Alternaria alternata* (400), *Aspergillus flavus* (2000), *Aspergillus niger* (100), *Fusarium* sp. (700).	*Acremonium potronii* (1000) *Aspergillus terreus (*1000)
S.3	*Achlya prolifera*	*Acremonium potronii* (200) *Alternaria alternate* (300) *Penicillium* sp. (100) White Sterile Mycelia (100).	*Acremonium curvulum* (1000) *Acremonium potronii* (200) *Fusarium oxysporum*. (2000) *Microascus* sp. (100) *Penicillium* sp. (2000). Yeasts (3000)
S.4	Nile	*Aspergillus niger (*100) *Penicillium* sp. (300) Yeasts (100). Black Sterile Mycelia (100).	*Aspergillus niger (*100) *Aspergillus terreus (*800) *Penicillium* sp. (100) White Sterile Mycelia (700).

Table 11: Fungal species which isolated from water and sediment samples of Al-Kirmashia (Khwesa) (CIMI-11) Southern Iraqi Marshlands.

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	Terrestrial fungi (No. of colonies/100 ml)	
S.1	*Achlya debaryana*	*Alternaria alternata* (300), *Aspergillus niger* (100), *Aspergillus ochraceus* (100), *Fusarium* sp. (200), *Penicillium* sp. (900)	*Acremonium* sp. (1000) *Paecilomyces viridis* (100) *Penicillium* sp.1 (1500) *Penicillium* sp.2 (1000) *Penicillium griseofulvum* (1000) Black Sterile Mycelia (100).
S.2	*Saprolegnia ferax* *Saprolegnia* sp.	*Alternaria alternata* (200), *Aspergillus niger* (100), *Fusarium occ.* (100), *Fusarium* sp. (100), *Penicillium* sp. (400), Yeasts (200).	*Cladosporium elayam* (200) *Microascus* sp. (300) *Penicillium* sp.1 (200) *Penicillium* sp.2 (1000) Yeasts (5000) White Sterile Mycelia (100).
S.3	Nile	*Aspergillus ochraceus* (1000), *Aspergillus terreus* (100), *Penicillium* sp. (600), Yeasts (700), White Sterile Mycelia (1200).	*Cladosporium herbarum* (300) *Paecilomyces viridis* (1000) *Penicillium* sp. (200)
S.4	Nile	*Aspergillus niger* (100) *Exophiala* sp. (100) *Paecilomyces viridis* (100) Black Sterile Mycelia (200).	*Aspergillus terreus* (200) *Cladosporium herbarum* (400) *Penicillium* sp.1 (2000) *Penicillium* sp.2 (3000) *Penicillium* sp.3(600) *Exophiala* sp. (100) Black Sterile Mycelia (100).

Table 12: Fungal species which isolated from water and sediment samples of Al-Bargah (CIMI-12) in Al- Hammar Marsh (Southern Iraqi Marshlands).

Sits	**Water samples**		**Sediment samples (No. of colonies/1 gm)**
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	Nile	*Aspergillus ochaceus* (100), *Penicillium* sp. (800), Yeasts (700).	*Acremonium* sp. (200) *Aspergillus terreus* (100) *Cladosporium herbarum* (2000) *Curvularia lunata* (100) *Penicillium* sp. (100) Black Sterile Mycelia (3000). White Sterile Mycelia (200).
S.2	Nile	*Acremonium* sp. (200), *Alternaria canicola* (100), *Cladosporium* sp. (800), *Penicillium* sp. (4300), Yeasts (1000), Black Sterile Mycelia (300), White Sterile Mycelia (200).	*Aspergillus terreus* (100) *Fusarium oxysporum* (3000) *Penicillium* sp. (100) *Scytalidium lignicola* (1000) Black Sterile Mycelia (100). White Sterile Mycelia (100).
S.3	*Dictyuchus* sp.	*Acremonium alabamense* (500), *Acremonium* sp. (100), *Alternaria alternata* (300), *Alternaria* sp. (300), *Aspergillus niger* (100), *Aspergillus* sp. (5600), *Cladosporium* sp. (1000), *Fusarium oxysporum* (400), *Penicillium* sp. (1700), Yeasts (2700), White Sterile Mycelia (500).	*Alternaria chlamydospora* (1000) *Aspergillus niger* (1000) *Penicillium* sp. (1000)
S.4	Nile	*Fusarium* sp. (100), *Penicillium* sp. (1300).	*Alternaria* sp. (2000) *Aspergillus terreus* (100) *Cladosporium herbarum* (2000) *Exophiala* sp. (100) *Penicillium* sp. (200), Yeasts (2000)

Table 13: Fungal species which isolated from water and sediment samples of Shatt Al-Arab (Upper of Al- Sindibad Island (CIMI-13).

Sits	Water samples		Sediment samples (No. of colonies/1 gm)
	True aquatic fungi	**Terrestrial fungi (No. of colonies/100 ml)**	
S.1	*Saprolegnia parasitica*	*Acremonium* sp. (400), *Penicillium* sp. (600), Yeasts (500), White Sterile Mycelia (300).	*Acremonium kilienes* (1000) *Microascus* sp. (100) *Penicillium* sp. (100) Black Sterile Mycelia (3000). White Sterile Mycelia (300).
S.2	*Saprolegnia parasitica* *Saprolegnia* sp.	*Acremonium alabamense* (500), *Aspergillus niger* (200), *Penicillium* sp. (800), Yeasts (300), White Sterile Mycelia (200).	*Cladophialophora boppii* (1000) *Cladosporium cladosporoides* (200) Black Sterile Mycelia (100).
S.3	*Achlya prolifera* *Dictyuchus* sp. *Saprolegnia parasitica*	*Acremonium alabamense* (500), *Aspergillus niger* (100), *Alternaria alternata* (300), *Peni-cillium* sp. (1300).	*Cladosporium herbarum* (1000) *Microascus* sp. (1000) *Scytalidium lignicola* (1000) Brown Sterile Mycelia (1000). White Sterile Mycelia (1000).
S.4	*Dictyuchus* sp. *Saprolegnia paras-itica*	*Acremonium alabamense* (700), *Alternaria alternata* (300), Aspergillus *niger* (100), *Cladosporium* sp. (100), *Penicillium* sp. (400).	*Alternaria alternata* (5000) *Aspergillus terreus* (300) *Cladosporium herbarum* (1000) *Cladosporium* sp. (100) *Fusarium oxysporum* (1000) *Microascus* sp. (100) White Sterile Mycelia (100).

Table 14: Occurrence and frequency of fungal species that isolated from water and sediment samples of Shatt Al-Arab and Southern Iraqi Marsh-lands.

No.	Fungal species	Water samples		Sediment samples	
		Occurrence (%)	Frequency (%)	Occurrence (%)	Frequency (%)
1.	*Acremonium alabamense*	61.54	6.1	15.38	0.08
2.	*Acremonium curvulum*	-	-	7.69	1.1
3.	*Acremonium kilienes*	-	-	15.38	1.43
4.	*Acremonium potronii*	7.69	0.31	7.69	0.7
5.	*Acremonium strictum*	7.69	0.7	-	-
6.	*Acremonium* sp.	46.15	9.98	38.46	1.58
7.	*Acremonium* sp.1	15.38	0.93	-	-
8.	*Acremonium* sp.2	15.38	0.93	-	-
9.	*Alternaria alternata*	84.62	4.96	38.46	11.11
10.	*Alternaria canicola*	15.38	0.31	7.69	0.01
11.	*Alternaria chlamydospora*	-	-	7.69	1.1
12.	*Alternaria* sp.	23.1	1.08	7.69	2.2
13.	*Aspergillus flavus*	30.77	2.4	23.08	0.25
14.	*Aspergillus fumigatus*	-	-	15.38	3.42
15.	*Aspergillus niger*	92.31	3.02	30.77	2.22
16.	*Aspergillus ochraceus*	23.1	1.47	15.38	0.12
17.	*Aspergillus terreus*	15.38	0.46	76.92	2.96
18.	*Aspergillus sp.*	15.38	11.59	15.38	0.2
19.	*Cladophialophora boppii*	-	-	15.38	1.27
20.	*Cladophialophora* sp.	-	-	7.69	0.11
21.	*Cladosporium cladosporoides*	-	-	38.46	2.12
22.	*Cladosporium elayam*	-	-	7.69	0.22
23.	*Cladosporium herbarum*	-	-	53.85	6.08
24.	*Cladosporium oxysporum*	-	-	7.69	5.51

No.	Fungal species	Water samples		Sediment samples	
		Occurrence (%)	Frequency (%)	Occurrence (%)	Frequency (%)
25.	*Cladosporium sphaerosperum*	7.69	1.55	-	-
26.	*Cladosporium* sp.	23.1	1.7	23.08	0.44
27.	*Curvularia lunata*	-	-	7.69	0.11
28.	*Exophiala jeanselme*	-	-	7.69	0.33
29.	*Exophiala moniliae*	-	-	7.69	0.11
30.	*Exophiala* sp.	7.69	0.15	23.08	0.26
31.	*Fusarium oxysporum*	38.46	2.78	53.85	3.98
32.	*Fusarium* sp.	61.54	3.57	7.69	0.01
33.	*Microascus* sp.	46.15	0.62	61.54	1.77
34.	*Mucor hiemalis*	-	-	7.69	0.11
35.	*Paecilomyces viridis*	7.69	0.15	7.69	1.1
36.	*Paecilomyces* sp.	7.69	0.46	-	-
37.	*Penicillium griseofulvum*	-	-	7.69	1.1
38.	*Penicillium* sp.	100	-	76.92	4.98
39.	*Penicillium* sp.1	7.69	25.44	15.38	1.39
40.	*Penicillium* sp.2	-	0.15	15.38	1.84
41.	*Penicillium* sp.3	-	-	7.69	0.66
42.	*Rhizopus microsporus*	15.38	0.31	-	-
43.	*Rhizopus stolonifer*	15.38	0.31	-	-
44.	*Rhizopus* sp.	7.69	0.46	7.69	0.11
45.	*Scytalidium lignicola*	-	-	23.1	2.31
46.	*Trichoderma* sp.	-	-	7.69	0.11
47.	Yeasts	53.85	9.92	69.23	15.44
48.	Black Sterile Mycelia	23.1	0.93	30.77	6.83
49.	Brown Sterile Mycelia	-	-	15.38	4.41
50.	White Sterile Mycelia	53.85	4.33	76.92	4.59
51.	Yellow Sterile Mycelia	53.85	3.11	7.69	0.44

Discussion

Microorganisms are essential components of every ecosystem and the microbial community plays a major role in biogeochemical cycling and both biological and chemical processes are involved in the cycling and transformations of nutrients important to microorganisms, plants and animals. This involves oxidation-reduction reactions (Perscott *et al*., 1996). Considering fungi, the filamentous fungi in soil with their filamentous growth will form bridges between separated regions when moisture is available and can move nutrients and water over greater distances. In this study most of the isolated fungi were filamentous belonged to fungi imperfecti (Table (1)). Because wetlands of lower Mesopotamia contain many aquatic plants with the dominancy of *Phragmites australis* and *Typha domingensis* which act as filters and together with their associated microorganisms can be used as integrated system to remove organic matter , inorganic nutrients, and metals from water (Prescott *et al*., 1996 ; Partow, 2001), therefore the southern Iraqi marshes are considered as a complete ecosystem and constitute a good environment for aquatic birds, fishes and mammals such as buffaloes**,** so sediment samples are rich in organic matters (plant and animal debris) and form enriched substrate which enhance the growth of different fungal flora with higher population. (Table :1).

Many fungi cause plant diseases, but only about 100 of the thousands of known species of yeasts and molds cause diseases in humans or animals. Only the dermatophytes and *Candida* are commonly transmitted from one human to another (Jawetz, *et al,* 1987). Also, fungi play important roles in biodegradation and bioremediation. In this study members of the family Saprolegniaceae have been isolated from fresh water of Shatt-Al-Arab river and many locations of Southern Marshes, but from other sites specially in Al-Hammar Marsh true aquatic fungi have not been detected for the high salinity of water (4-6 ppt). This result is agreed with that done by Muhsin (1977), Rattan *et.al*. (1978, 1980), Al-Rekabi *et.al*. (1996). While many species of fungi imperfecti and few ascomycetous species have been isolated from water samples (Table (1)). In this study, sediment samples were collected beneath water surface at a depth of 0.5 – 2 meters and at many locations the depth reached 5-7 meters. All samples showed heavy growth of many terrestrial fungi which indicate that fungi can grow under low oxygen level (microaerophilic).

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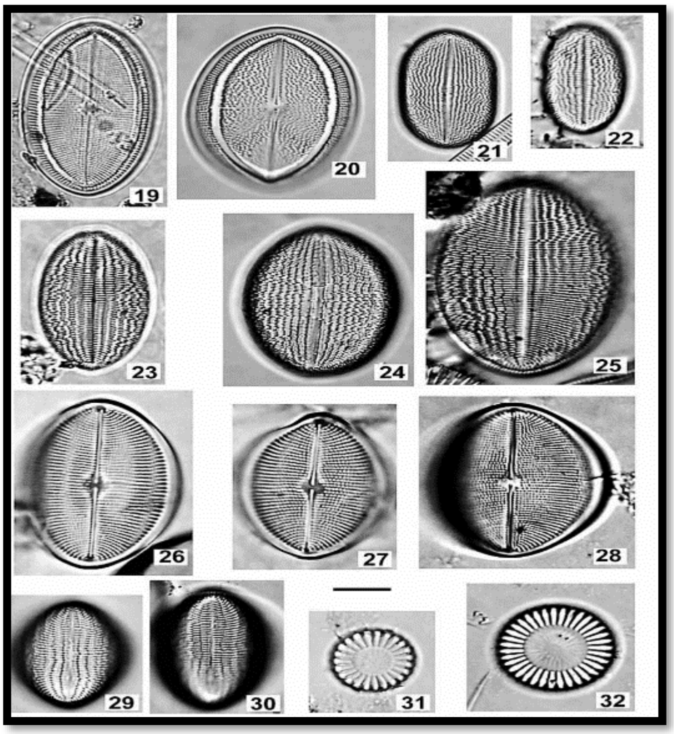
CHAPTER TWO



DIATOMS

Adil Y. Al-Handal

Dept. of Biological and Environmental Sciences,
Gothenburg University, Sweden.

Introduction

Studying biodiversity is very important in all aquatic ecosystems. The overall change in environmental conditions have resulted in a loss of biodiversity in global level (Loreau *et al*. 2002). As has been shown by several investigations, any change in biodiversity has a remarkable impact on primary production, retention of nutrients and ecosystem stability (Chapin *et al*. 2000). Since diatoms are major components of any aquatic ecosystem biodiversity, it is of great importance to monitor their distribution and species composition.

Diatoms are unicellular or colonial microalgae which vary in length or diameter from 3 μm to 200 μm. They differ from other algal groups by their cell walls (frustules) which are composed of silica and pectin. Each diatom cell is composed of two valves connected to each other by a cingulum. Each valve is furnished with variable markings (striae and areolae) which are key characteristics to identify diatoms.

Diatoms, with more than 100,000 species, play an important role in aquatic ecosystems on a global scale (Mann and Droop 1996, Mann and Vanormelingen 2013). These photoautotrophic unicellular microalgae are responsible for 20% of global carbon fixation and 40% of primary production in the world oceans, they generate organic carbon equal to that of all rain forests on earth (Field *et al.* 1998). In the climate change processes, diatoms are important contributors for their role in absorbing excessive amounts of carbon entering the oceans. They are also fundamental components of the food web in the marine environment and support the most productive fisheries in coastal regions

Diatoms are found in all kinds of aquatic habitats. Fresh and marine water are inhabited by planktonic and benthic species. Most species have ubiquitous distribution all over the world (cosmopolitan) and therefore they exhibit a wide range of adaptations to variable environmental preferences. Life strategies include planktonic forms, benthic species adhering to many different kinds of substrate (e.g., mud, sand, stones, plants, algae, animals), but also appearing in interstitial and intertidal communities. Diatoms have one of the shortest generation times of all biological indicator groups and therefore have the potential to also provide short term indications of environmental change. While some diatom species have a broad ecological plasticity, others are adapted to specific environmental conditions. Those species with narrow optima and tolerances for different environmental variables often react quickly to an alteration of their environment with changes in their growth rate. In many countries, diatom indices are widely used for water quality assessment in lakes and rivers.

Diatoms of the Inland water of Basrah

Diatoms of the vast wetlands of Southern Iraq have not been thoroughly investigated. Most works on diatoms in this region were either limited to a particular area or appear as part of broader algal surveys. The only works that were merely devoted to studying diatom assemblages were those of Hadi *et al.* (1984), Al-Handal (1988, 2009), Al-Handal and Abdulla (2010) and Al-Handal *et al.* (2014). Other works in which diatoms appear as part of algal surveys include but not all, Saad and kell 1973; Kell and Saad 1975; Maulood *et al.* 1979, 1981; Pankow *et al*. 1979; Hinton and Maulood 1980,1983 and Hassan *et al.* (2012).

In this work, the aquatic ecosystems of Southern Iraq will be divided into two parts; the Mesopotamian wetlands and the Shatt Al-Arab River, diatoms of each part will be presented. It is not expected, however, that diatom assemblages of each part will be totally different but some species might have certain environmental preferences and cannot be found widely distributed. The following list of diatoms is a result of three decades of work by the author. Names of species are those currently in use. The list, however, is the findings of the author and is far from complete and do not represent all diatom flora of the wetlands of Southern Iraq but exhibit up to date records of diatoms in several parts of the region. Other investigators have published diatom lists without images which were difficult to verify and were not included in the present survey.

Material and Methods

The samples studied were collected from several parts of the Mesopotamian marshes, mostly Al-Hammar and Huwaiza marshes and from Shatt Al-Arab River (Fig. 1) during different periods of the last three decades. Samples included all substrates which diatoms were thriving such as the plankton, sediments and submerged macrophytes (epiphytic diatoms). Identification of diatom taxa was based on a number of literature including but not all Hustedt (1930–66); Patrick and Reimer (1966); Germain (1981); Krammer and Lange-

Bertalot (1986, 1988, 1991); Lange-Bertalot (2001); Simonsen (1987); Witkowski *et al*. (2000); Metzeltin and García-Rodríguez (2003) and Mann *et al*. (2004). Permanent slides contained all taxa listed in this work were made by mounting in Naphrax and are all deposited in the diatom collections of the author. This worthwhile list is accompanied by ecological preferences of all taxa encountered as well as LM images.

Fig.1. Map showing the Mesopotamian marshes and the Shatt Al-Arab River. Black circles indicate sampling locations.

Diatoms of the Shatt Al-Arab River

Shatt Al-Arab River extends for a distance of ca 130 km from its origin north of Basra city until its lower reaches at the north western part of the Gulf. Lower parts of the River are influenced by the sea water front from the Gulf, particularly during high tide, making this part ecologically different from upper regions of the River. This also produce varying diatom assemblages. For this reason, diatom populations will be treated separately in regard to northern and southern parts.

Diatoms of the lower reaches of Shatt Al-Arab River

A total of 169 diatom taxa belonging to 70 genera were encountered in the region extending from Faw town to the north western part of the Gulf. All species identified are listed alphabetically in Table 1 which also shows habitat of the recorded taxa. Diatoms of this part which constitute estuarine conditions are a mixture of freshwater, brackish water and marine taxa.

Freshwater taxa (56 species) were rather but few of these appeared in moderate numbers and include *Cocconeis placentula, Cocconeis euglypta*, *cyclotella atomus*, *Cymbella aspera*, *Gomphonema accuminatum*, *Pinnularia divergens* and *Surirella capronii*. The occurrence of healthy frustules of *Cocconeis euglypta* in water with high salinity (>22 psu) indicates a wide ecological amplitude enabling it to thrive in a habitat other than that known for its ecological preference. This species is considered as oligohalobous (freshwater), alkaliphilic and epiphytic taxon (Patrick & Reimer, 1966). Similarly, *Pinnularia divergens*, *Pinnularia major* and *Pinnularia nobilis* occurred frequently but most likely been drifted from the upper parts of the river.

Brackish water species were the most common among all recorded taxa. These include *Berkeleya scopulorum*, *Gyrosigma eximum*, *Mastogloia braunii*, *Mastogloia elliptica* var. *densei*, and to less extent *Achnanthes brevipes*, *Cyclotella striata* and *Gyrosigma acuminatum.* True marine forms constituted 55 taxa, the most common of which were *Ardissonea robusta*, *Pleurosigma diversestriatum*, *Nitzschia sigma*, *Trachyneis debyi* and *Trachyneis antillarum*.

Plankton diatoms are quite common in the lower section of the River, particularly from Siba village southwards (ca 60 km from the Gulf). Common plankton forms include *Chaetoceros* spp., *Coscinodiscus* spp., *Rhizosolenis* spp. and *Bacteriastrum* spp.

Diatoms from the upper parts of Shatt Al-Arab River

Diatom assemblages in the upper parts of the river do not considerably differ from those found in the lower marshes and therefore their taxa are included in Table 2 together with marshes diatoms.

Diatoms from the Southern marshes

Diatoms assemblages in this region are also interesting mixture of fresh, brackish and some marine taxa. A total of 131 taxa were encountered including 49 Oligohalobous (freshwater) forms, 35 mesohalobous (brackishwater), four polyhalobous (marine) and the rest are of uncertain environmental preferences. 33 taxa were found new to Iraqi inland water and appeared after restoration of the marshes. All recorded taxa are presented alphabetically in

Table 2. The most common truly freshwater diatom taxa encountered were *Amphora veneta, Cocconeis pediculus, C. placentula* var *placentula, C. euglypta, Cyclotella atomus, Fragilaria pulchella, Nitzschia obtusa, Ulnaria capitata* and *Ulnaria ulna.* All of these taxa are cosmopolitan and were previously encountered most frequently in the southern marshes (Hinton and Maulood 1980, Al-Zubaidi 1985). A number of mesohalobous taxa were found common in the most southern Qurna marsh only, these were *Entomoneis alata, Epithemia sorex, Mastogloia braunii* and *Rhopalodia gibba*. Some species of marine origin penetrated into this marsh, these were *Gyrosigma sinensis, Nitzschia sigma, Petroneis plagiostoma* and *Pleurosigma angulatum*. Qurna marsh however is directly connected to the Shatt Al-Arab river which during high tides receives water from the Arabian Gulf through which many marine diatoms could be drifted as far as this region.

Most interesting is the occurrence of acidophilic taxa in a truly alkaline environment (pH range 8.4-8.7). These were *Eunotia formica*, *E. monodon*, *Frustulia rhomboids*, *Pinnularia major*, *P. nobilis*, *P. streptoraphe* and *Tabellaria fenestrata*. These species occurred frequently and could not be washed away to the area from any surrounding acidic environment as the whole inland water in southern Iraq is alkaline. Similarly, two taxa known only from cold water appeared in the warm water of the marshes, these were *Pinnularia borealis* var. *rectangularis* and *Stephanodiscus alpinus*. The occurrence of such taxa in a habitat other than that known before calls for reconsidering their ecological amplitudes.

It is not surprising to find a relatively large number of brackish water diatoms as the salinity of the southern parts of the marshes rise and fall depending on water flow rate from Tigris and Euphrates. When this rate drops remarkably, salinity rises owing to excessive rate of evaporation caused by high temperature. Increased salinity also occurs due to proceeding of the sea water front from the Gulf, which normally does not reach the marshes, but when freshwater discharge severely declines, it may proceed up to this region. This could also explain the occurrence of some truly marine taxa in Huwaiza marsh such as *Actinocyclus subtilis* and *Sieminskia wohlenbergii.* Most of the marine diatoms were rarely encountered except for *S. wohlenbergii* which was dominant on the aquatic plant *Vallisneria spiralis.* This is a marine species widely distributed in temperate and subtropical regions (Witkowski *et al*. 2000), it appeared solely on *V. spiralis* and apparently it is thriving outside its natural habitat or it can tolerate a rather wide range of salinity, but such case has not been reported elsewhere. Majority of the diatoms found in this region were benthic forms, either epipelic or epiphytic. Planktonic forms were very rare. The wide distribution of epiphytic taxa is attributed to the extensive distribution of aquatic plants and other submerged macrophytes from which attached diatoms are released and disperse.

A considerable part (30%) of the diatoms presently recorded was not previously known from the marshes or the other Iraqi inland water. The noticeable change in the chemistry of marshes water after restoration (Tahir *et al*. 2008) might be the reason behind the occurrence of these taxa. All taxa appeared after restoration are marked with asterisk in Table 2.

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Table 1: Diatoms from the lower reaches of the Shatt Al-Arab River with their type of habitat. f: freshwater, b: brackish water, m: marine.

	Figure	Habitat
Achnanthes brevipes C. Agardh *Achnanthes*	59,61	b
kuwaitensis Hendey *Actinoptychus annula-*	58	m
tus var *minor* . Grunow *Actinocyclus nor-*		m
mannii forma *subsalsus*	21	b,m
(Juhlin-Dannfelt) Hustedt *Actinocyclus oc-*		
tonarius Ehrenberg	8	m
Actinocyclus subtilis (Gregory) Ralfs in Pritchard	15	m
Amphora copulata (Kützing) Schoeman et Archi-	167	f
bald *Amphora cf. costata* W. Smith	164	m
Amphora exigua Gregory	172	b,m
Amphora macilenta Gregory	168	b
Ardissonea robusta (Ralfs ex Pritchard) De Notaris	33-35	M
Asterionella formosa Hassall *Asteromphalus*	39	b
brookei Bailey	9	m
Berkeleya scopulorum (Brébisson ex Kützing) Cox	124	b
Caloneis permagna (Bailey) Cleve	125	b
Caloneis silicula (Ehrenberg) Cleve	126,131	f
Campylodiscus demelianus Grunow	217	m
Campylodiscus intermedius Grunow	218	m
Catacombas gaillonii (Bory) D.M. Williams &	32	
Round *Cocconeis euglypta* Ehrenberg *Cocconeis*	71,73	f
convexa Giffen	68,69	f,b
Cocconeis maxima (Grunow) Peragallo *Coc-*	65	m
coneis pediculus Ehrenberg *Cocconeis*	66	f
placentula Ehrenberg *Cocconeis scutellum*	70,72	f
Ehrenberg *Coscinodiscus marginatus* Ehren-	74	b,m
berg *Coscinodiscus oculus-iridis* Ehrenberg	13	m
Coscinodiscus cf. rothii (Ehrenberg) Grunow	3	m
Coscinodiscus sp.	4	m
	14	
Craticula cuspidata (Kützing) D.G.Mann	118	f
Craticula halophila (Grunow) D.G.Mann	99	F
Ctenophora pulchella (Ralfs ex Kützing)	38	b
D.M. Williams & Round		
Cyclotella meneghiniana Kützing	23,24	f
Cyclotella radiosa Grunow *Cy-*	26	f
clotella striata (Kützing) Grunow	17,18	b
Cyclotella stylorum Brightwell *Cy-*	16	b
clotella sp.	19,20	
Cymatopleura elliptica (Brébisson) W. Smith	214	f

Cymatopleura solea (Brébisson) W. Smith var. *solea*	216	f
Cymatopleura solea var. apiculata (W.Smith) Ralfs	215	f
Cymbella aspera (Ehrenberg) Cleve	88	f
Cymbopleura sp.	180	
Delphineis surirella (Grunow) Andrews	57	m
Delphineis surirelloides (Simonsen) Andrews	56	m
Diatoma mesodon (Ehrenberg) Kützing	54	f
Diatoma tenuis Agardh	40	f,b
Diatoma vulgaris Bory	55	f,b
Diploneis chersonensis (Grunow) Cleve	204	m
Diploneis crarbo Ehrenberg	205	m
Diploneis didyma (Ehrenberg) Cleve	206	
Diploneis smithii (Brébisson) Cleve	208	b
Diploneis suborbicularis (Gregory) Cleve	203	m
Diploneis sp.	207	
Encyonema pusilla (Grunow) D.G. Mann	175,176	f,b
Encyonema ventricosum Kützing	173	f,b
Encyonema sp.	174	
Entomoneis corrugata (Giffen)		b
Witkowski, Lange-Bertalot & metzeltin	181	
Eunotia bilunaris (Ehrenberg) Mills	78	f
Eunotia sp.	77	
Fallacia oculiformis (Histedt) D.G. Mann	179	b,m
Fogedia finmarchica (Cleve & Grunow)		b,m
Witkowski, Medlin & Lange-Bertalot	114	
Frustukia interposita (Lowis) De Toni	121	
Gomphonema affine Kützing	210	f
Gomphonem clavatum Ehrenberg	200	f
Gomphonema coronatum Ehrenberg	196	
Gomphonem truncatum Ehrenberg	197-199	f
Gomphonema sp.	202	
Gomphotheca sinensis (Skvortzow) Hendey and Sims	50-52	b
Grammatophora marina (Lyngbye) Kützing	48	m
Grammatophora oceanica Ehrenberg	49	m
Gyrosigma acuminatum (Kützing) Rabenhorst	158	f,b
Gyrosigma eximum (Thwaites) Bayer	155	b
Gyrosigma parkeri (Harrison) Elmore	154	f
Gyrosigma peisonis (Grunow) Hustedt	157	b
Gyrosigma sinensis (Ehrenberg) Desikachary	156	b
Halamphora coffeaeformis (C. Agardh) Levkov	166	f,b
Hantzschia virgata (Roper) Grunow	140	m
Hantzschia virgata var. *capitellata* Hustedt	141	m
Hippodonta capitata (Ehrenberg) Lange-bertalot, Medlin & Witkowski	102	f
Lyrella abrupta (Gregory) D.G. Mann	115	m
Lyrella clavata (Gregory) D.G.Mann	116	m
Lyrella hennedyi (W.Smith) Stickle & D.G.Mann	112	m

Lyrella robertsiana var. *abnormis* (Amosse) Al-Handal	113	m
Lyrella spectabilis (Gregory) D.G. Mann	119,120	m
Lyrella sp.	111	
Mastogloia apiculata W. Smith	91	b
Mastogloia braunii Grunow	92	b
Mastogloia elliptica var. *dansei* (Thwaites) Cleve	79-81	b
Mastogloia fimbriata (Brightwell) Cleve *Mas-*	87	m
togloia pumila (Grunow) Cleve *Mastogloia quin-*	85,86	b
quecostata Grunow *Mastogloia smithii* Thwaites	90	m
var. *smithii Mastogloia smithii* var. *amphicephala*	82,83	b
Grunow *Melosira moniliformis* (Muller) Agardh	84	b
Navicula arenaria Donkin	42	b,m
	97	m
Navicula directa (W.Smith) Ralfs *Na-*	104	m
vicula digitoradiata (Gregory) Ralfs	95	f,b
Navicula cf. *gregaria* Donkin	98	b,m
Navicula perrhombus Hustedt ex Simonsen	101	f
Navicula radiosa Kützing	94	f
Navicula rhynchocephala Kützing	117	f
Navicula schroeterii Meister	106	b
Navicula sp.1	96	
Navicula sp.2	103	
Neidium affine (Ehrenberg) Pfizer	129,130	f
Neidium iridis (Ehrenberg) Cleve	128	f
Neosynedra provincialis (Grunow) William et Round	41	m
Nitzschia capitellata Hustedt *Nitzschia elegantula*	149	b,m
Grunow	145	b,m
Nitzschia cf. *filiformis* (W.Smith) van Heurck	148	
Nitzschia cf. *fonticola* (Grunow) Grunow	146	f
Nitzschia hybrida Grunow	150	b
Nitzschia sigma (Kützing) W.Smith	143	m
Nitzschia sp.	151	
Paralia sulcata (Ehrenberg) Cleve *Parlibel-*	22	m
lus crucicula (W.Smith) Witkowski	105	m
Petrodictyon gemma (Ehrenberg) D.G.Mann	209	b,m
Petroneis granulata (Bailey) D.G.Mann		m
Petroneis marina (Ralfs) D.G.Mann	123	m
Petroneis monilifera (Cleve) Stickle & D.G.Mann	122	m
Pinnularia cruciformis (Donkin) Cleve *Pinnular-*	138	m
ia divergens W.Smith *Pinnularia gibba* Ehren-	135	f
berg		
Pinnularia legumen (Ehrenberg) Ehrenberg	132	f
Pinnularia nobilis (Ehrenberg) Ehrenberg	134	f
Pinnularia viridis (Nitzsch) Ehrenberg	133	f
Planothidium frequentissima (Lange-Bertalot)	136,137	f
Round & Bukhtyarova	62,63	f
Pleurosigma aestuarii (Brébisson ex Kützing) W. Smith	152	m

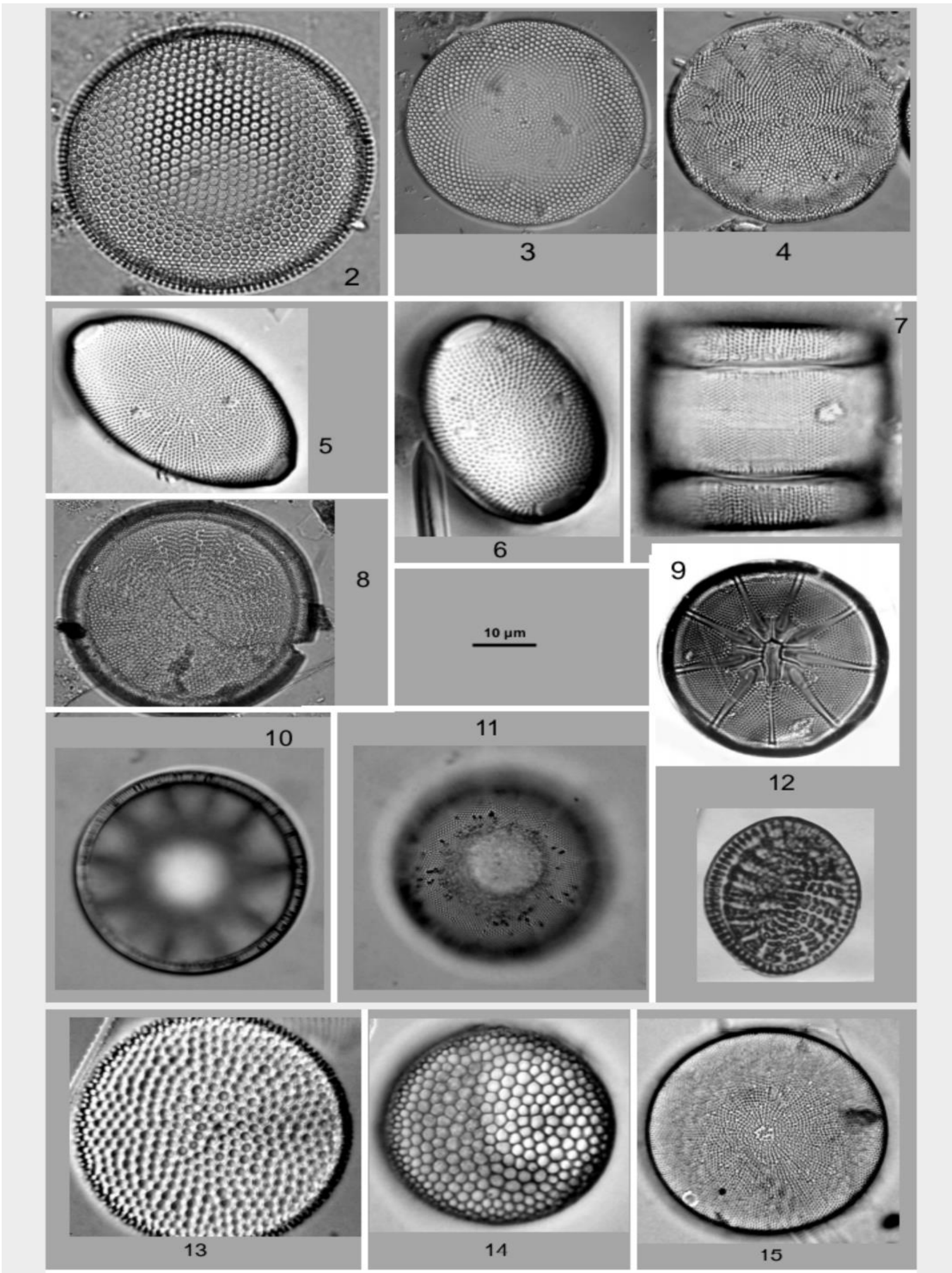
Pleurosigma diverse-striatum Meister	153	m
Pleurosigma salinarum (Grunow) Grunow	159,160	m
Pleurosira laevis (Ehrenberg) Compère	7-May	b
Podosira stelliger (Bailey) Mann	10,11	m
Psammodictyon panduriformis (Gregory) D.G. Mann	142	m
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot	177,178	f
Rhopalodia gibba (Ehremberg) O.Müller	184,185	f,b
Rhopalodia musculus (Kützing) O.Müller	182,183	b,m
Sellaphora pupula (Kützing) Merschkovsky	100	f
Seminavis ventricosa (Gregory) M. Garcia-Baptista	89	m
Sieminskia wohlenbergii (Cleve) Metzeltin & Lange-Bertalot	107-109	m
Stauroneis phoenicenteron (Nitzsch) Ehrenberg	161-163	f
Staurosira construens var. *binodis* (Ehrenberg) Hamilton	43	f
Stephanodiscus neoastraea Håkansson & Hickel	28	b,m
Surirella brightwellii W.Smith	219	b
Surirella capronii Brébisson ex Kitton	210	f
Surirella fastuosa (Ehrenberg) Kützing	213	m
Surirella ovalis Brébisson	211	f,b
Surirella striatula Turpin	212	b
Tabellaria fenestrata (Lynbye) Kützing	75,76	f
Tabullaria tabulata (Agardh) Kützing		f,b
Thalassiosira cf. lacustris (Grunow) hasle	27	
Thalassiosira spinosa Simonsen	2	m
Thalassiothrix sp.	64	
Trachyneis antillarum Cleve	190	m
Trachyneis aspera (Ehrenberg) Cleve	194,195	m
Trachyneis debyi (Leudiger-Fortmorel) Cleve	191,193	m
Trachyneis sp. 1	186,187	m
Trachyneis sp. 2	188,189	m
Trachysphenia sp.	53	m
Triceratium dubium Brightwell	30,31	m
Tropidoneis vitrea (W.Smith) Cleve	127	b,m
Trybionella hungarica (Grunow) D.G.Mann	144	b,m
Tryblioptychus cocconeiformis (Cleve) Hendey	12	m
Ulnaria ulna (Nitzsch) P.Compère	36,37	f

Table 2: Diatoms from the Mesopotamian marshes showing their habitat and their occurrence in the marshes: f: freshwater, b: brackishwater, m: marine, Q: Qurna marshes, H: Huwaiza marsh, A: Al-Hammar marsh. Species with asterisk indicate appearance after marshes restoration.

	Habitat	Marsh
Achnanthes brevipes C. Agardh	b	H
Actinocyclus subtilis (Gregory) Ralfs in Pritchard	m	H
**Amphora copulata* (Kützing) Schoeman et Archibald	F	Q
**Amphora macilenta* Gregory	b	Q,A,H
**Amphora mexicana* A. Schmidt	b	Q,A,H
Amphora ovalis (Kützing) Kützing	F	Q,A,H
Amphora veneta Kützing	F	Q,H
Anomoneis costata (Kützing) Hustedt	f,b	H
Bacillaria pxillifer (O. Möller) Hendey	b	Q,A,H
Brachysira sphaerophora (Kützing) Round ex D.G.Mann	b	Q
Caloneis permagna (Bailey) Cleve	f	Q
Caloneis silicula (Ehrenberg) Cleve	F	Q,A
Campylodiscus bicostatus W. Smith	b	Q,A,H
Campylodiscus clypeus Ehrenberg	b	Q,A
Cocconeis pediculus Ehrenberg	f	Q,A,H
Cocconeis placentula Ehrenberg	f	Q,A,H
Cocconeis euglypta Ehrenberg	f	Q,A,H
Craticula cuspidata (Kützing) D.G. Mann	f	Q,A,H
Craticula halophila (Grunow ex Van Heurck) D.G.Mann	f	Q,A,H
Ctenophora pulchella (Ralfs ex Kützing) D.M.Williams & Round	b	Q,A,H
Cyclotella atomus Hustedt	F	Q,A,H
Cyclotella meneghiniana Kützing	f	Q,A,H
Cymatopleura elliptica (Brébisson) W. Smith	f	H
Cymatopleura solea (Brébisson) W. Smith var. solea	f	Q,H
**Cymatopleura solea* var. *apiculata* (W. Smith) Ralfs	f	Q
Cymbella cistula (Ehrenberg) Kirchner	f	Q,A,H
Cymbella cymbiformis var. nonpunctata Fontell	f	H
Cymbella helvetica Kützing	f	Q,A,H
Cymbella lanceolata (Ehrenbrg) Kirchner	f	A
Cymbella mesiana Cholnoky	f	H
Cymbella tumida (Brébisson) Van Heurck	f	Q,A,H
Diatoma tenuis Agardh	f	Q
Diploneis smithii var. *pumila* (Grunow) Hustedt	f	Q
**Encyonema alpinum* (Grunow) D.G. Mann	f	A,H
**Encyonema caespitosa* Kützing	f	Q,A,H
Entomoneis corrugata (Giffen) Witkowski, Lange-Bertalot et Metzlin	b	Q,A,H
Epithemia adnata (Kützing) Brébisson	f	Q
Epithemia turgida (Ehrenberg) Kützing	b	Q
Epithemia sorex Kützing	f	Q,A
Eunotia formica Ehrenberg	f	Q
**Eunotia monodon* Ehrenberg	f	H

Eunotia gracilis (Ehrenb.) Rabenhorst	f	H
Fallacia pygmaea (Kützing) Stick. et D.G.Mann	b,m	H
Fragilaria construens var. *binodis* (Ehrenberg) Cleve	f	Q,A,H
Frustulia rhomboides (Ehrenberg) De Toni	f	Q
**Gomphonema angustum* C. Agardh	f	H
**Gomphonema affine* Kützing	f	Q,A,H
Gomphonema coronatum Ehrenberg	f	Q,A,H
Gomphonema gracile Ehrenberg	f	Q,A,H
**Gomphonema olivaceum* var. *minutissima* Hustedt	f	H
Gomphonema truncatum Ehrenberg	f	Q,H
Gyrosigma acuminatum (Kützing) Rabenhorst	f	Q,A,H
Gyrosigma fasciola (Ehrenberg) Griffi th et Henfrey	b	Q,A,H
Gyrosigma sinensis Ehrenberg	m	Q,A,H
Gyrosigma spencerii (Quekett) Griffi th et Henfrey	b	Q
Hantzschia amphioxys (Ehrenberg) Grunow	f	Q
**Haslea spicula* (Hickie) Lange-Bertalot	b,m	H
**Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski	f	A,H
**Hippodonta hungarica* (Grunow) Lange-Bertalot	f	Q,A,H
**Hyalodiscus ambiguus* (Grun.) Temp. et Peragallo	f	H
**Hydrosera triquetra* Wallisch	m	H
**Luticola cf. saxophila (* Bock) D.G. Mann	f	A
Mastogloia braunii Grunow	b	Q,A,H
Mastogloia elliptica (C.A. Agardh) Cleve var. *elliptica*	b	Q,A,H
Mastogloia elliptica var. *dansei* (Thwaites) Cleve	b	Q,A,H
Mastogloia pumila (Grunow) Cleve	b	Q,A,H
Mastogloia smithii Thwaites var. smithii	b	Q,A,H
Mastogloia smithii var. *amphicephala* Grunow	b	Q,A,H
**Mastogloia recta* Hustedt	b	Q,A,H
**Navicula confervacea* (Kützing) Grunow	f	Q,A,H
Navicula digitoradiata (Gregory) Ralfs in Pritchard	b	Q,A,H
Navicula radiosa Kützing	f	Q,A,H
**Navicula recens* Lange-Bertalot	f	H
Navicula rhynchocephala Kützing	b	Q,A,H
**Navicula subrhynchocephala* Hustedt	b	H
Neidium amplicatum (Ehrenberg) Krammer	b	Q,A,H
Neidium iridis (Ehrenberg) Cleve	f	H
Nitzschia amphibia Grunow	f	Q,A,H
**Nitzschia cf. bilobata* W. Smith	f	H
**Nitzschia dubia* W. Smith	F	Q
**Nitzschia elegantula* Grunow	b,m	Q
Nitzschia fi liformis (W. Smith) Van Heurck	b	Q,A,H
Nitzschia obtusa W. Smith	F	Q,A,H
Nitzschia palea (Kützing) W. Smith	F	Q,A,H
**Nitzschia recta* Hantzsch in Rabenhorst	F	Q,A,H
Nitzschia scalaris (Ehrenberg) W. Smith	b	Q
Nitzschia sigma (Kützing) W. Smith	m	Q,A
Nitzschia tubicola Grunow	b	H
Nitzschia umbonata (Ehrenberg) Lange-Bertalot	f	Q,A,H
**Parlibellus crucicula* (W. Smith) Witkowski	b	Q

**Petroneis plagiostoma* (Grunow) D.G. Mann	m	Q
**Pinnularia acrosphaeria* Rabenhorst	f	Q
Pinnularia borealis var. *rectangularis* Carslon	f	A
**Pinnularia divergens* var. *elliptica* Cleve-Euler	f	H
**Pinnularia legumen* (Ehrenberg) Ehrenberg	f	Q
Pinnularia major (Kützing) Rabenhorst	f	H
**Pinnularia nobilis* (Ehrenberg) Ehrenberg	f	H
**Pinnularia streptoraphe* Cleve	f	Q,A,H
**Pinnularia viridis* (Nitzsch) Ehrenberg	f	Q,A,H
**Placoneis constans* (Hustedt) E.J. Fox	f	Q
Plagiotropis lepidoptera (Gregory) Kuntze	b	Q
Planothidium lanceolata (Brébisson ex Kützing) Round et Bukhtiyarova	f	Q,A,H
Pleurosigma angulatum (Quekett) W. Smith	b,m	Q
Pleurosigma elongatum W. Smith	b	Q,A,H
Pleurosigma strigosum W. Smith	b	H
Pleurosira laevis (Ehrenb.) Compère	b	H
Rhoicosphenia abbreviata (C.A. Agardh) Lange-Bertalot	f	Q,A,H
Rhopalodia gibba (Ehrenberg) O. Müller	b	Q,A,H
Rhopalodia musculus (Kützing) O. Müller	b	Q,A,H
Sellaphora pupula (Kützing) Mereschkowsky	f	Q,A,H
**Sieminskia wohlenbergii* (Brockm.) Metz.et Lange-Bertalot	f	Q,A,H
**Stephanodiscus alpinus* Hustedt	f	Q
Stephanodiscus astreae (Ehrenberg) Grunow	b	H
**Stauroneis acuta* W. Smith	f	Q,A,H
Stauroneis phoenicentron (Nitzsch) Ehrenberg	f	Q
**Surirella brebissoni* Krammer et Lange-Bertalot	b	Q,A,H
Surirella capronii Brébisson	f	Q,A,H
Surirella ovalis Brébisson	f	Q,A,H
Surirella peisonis Pantocseck	b	Q,A,H
Surirella cf. robusta Ehrenberg	f	Q,A,H
Surirella striatula Turpin	b	Q,A,H
Surirella tenera Gregory	f	Q,A,H
Tabellaria fenestrate (Lyngbye) Kützing	f	Q,A,H
Tabularia tabulata (C.A. Agardh) Snoeijs	b	Q
**Tryblionella coarctata* (Grunow) D.G. Mann	m	Q,A,H
Tryblionella hungarica (Grunow) D.G. Mann	b	Q,A,H
**Tryblionella levidensis* W. Smith	b	Q,A,H
Tryblionella littoralis (Grunow) D.G. Mann	b	Q
Ulnaria biceps (Kutzing) Comperre	f	Q,A,H
Ulnaria capitata (Ehrenberg) P.Compère	f	Q,A
Ulnaria ulna var. claviceps (Hustedt) Pierre	f	Q,A,H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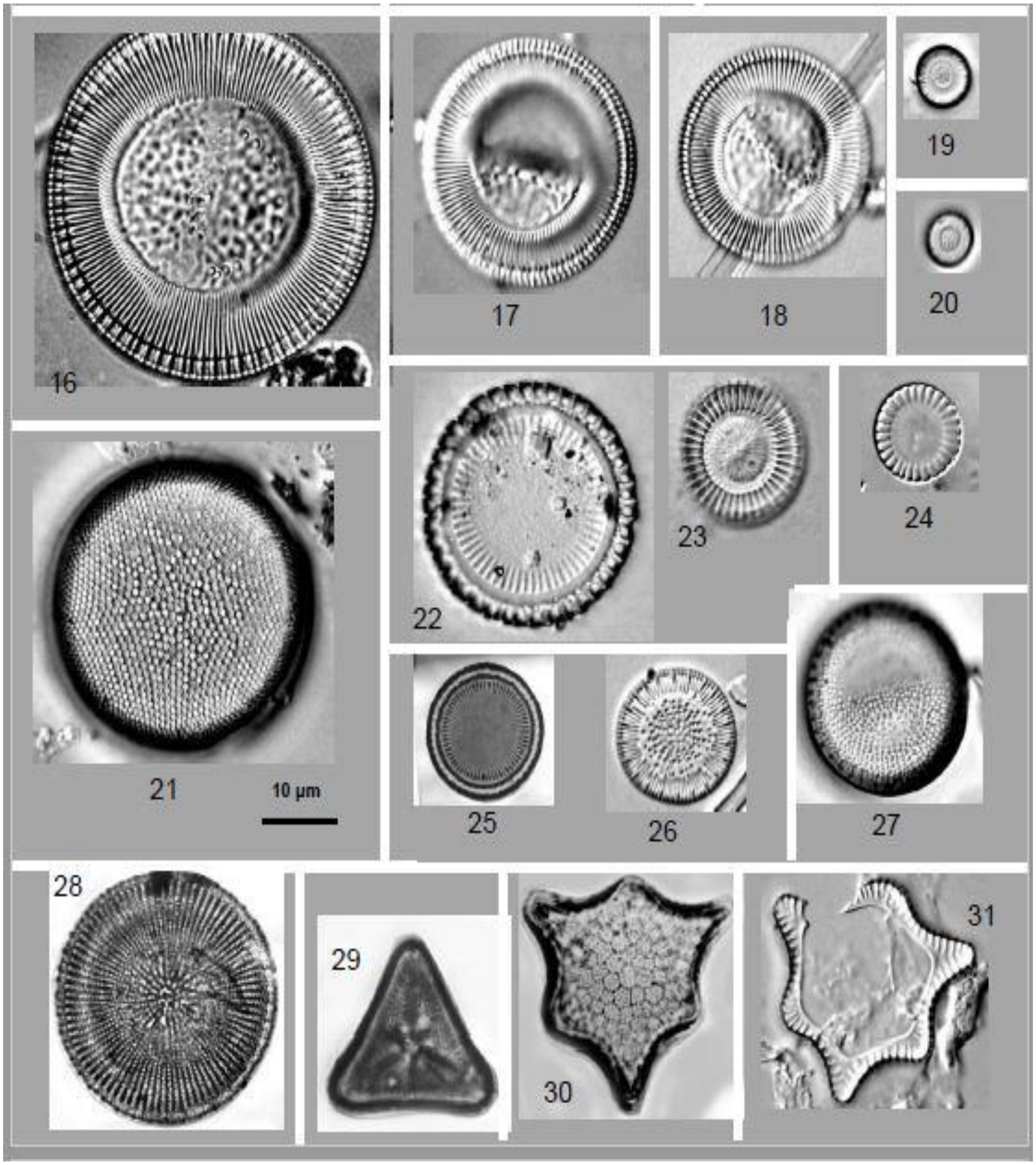
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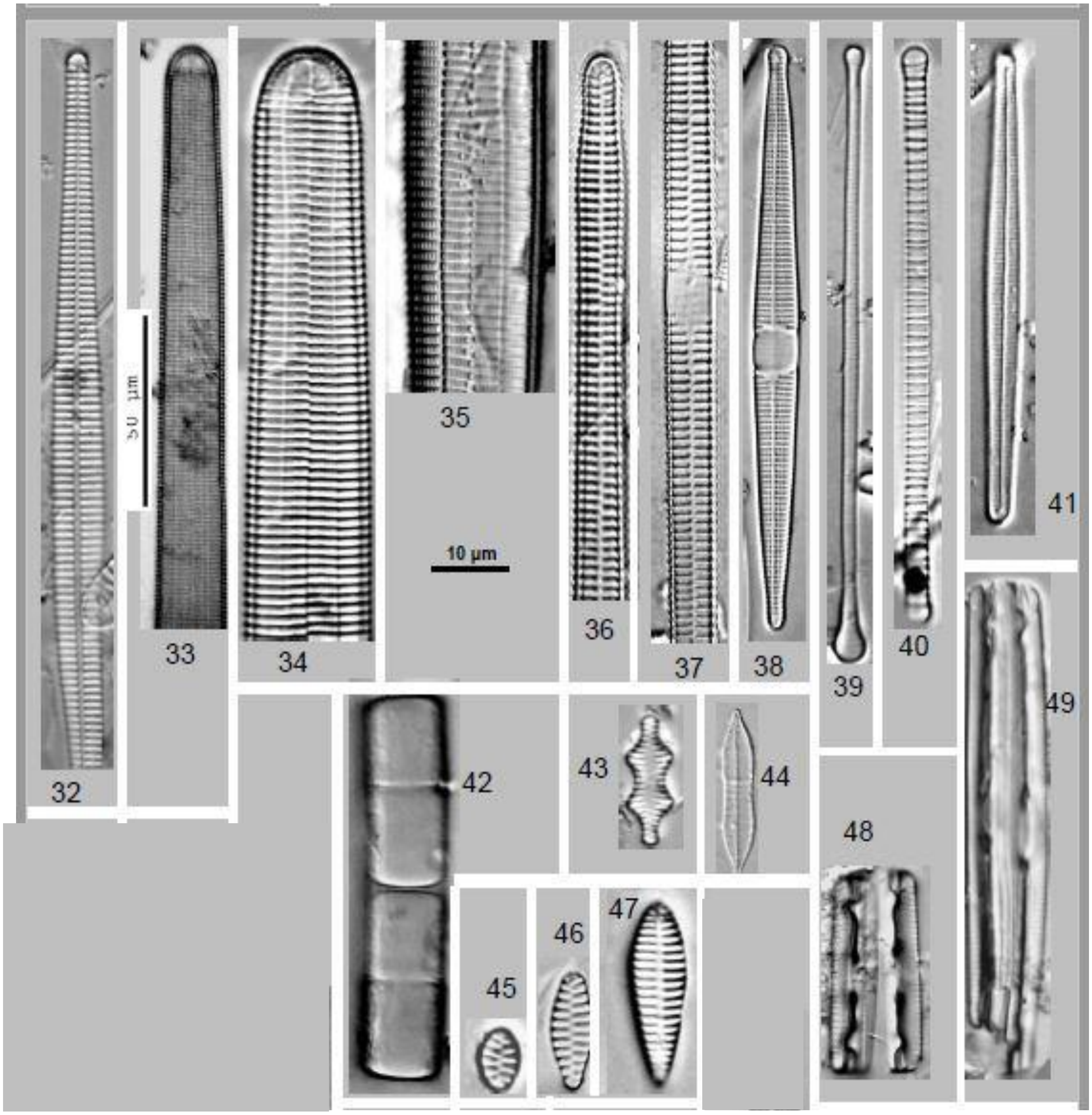
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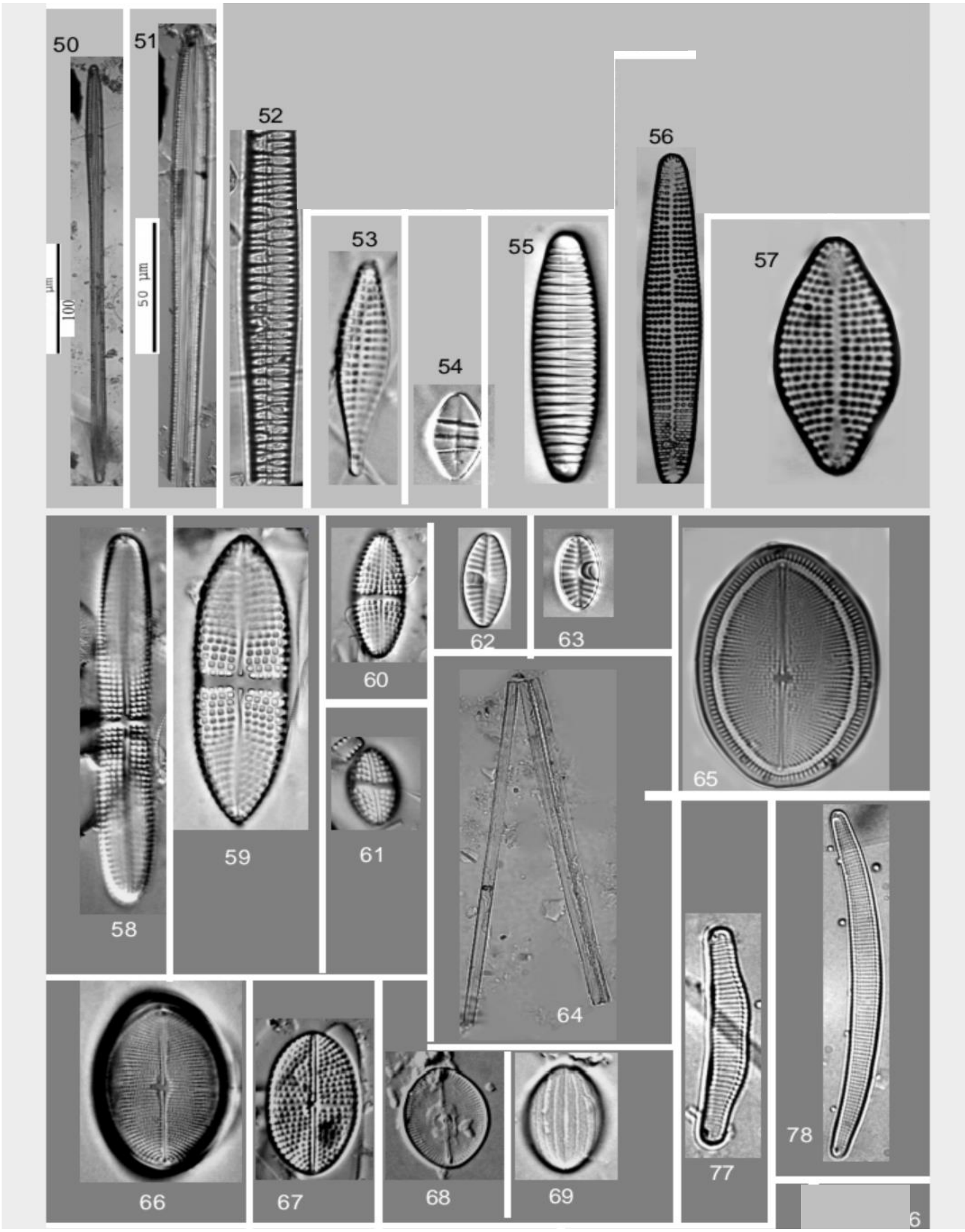
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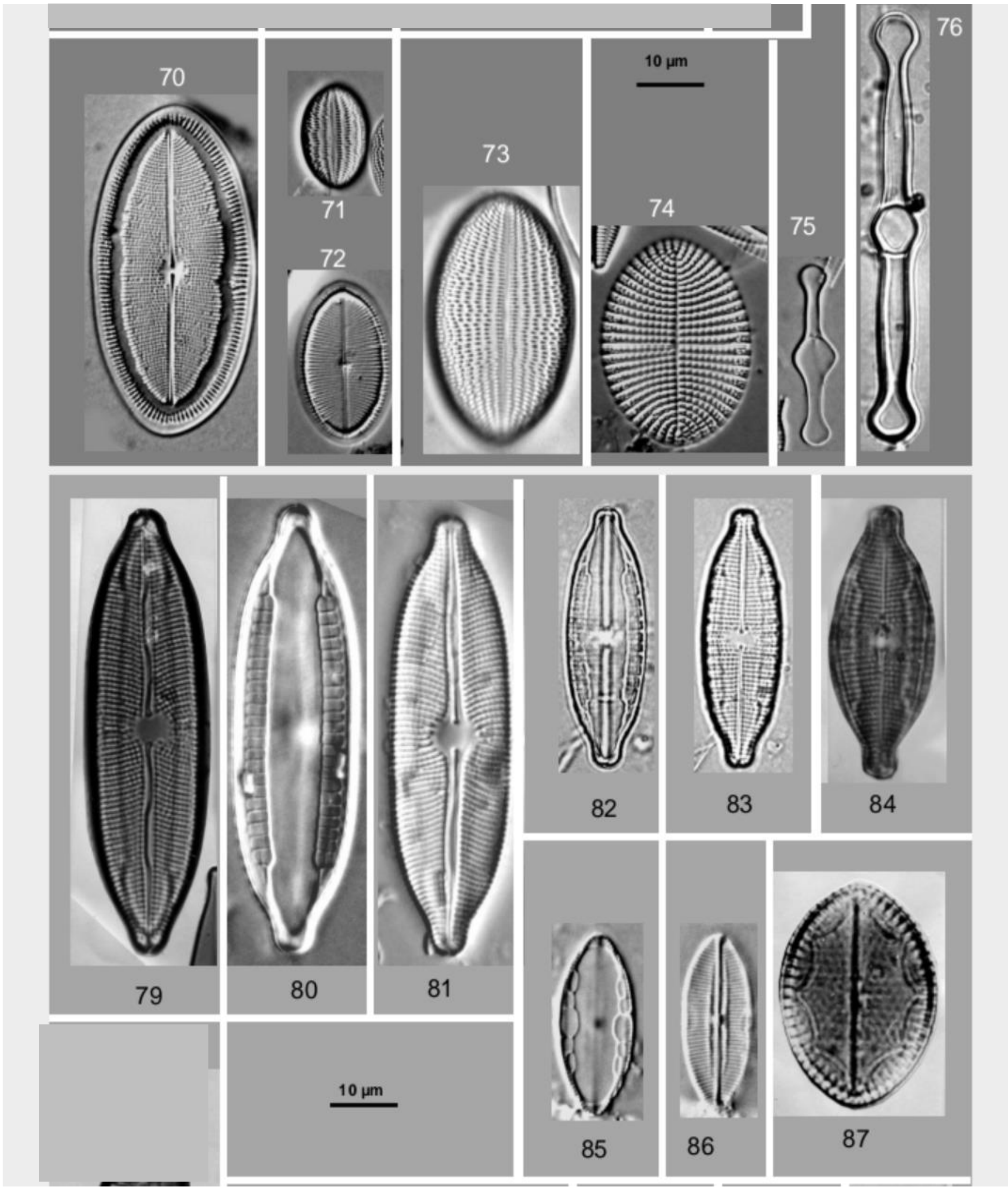
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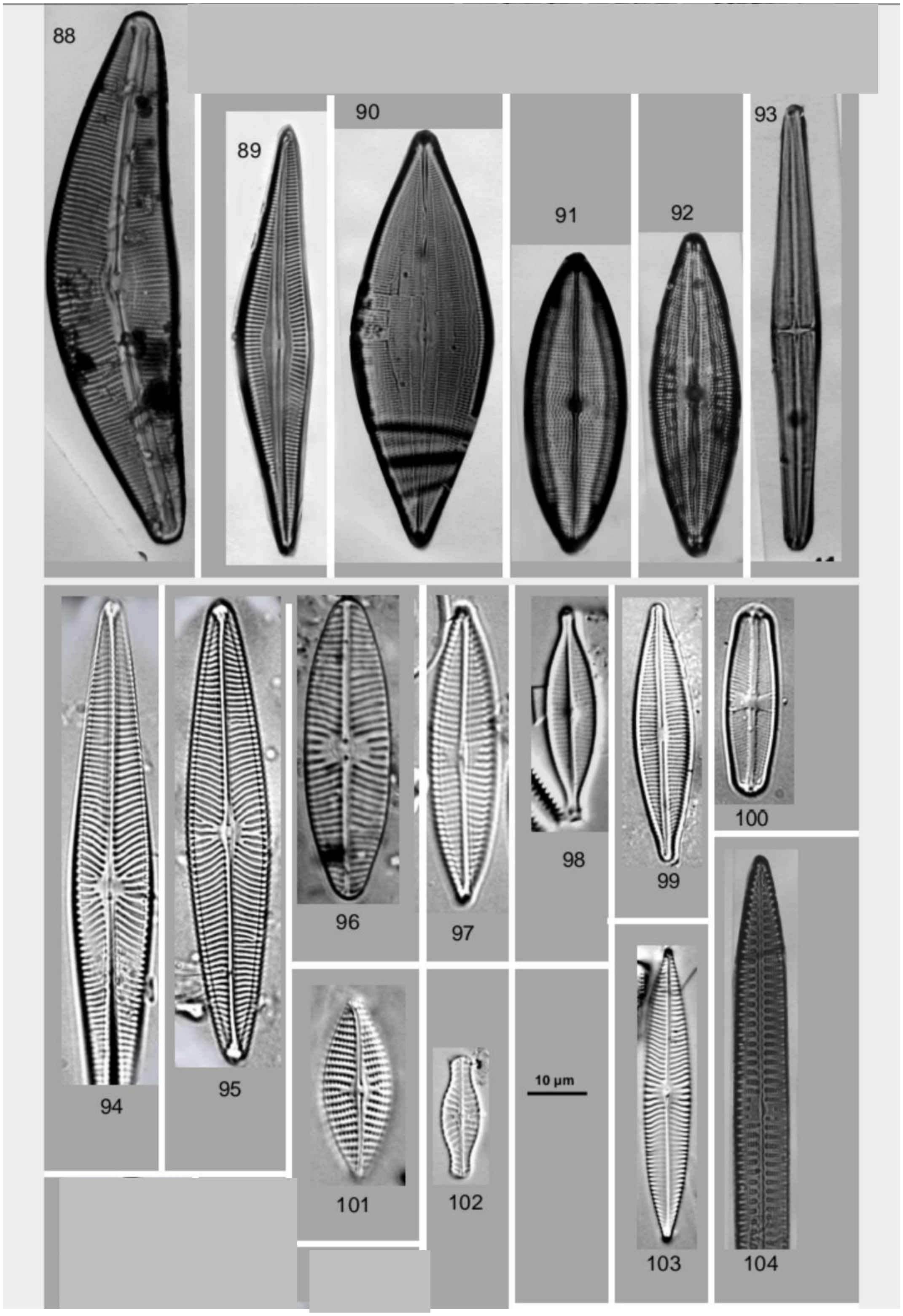
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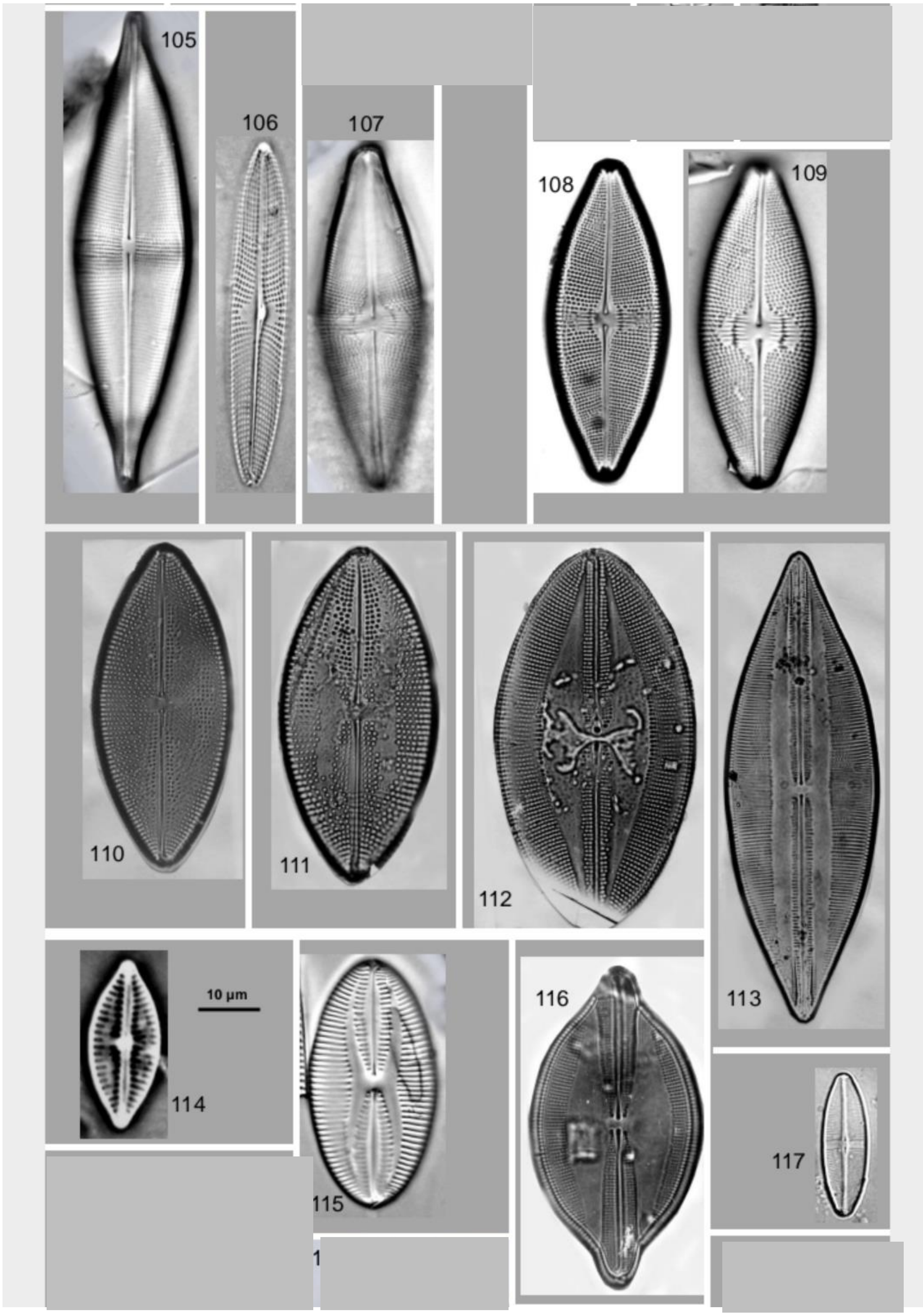
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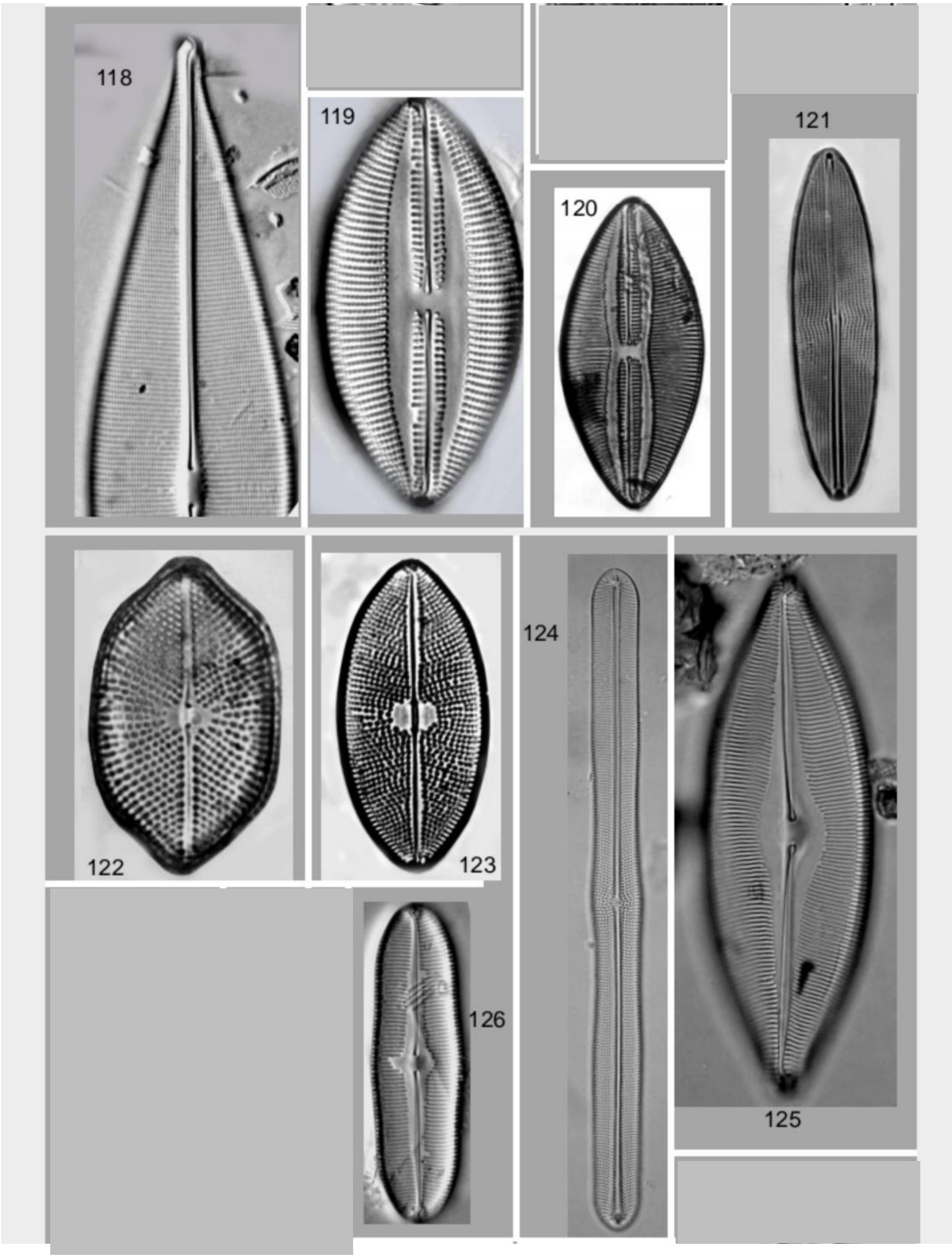
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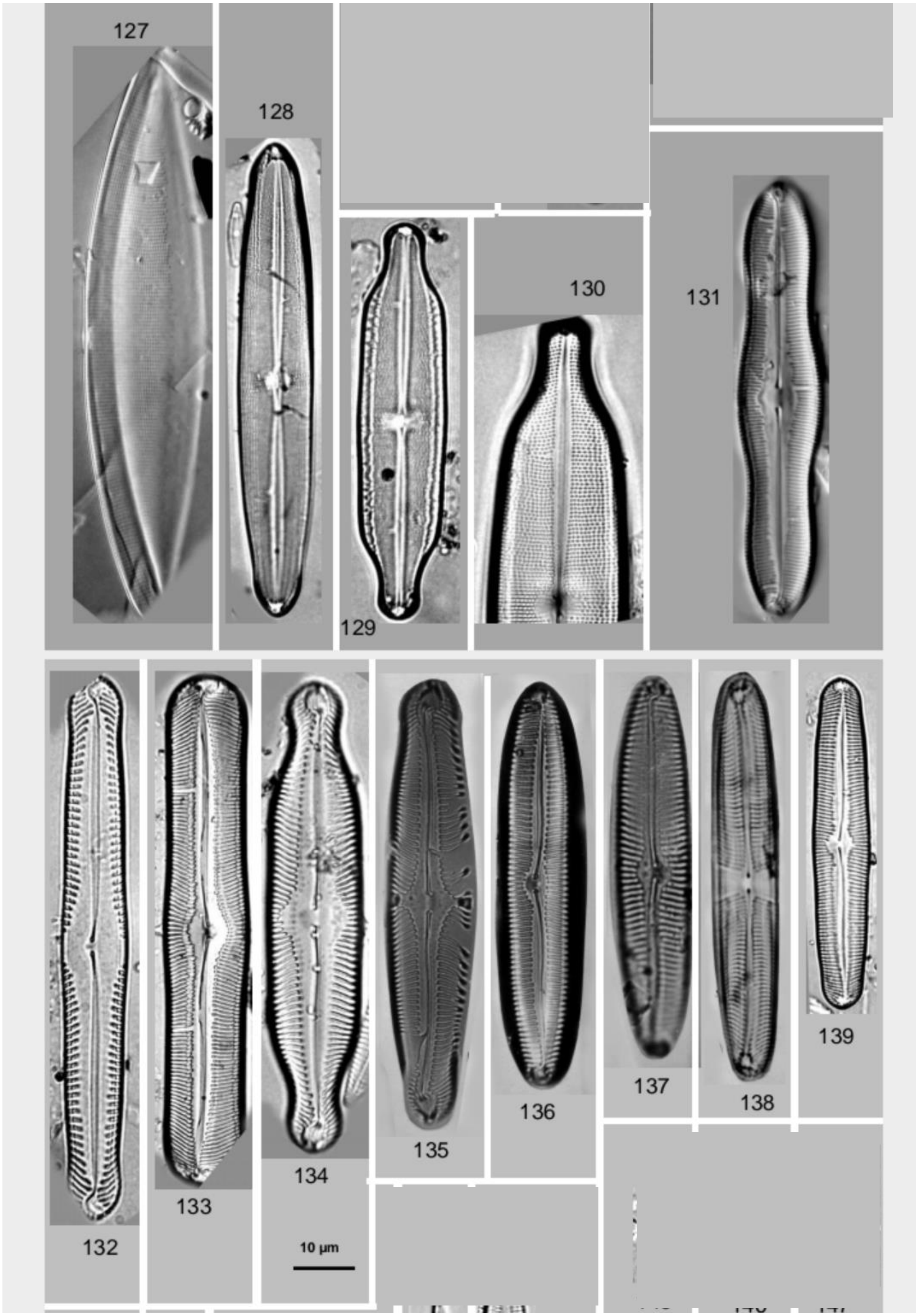
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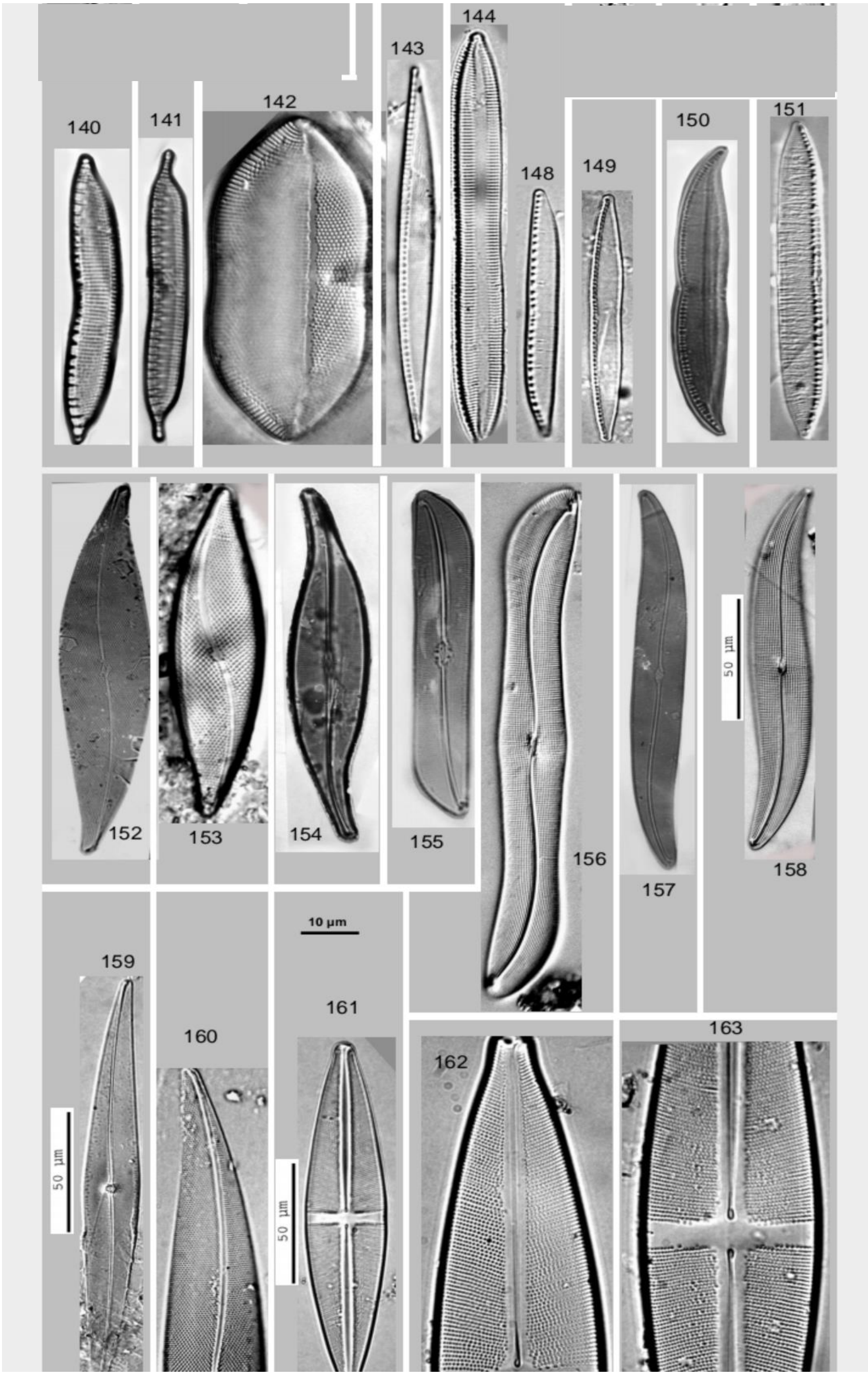
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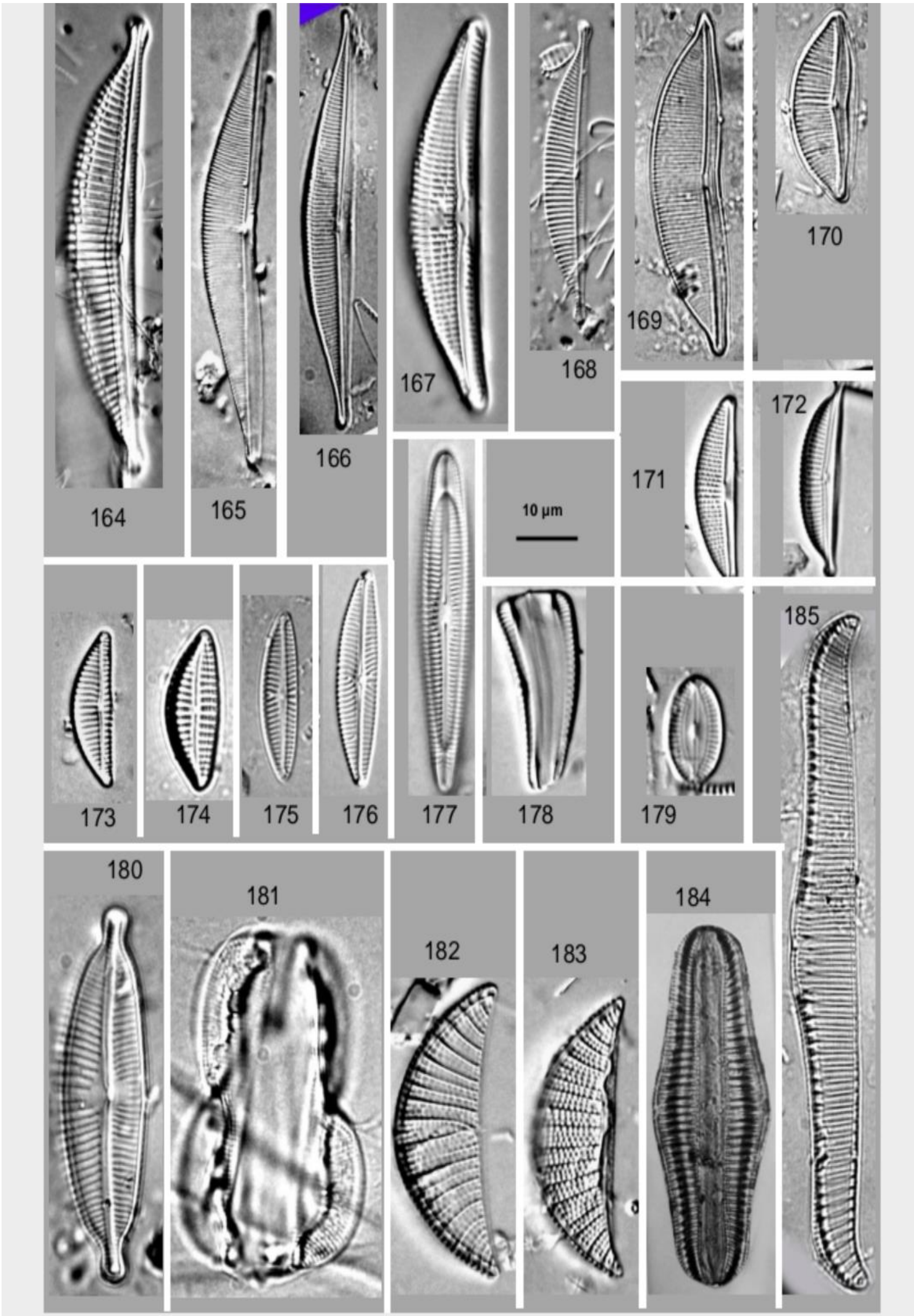
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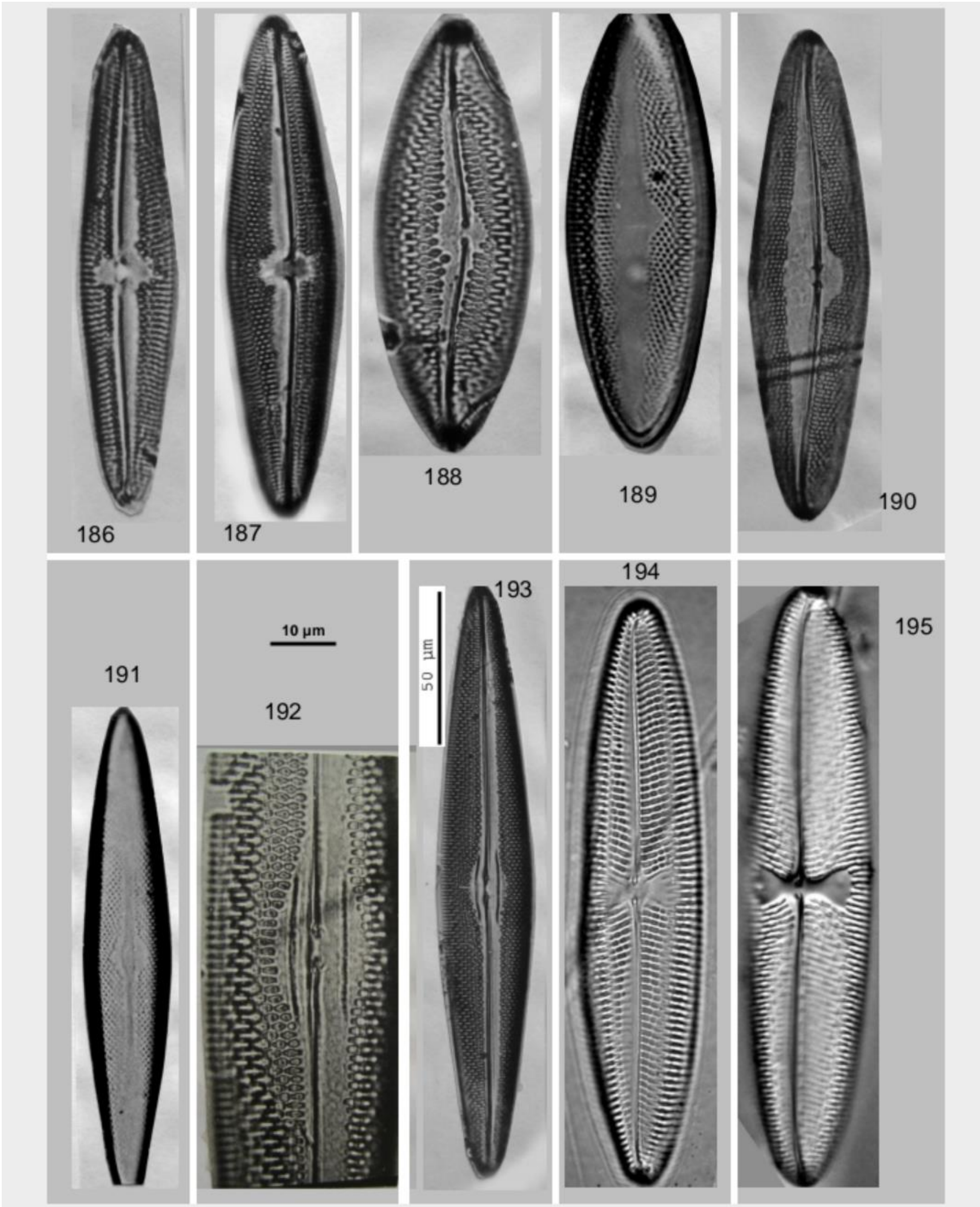
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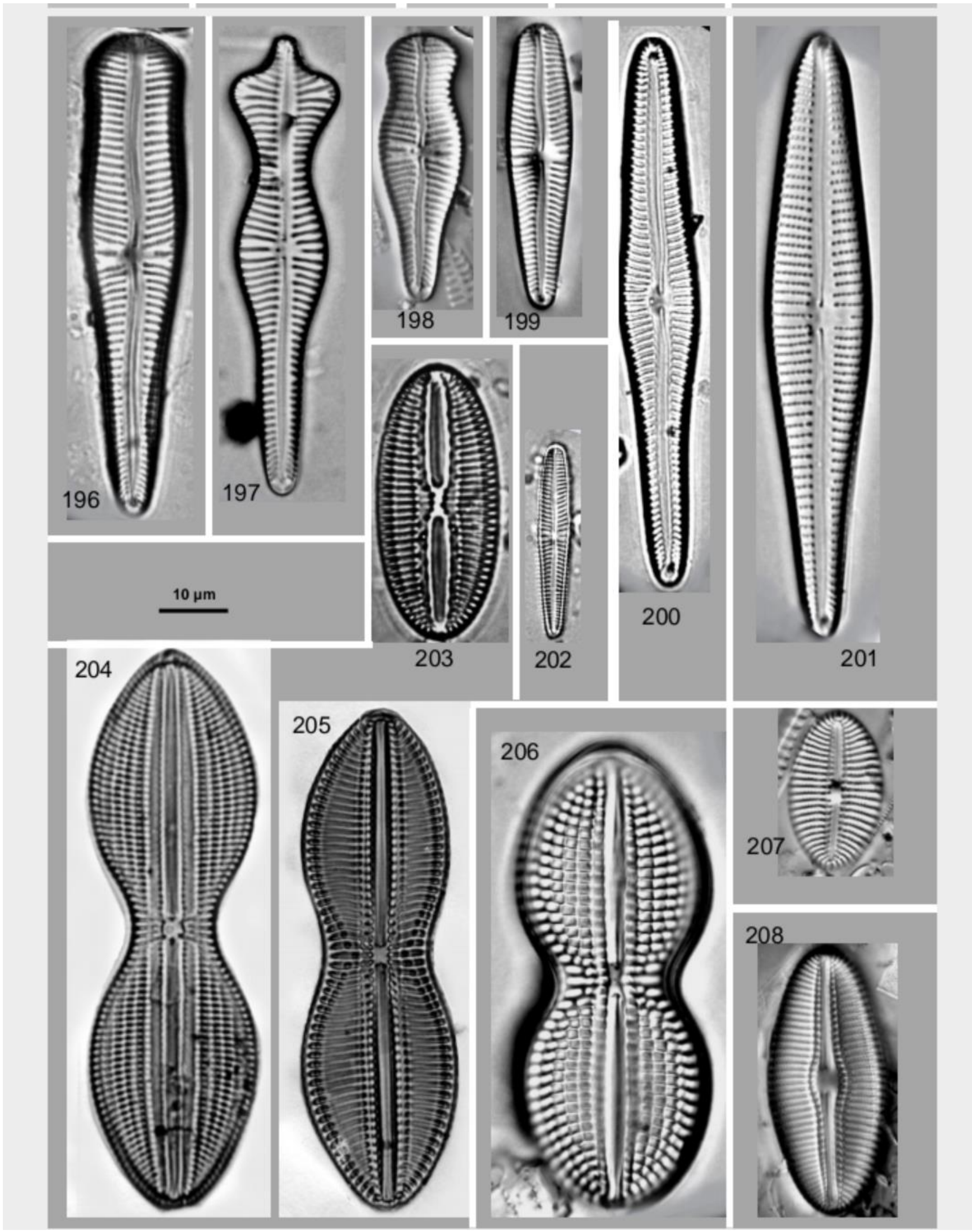
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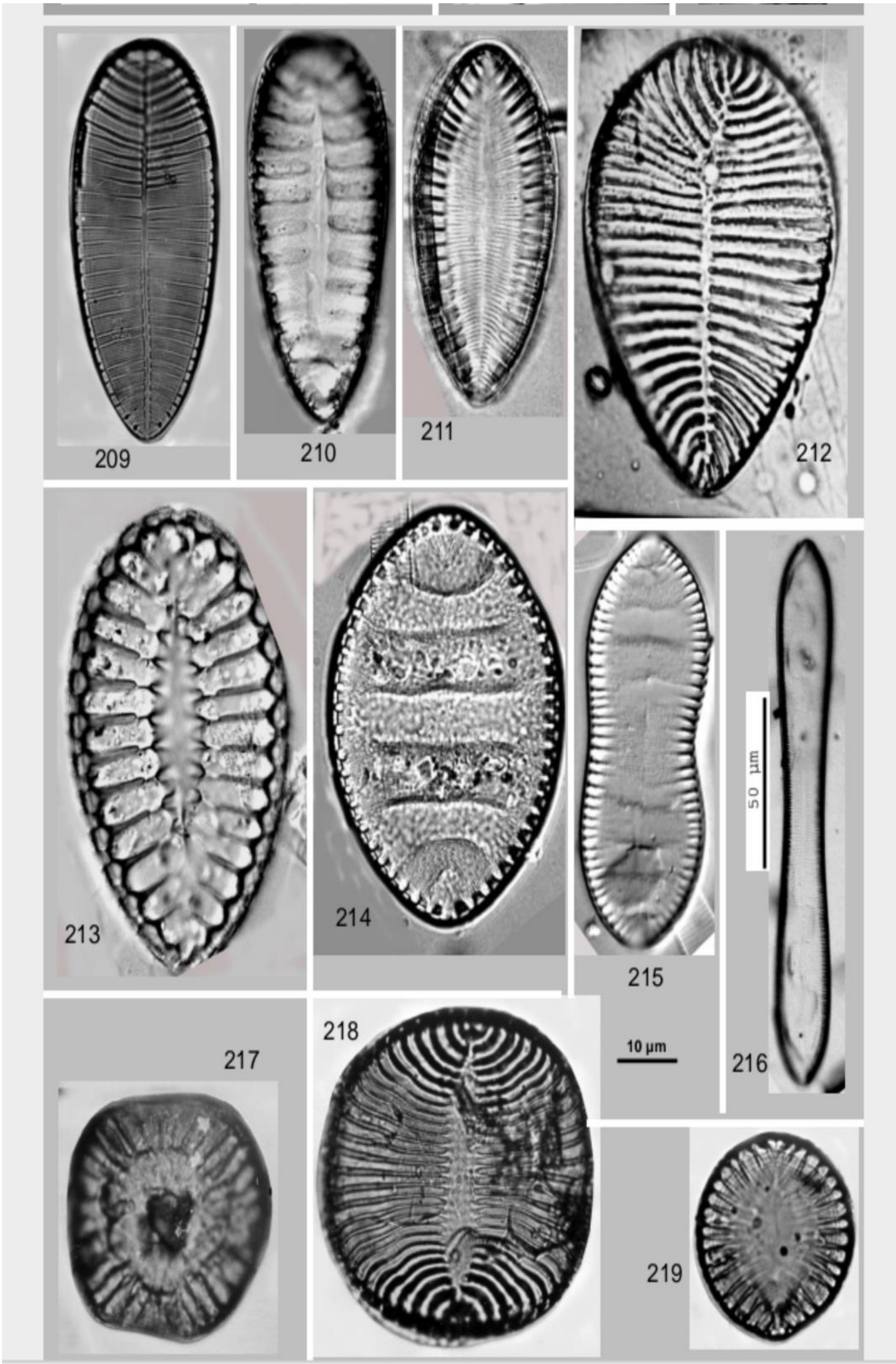
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CHAPTER THREE

MACROPHYTES

Abdul Ridha A. Al-Mayah[1] and Taha Y. Al-Edany[2]

[1]Dept. of Ecology, College of Science,
Univ. of Basrah, Iraq
[2]Dept. Plant Protect, College of Agriculture,
Univ. of Basrah, Iraq

Introduction

Plants are the primary source of energy in the biosphere and are therefore the basis of all life on land, in fresh water and in the oceans. They also sustain life by providing food, shelter, and oxygen and play a fundamental role in regulating world climate. For humankind plants provide a great deal of timber and medicines, fibers and dyes, spices and beverages, oils and fuels.

They sustain us spiritually, too, by clothing the landscapee and beautifying our parks and gardens as well as the wild places.

To destroy such an essential resource appears to be madness, yet in yielding important human foods and commodities plants have been killed. Huge areas of date palm cultivation have been completely destroyed and millions of trees have been killed and felled in the southern Iraq especially on the banks of Shatt al-Arab in Basrah during the Iraqi-Iranian war from 1980-1988. Also, tens of thousands square kilometers of the Iraqi marshlands have been desiccated due to drainage schemes during the years 1990-2000.

Relatively large number of species described in different habitats in Basrah (30% of the total number) belongs to the families Gramineae and Leguminosae, the most important two families of plant kingdom, producing food grains for human beings and animals as well as improvement of soil properties by fixation of nitrogen by their roots. Vegetation of Basra exposed to different degrees of damage. For example, about one quarter of the flowering aquatic plants have not been collected since the desiccation of the marshes but some of them may be occur gradually in the coming years. Mesophytes are generally less affected except the cultivated date palms which exposed to catastrophic damage during the first gulf war (1980-1988). So many other species in the desert (xerophytes) are also exposed to huge damage due to the extension of tomato cultivation in Zubair, Safwan and other localities, the compact of soil by tanks and other army instruments during the three previous gulf wars, overgrazing and fuel gathering. After rehabilitation of marshes the water reeds has started growing again in the well-flooded areas. Care should be focused on developing such useful plant in the marshy areas of Basrah.

Physiographic Regions and Districts of Basrah

Basrah Province includes three physiographic districts, these are:

1. **Basrah Estuarine District (LBA)**

   This district covers the lower part of the lower Mesopotamian Region, from Qurna on the south-east margin of the marshes to Fao at the end of Shatt al-Arab on the Arabian Gulf.

2. **Southern Marsh District (LSM)**

   The limits of this district cannot be defined precisely: the large distinctive but unstable tract of country-mostly occupied by permanent marsh, through which the lower reaches and distributaries of the Tigris and Euphrates flow, approximately in the triangle Amara – Nasirya – Basrah and extending eastwards from the Tigris to the Persian frontier. The southern part of this district lies in Basrah Province. This district belongs to lower Mesopotamian Region (L) too.

3. **Southern Desert District (DSD)**

   This district belongs to Desert Plateau Region. The district covers the southern (lower) part of the region which lying south- east of the Wadi al-Khirr, through Badiya Al-Janubiya to safwan and Um Qasser.

Number of species and Botanical inventory

There are more than 250000 described species of plants in the world (Heywood 1978). Plant families vary considerably in the number of their constituent species. For instance, the Compositae contains 25000 species and the Orchidaceae contains 18000 species while there are many other families having very much smaller number of species for example Butomaceae and Liliaceae are families of aquatic and marsh herbs each of them having only a single genus with a single species.

In Iraq there are more than 3000 described plant species, of wich 610 (20%) occur in Basrah. Most plant species of Basrah belong to the family Gramineae (90 species) and the family Leguminosae (86 species). This means that these two families contain 176 species or 30% of the total number of species occurs in Basrah province.

The diversity of plants is not evenly distributed around the globe. Plant Conservation Office (Davis *et al*; 1994-96) has identified 234 areas of especially high species diversity and these frequently coincide with areas of high habitat diversity.

Within an area biodiversity can be comparatively quantified, through inventory, by assessing the local distribution of species, similarity between groupings of species and the rate change between groups of species.

Plant diversity of Basrah

The vegetation of Basrah area can be classified into five ecological groups:

1- Aquatic plants (Lacustrine), Hydrophytes
2- Riverine plants (Reparain)
3- Field and weed plants (Mesophytes)
4- Saline plants (Halophytes)
5- Desert plants (xerophytes)

Aquatic plants

There are more than 100 species of aquatic and amphibian species occur in Iraq (Table 1). 20 of which occur outside of Basrah Area. The remaining eighty species mainly distributed in the southern marshes district (LSM) and extend to Shatt al-Arab and its lateral branches and canals. The aquatic plants of Basrah contain: three species of pteridophytes, 67 species of flowering plants & 8 species of algae. The pteridophytes are:

1-*Salvinia natans* (Ghiziziya in arabic)
The most common free-floating species.
2-*Marsilea capensis* (in Arabic called Zamra or Charkhat)
Distributed in Bani Mansor, Qurna and Medaina
3-*Ceratopteris thalictroides* (Barbakh Hor)
Dist. 10 Km west of Medaina

From the above 3 species only the first species has been recently collected after the restoration of some parts of the marshes.

Table 1. The most common aquatic plants historically recorded in Basrah with their habitat and Distribution.

Botanical name	Habitat			Distribution			ollected recently
	Submerged	Floating	Emerged	Marshes	Shatt Al-Arab	others	
Alisma plantago-aquatica			+	+			
Alternanthera sessilis			+	+	+	+	+
Arundo donax			+		+	+	+
Bacopa monnieria			+	+	+	+	+
Butomu sumbellatus			+	+			
Ceratophyllum demersum	+			+	+	+	+
Ceratopteris thalictroides		+		+			
Cladium mariscus			+	+			+
Cyperus malaccensis			+		+		+
Cyperus rotundus			+	+	+	+	+
Lemna gibba		+		+		+	+
Lemna minor		+		+		+	+
Limnophila indica	+			+			
Ludwigia repens		+		+	+		+
Marsilea capensis		+		+			
Myriophyllum spicatum	+			+			+
Myriophyllumverticillatum	+			+			
Najas marina	+			+			+
Najas minor	+			+			+
Nymphaea alba		+		+			+
Nymphoides indica		+		+			
Nymphoides peltata		+		+			
Ottelia alismoides		+		+			
Paspalum paspaloides			+	+	+		+
Phragmites australis			+	+	+	+	+
Polygonum lapathifolium			+	+			
P. persicaria			+			+	
P. salicifolium			+	+			
Potamogeton crispus	+			+	+		+
Potamogeton lucens	+			+	+		+
P. nodosus		+		+			+
P. pectinatus	+			+		+	+
P. perfoliatus	+			+	+		+
Ranunculus sphaerospermus	+			+			+
Rorippa amphibia			+	+			
Roppia maritima	+			+		+	+

Sagittaria sagitifolia			+	+			
Salvinia natans		+		+	+	+	+
Schenoplectus litoralis			+	+	+		+
S. triquater			+	+		+	
Typha domingensis			+	+	+	+	+
Utricularia australis	+			+			
Vallisneria spiralis	+			+	+	+	+
Zannichellia palustris	+			+			+

Sixteen species of the 40 aquatic flowering plants previously recorded in our area (Table 1) have not been recollected since the desiccation of the Iraqi marshes in 1990. These species which indicated on the Table 1 are only distributed in the marshes. Because of the catastrophe of the drainage of the marshes by the previous regime of Iraq during the past 2 decades, many important species of aquatic plants have been lost or disappeared.

The drying of the marshes caused a huge damage not only to the plant biodiversity but also to the whole ecosystem of the marshland of Iraq and in long term may have a disastrous impact on both species' diversity and ecological processes.

The other Hygrophilous (Table 1), and the amphibian or semi-aquatic plants (Table 2) which have wider range of distribution and not restricted only to the marshes have been less affected by the impact of the marsh desiccation.

However, many species found in less density than they were before such as *Plantago lanceolata* and *Sonchus maritimus*.

Riparain plants

These groups of plants are growing by streams or on or near river banks. Just on the bank of the river or a little inland from the river a dense population of thick small shrubs or herbs of Legumes such as *Glycyrrhizaglabra* (in Arabic Suse), *Prosopis farcta* (Kharnob) and *Alhagi graecorum* (Aaqul) are widely grown and obviously dominated. Other species but less dominant such as *Capparis spinosa* are also common. In more saline areas, *Suaeda baccata*, S. *vermiculata, Tamarix brachystachys* and *T. ramosissima* (Tarfa or zor) are usually dominated.

Field and weed plants

The most common weed plants growing in fields and irrigated cultivated districts, in addition to the reverine plants are shown in Table 3. The presence or absence of such a species depends on the duration of the species and the seasons of the year.

Mesophytes

Degradation of date palm orchards started in the middle of the last century, firstly due to floods of ShattAl-ArabRiver in the fourteenth, fifteenth and seventeenth decades. Thousands of young date palm trees were killed.

Salinity of soil increased and qualitative features of soil declined. Water properties began to vary due to the foundation of some factories the river side where their waste waters are thrown directly.

Waste water of more then two million people is thrown directly or indirectly via Shatt Al-Arab including swage or restaurants remains.

Drainage water of irrigated lands of north and middle Iraq as well as large dams constructed along Tigris and Euphrates in Iraq, Syria and Turkey decrease quantity of water reaching Shatt Al-Arab in addition to eight years of Iraqi-Iranian war (1980- 1988). The most effective factor was acting to destroy large are of date palm orchards.

Catastrophic damage occurred due to the desiccation of the marsh lands where humidity with increasing of atmospheric temperature and storms which increased infection by insects and fungi.

Table 2. A list of amphibian plants found in damp soils and tidal estuaries

Aster tripolium
Bolboschoenus maritimns
Cynancum acutum
Cyperus alopecuroides
C. corymbosus
C. difformis
C. laevigatues
C. michellianus
Diplachne fusca

Echinocloa cruss-galli
Eclipta alba
Fimristylis bisumbillata
Fimristylis sieberiana
Torolinium odoratum
Juncusa cutus
J. articulatus
J. rigidus
Plantago lanceolata
Lycopus europaens
Mentha longifolia
Panicum repens
Papelidum maritimum
Phyla nodiflora
Polypogon monspeliensis
Pulicaria revularia
Sonchus maritimus
Verbena officinalis

Table 3. Alphabetical list of the most common field weed plants of Basrah.

Botanical name	Dicots		Monocots	
	annual	Perennial	annual	perenial
Anagallis arvensis	+			
Cardaria draba	+			
Convolvulus arvensis		+		
Cynodon dactylon				+
Eragrostis diarrhera			+	
Euphorbia helioscopia	+			
Imperata cylindrica				+
Inula graveolens	+			
Lathyrus sativus	+			
Malva parviflora	+			
Medicago hispida	+			
Melilotus indica	+			
Trifolium repens		+		
Solanum nigrum	+			
Sonchus asper	+			
Sonchus oleraceus	+			

Table 4. The most common Halophytic plants of Basrah.

Atriplex leucoladia
A.tatarica
Aleuropus lagopoides
Cressa cretica
Frankenia intermodia
Halocharis sulphurea
Halocnemum strobilaceum
Limonum spicutum
Salicornia europaea
Salsola tetrandra
Seidlitzia rasmorinus
Suaeda baccata
S. vermiculata

The species listed in Table 4 can be sited as common halophytic plants in Basrah and southern Iraq. But the most common species in a very saline are-as are *Halocnemum strobiluceum* (on a dry saline soil) *salicornia europaea* (in a moist or wet saline)

Southern Desert District (DSD)

Desert vegetation is that which often appears luxuriously and uniformly distributed in spring (Table 5), but which disappears completely during summer or survive very sparsely in special and well-defined localities. Agri-culturally speaking it is generally impossible to cultivate without irrigation. Buxton (1923) divided desert into two categories, semi–desert (sub–desert) which provide grazing, though often bad grazing, at all seasons. By contrast desert (absolute desert) is territory so devoid of vegetation that cannot pro-vide appreciable grazing. The greater part of the desert region in Iraq if not all of it is classified as sub – desert. Locally in the sub–desert there may be barren tracts almost devoid of vegetation. Examination usually raveals that these de-sert places are either of secondary origin (the result of overgrazing and exces-sive fuel gathering for prolonged period of years) or due to local features of soil or topography or so on. Only the extreme southern corner of Iraq does the sub desert begin to give way to desert in the stricter sense.

Usually the barren tract found around wells, settlements and camping grounds and along ancient caravan routes are the result of the destruction of the original sub – desert vegetation by intense and prolonged overgrazing and fuel gathering especially in the later 2-3 decades as it will be shown. There are about 455 wild species belong to 35 different families of moncots (4 families) and dicots (31 families) growing in Basrah province of which 209 species (40%) grow in the desert part to the west and southwest of the city.

122 species (58.8%) of the desert plants are annual herbs, 43 species (20.5%) are perennials, but only 2 species (0.9%) are recorded to be biennials. The remaining are 5 species (2.4%) ranging between annual and biennial another 6 species (2.8%) ranging between annual and perennial habitats.

Though herbs are represented by 178 species (80%), 22 species (10.5%) are shrubs, 2 species (0.9%) one subshrubs, 6 species (2.8%) are suffruticents while only one species is real tree that is *Tamarix aphylla* (Athel)

Although xerophytes are less affected than hydrophytes or mesophytes (especially date–palm orchards) some of them exposed to huge damage, others are lost or disappeared due to the wrong policies of the previous regime of Iraq through more than two decades. For example, Forest man-made of tamarisk (*Tamarix aphylla*) were exposed to huge damage due to the extensive need for fuel by people through that period because of the shortage in petroleum fuel supply. Some other important species that were common in more than one location of Basrah desert forming natural community one now very difficult to be found for example *Calligonum comosum*. Another important species (*Salvia spinosa)* was very common in the desert near Zubair become very rare in the recent time due to the compact of soil by tanks and other instruments during the army operations of two big wars in this area. Change in the climate due to dessication of marshlands also affect this part of desert to a limited extent.

Phyto sociology associations of the desert

Some plant communities were historically observed in the desert west and south west of Basrah, some of them occupying many square kilometers in one or more locations of the desert (See enclosed maps). They are:

1- Haloxyletum ammodendri

Long (1956) mentioned it as an association of *Haloxylon ammodendron* (shrub) and *Panicum turgidum* on moving dunes. This community was found some 110 Km S.W. of Basrah.

Charcoal burners digging up the root and all plant. The dominant species of the community is *H. ammodendron* a woody shrub of tree 2zlike form some 2-3 m high in appearance not unlike a tamarisk.

2- Ziziphetum nummulariae

Zohary (1940) found single shrubs of *Ziziphus nummularia* near Luqait between Basrah and Ur. Guest (1966) found the community along the wide flood plain of Wadi Busaiya between Busaiya and Tuqaiyid. The authors found it in Jerishan near Wadi Al-Batin at the end of the last Century.

Occasional stunted *Ziziphus* shrubs and small culms of *Lycium depressum* another thorny shrub of similar size (2-3m high) under the shade and protection of the two leading shrubs a numder of meadow grasses and other small herbs flourish like *Convolvulus pilosellaefolius, Emex spinosus, Trigonella anguina* etc.

*Ziziphus nummularia*has managed to survive even in remote desert localities due to two factors:

a- The extremely thorny and bushy nature of both leading species of the *Ziziphetum.*

b- Wide spread popular belief that *Ziziphus* is scared or haunted.

3-Haloxyletum salicornici

Found between Twai al Hashash and Khubrat al-Boliya. Zohary (1940) considered this probably the most important and most characteristic association of the Saharo-Sindian region.

According to Guest (1966) it is predominate community in the most part of southern desert. The dominant species of the community is *Haloxylon salicornicum* (Rimth).

The co-dominant species are *Salsola jordanicola*, *Aristida plumosa*, *Anabasis setifera* and *Artemisia herba-alba*.

Table 5.: Alphabetical list of monocot and dicot families growing in Basrah desert.

Class	Serial	Species / Families	Number in Basrah	Number in desert	Duration					Habitat				
					Annual	Annual-Biennial	Annual-Perennial	Biennial	Perennial	Herbs	Shrubs	Sub-shrubs	suffrutiscents	Trees
Monocots	1	*Cyperaceae*	15	1	-	-	-	-	1	1	-	-	-	-
	2	*Gramineae*	81	24	14	-	-	-	10	24	-	-	-	-
	3	*Iridaceae*	2	1	-	-	-	-	1	1	-	-	-	-
	4	*Liliaceae*	9	8	4	-	-	-	4	8	-	-	-	-
Dicots	5	*Aizoaceae*	1	1	1	-	-	-	-	1	-	-	-	-
	6	*Apocynaceae*	4	1		-	-	-	-	-	1	-	-	-
	7	*Balanophoraceae*	1	1	1	-	-	-	-	-	1	-	-	-
	8	*Boraginaceae*	9	9	6	-	-	-	-	6	3	-	-	-
	9	*Caryophyllaceae*	20	17	14	-	-	-	3	17	-	-	-	-
	10	*Chenopodiaceae*	17	12	3	-	-	-	-	3	9	-	-	-
	11	*Cistaceae*	4	4	2	-	-	-	-	2	2	-	-	-
	12	*Cleomaceae*	2	2	1	-	-	-	1	2	-	-	-	-
	13	*Compositae*	51	35	23	-	1	2	4	30	-	1	4	-
	14	*Convolvulaceae*	5	3	-	-	=	-	2	2	-	-	1	-
	15	*Cruciferae*	46	22	18	-	1	-	2	21	-	-	1	-
	16	*Cucurbitaceae*	3	1	1	-	-	-	-	1	-	-	-	-
	17	*Dipsacaceae*	2	1	1	-	-	-	-	1	-	-	-	-
	18	*Euphorbiaceae*	18	6	3	-	-	-	3	6	-	-	-	-
	19	*Geraniaceae*	7	4	-	3	-	-	1	4	-	-	-	-
	20	*Labiatae*	5	3	-	-	-	-	2	2	-	1	-	-
	21	*Leguminosae*	71	13	8	1	-	-	2	11	2	-	-	-
	22	*Malvaceae*	10	1	1	-	-	-	-	1	-	-	-	-
	23	*Orbanchaceae*	3	2	-	-	-	-	2	2	-	-	-	-
	24	*Papaveraceae*	4	3	3	-	-	-	-	3	-	-	-	-
	25	*Plantaginaceae*	8	6	5	1	-	-	-	6	-	-	-	-
	26	*Polygonaceae*	7	2	1	-	-	-	-	1	1	-	-	-
	27	*Resedaceae*	7	7	2	-	4	-	1	7	-	-	-	-
	28	*Rhamnaceae*	3	1	-	-	-	-	-	-	1	-	-	-
	29	*Rosaceae*	3	1	1	-	-	-	-	1	-	-	-	-
	30	*Rubiaceae*	7	3	3	-	-	-	-	3	-	-	-	-
	31	*Scrophulariaceae*	2	2	-	-	-	-	1	1	1	-	-	-
	32	*Tamaricaceae*	8	1	-	-	-	-	-	-	-	-	-	1
	33	*Thymeliaceae*	2	2	1	-	-	-	-	1	1	-	-	-
	34	*Umbelliferae*	9	5	5	-	-	-	-	5	-	-	-	-
	35	*Zygophyllaceae*	9	4	-	-	-	-	3	3	1	-		-

*All numbers mentioned are approximate.

4- Rhanterietum epapposi (Arfaj)

This most important community predominates over a large tract between Busaiya and Um Qasser. Along the Busaiya-Zubair tract *Rhanterium epapposum* is the dominant shrub over some 100 out of 180 Km. The densest stand is observed at Um Qasser. Economically the *Rant-erietum* is of great importance to the desert dwellers both as a source of fedder and fuel.

There are certain districts that have been completely denuded of *Rhanterium epapposum* for instance the desert of the vicinity of Zubair. Of the major associates of *Rhanterium* we can observe *Aristida plumosa* near Busaiya and in the Batin.

5- Cornulacetum leucanthae

This community has been denoted in the middle of a very large territory of Haloxyletum salicornici stretching from Jarishan near the border of Kuwait to Jaliba near south west shore of Hor Al-Hammar, *H. salicornicum* is generally associated with *Cornulata leucantha* (Chibchab) Cornulacetum merely represents a local degradation stage in the more important and extensive Haloxyletum.

6-Anabasetum setiferae

Covers a limited area on silty soil near Khadhr al-Mai, *Agathophora alepecuroides* is co-dominant in some parts of this area, the next major associate being *Haloxylon salicornicum*, then *Cornulaca monacantha* and *Salsola subaphylly, Anabasis setifera* has been noted between Zubair and Basrah and 50-80 Km E- S.E of Busaiya.

7-Anabasetum articulatae

This community has been observed in the vicinity of Khadhr al-Mai. *Anabasis articulatum* the predominant species of the community is a halophyte though to some extent able to endure saline soils.

8- Convolvuletum oxyphylli

The existence of this community is in the environs of Zubair (about 15 Km S. by W. of Zubair) and it is the only place of Iraq where *Convolvulus oxyphyllus* is observed as the dominant plant. Associate perennial species were *Panicum turgidum, Rhanterium eppaposum* with *Aristida plumosa* annuals are *Stipa capensis*, *Neurada procumbens and Emex spinosus.*

9- Calligonctum comosi

Calligonum comosum is an important associate of *Haloxylon ammodendron* on sand dunes in the southern desert. It is found also as an occasional species in other sandy habitats where *Haloxylon ammodendron* is absent at Jabal Sanam, Ghazlani and between Basrah and Ur.

10. Haloxyletum articulati

This community is observed only in the Southern desert in the Batin Valley near Jarishan, near Jabal Sanam and near Ghazlani. The habitat in each place occupied by *Haloxylon articulatum* being sandy gravel.

11. Halocnemetum strobilacei

This community thrives in the most saline terrains, on saline mud flats at Basrah and Um Qasser. Here the large clumps of *Halocnemum strobilaceum*were predominant. Part of the intervening spaces being occupied by abundant *Aeluropus lagopoides* and frequent plants of *Cressa cretica.*

12. Salsoletum longifoliae

The leading member of this halophytic community is probably *Salsola longifolia.* The association has been found about 35 km S.E. by S. of Zubair where *Bienertia cyloptera* was a frequent associate and *Halocnemum strobilaceum* a rare one.

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CHAPTER FOUR

ROTIFERA

Malik H. Ali and Huda K. Ahmed

Dept. Marine Biology, Marine Science Center,
Univ. of Basrah, Iraq

Introduction

Microzooplankton as rotifera, have a very important role in the production ecology of equatic ecosystem (Beers *et al.*,1980; Chang, 1983) and many species of rotifers are good growing organisms and of high nutritional quality for aquaculter (James *et al.* 1987). Rotifera means "Wheeld animals" and when viewed under a microscope these organisms appear to have wheels rotating about the tops of their heads.

The Phylum Rotifera consist of 3 classes, 120 genera and approximately 2000 described species (Mrini,2003). The systematic account of rotifera is as follow: -

Phylum: Ascheleminthes

Class: Rotifera

Basrah inland waters is mainly formed from Shatt Al-Arab River system and a marshes area. Shatt Al-Arab River system which is a large brackish-water river with a many small canals or creeks. Its water characteristics has been described by Douaul and Al-Saad (1985). At Basrah city centre , Shatt Al-Arab River receives several small canals and these canals continuously receives a large supply of untreated sewage , agricultural and industrial wastes (Antoine, 1983), and they considered as highly polluted canals (Al-Saadi and Antoine, 1982).Basrah marshes is a shallow freshwater or oligohaline brackish water receive their water from the two major rivers Tigrates and Euphrates which then formed Shatt Al-Arab .

It is well Known that rotifera plays a most prominent role in such ecosystems , and they are widely used as biological indicators of water quality (Sladecek,1983).Therefore, identification of rotifera from different habitats of Shatt Al-Arab River is very necessary for future work.Actually there is only few studies on rotifers in these aquatic system:

Al-Saboonchi *et al*. (1986) reported 19 species and seasonal density of rotifera in Garma marshes, southern Iraq and found that *Lecan* spp., was the dominant in Garma marshes. Abdual-Hussein *et al.* , (1989) investigated the *Brachionus* rotifera in the open water of Shatt Al-Arab River and in its outlet polluted canals.Ahmed *et al.*,(2005) investigated the rotifers community qualitatively and quantitatively in another site of the Shatt Al-Arab river located between Al-Dair and Khalid bridges and reported that *Ascomorpha* sp., *Ascomorphella* sp. and *Keratella tropica* were the most dominants in all stations of the study.

Ali and Abdulla (1999) investigated the relationship between the rotifers biomass and the phytoplankton in the Shatt Al-Arab river at a station between Al-Chibassy and Al-Kohra during the period from June-1997 to February-1998 and they determined 17 species of rotifers , the four species of the genus *Notholca* were the most important and constituted 56% of the rotifers throughout the period of the study , a positive relationship was found between the biomass of rotifers and the chlorophyll-a values **.** Ahmed & Mohammed (2006) give some notes on the biodiversity of rotifera in the south marshes of Iraq. In the present survey the rotifer species and the density at a different sites of Shatt Al-Arab River system, Basrah, Iraq in June 2005 was investigated.

Summarised Basic Data

The results and basic informations which have been reviewed in the background were reestimated, reordered, summarised and given in checklist, Tables (1 to 6) or Figure (1)

Table 1. Checklist of taxa-composition and the estimated mean monthly density of rotifers community in Garma marshes, Southern Iraq during the period from August-1980 to October-1981.

Number	The Species of Rotifera
1	*Asplanchna* sp.
2	*Asplanchnopus multicep*
3	*Brachiouns havaensis*
4	*Harrinigia sp.*
5	*Keratella cochlearis*
6	*K. hiemalis*
7	*K. procurva*
8	*K. quadrata*
9	*Lecane* (Monostyla) *bulls* *
10	*L*. (Monostyla) *closterocerca* *
11	*L.* (Monostyla) *lunaris* *
12	*L.luna*
13	*L.(lecane) indwigi*
14	*Mytilina bisulcata*

15	*Notholca sp.*
16	*Testudinella patina*
17	*Trichocerca rattus*
18	*T. capucina*
19	*Trichotria teractis*
Mean of Rotifera density (ind./m³/month) =4491	

* Dominant species

Table 2. Taxa-composition and density of rotifers community in the Basrah marshes of Iraq during the period December –2003 and August-2004.

Seriatim	Stations location	The species	Date of collection	Rotifera density (ind./m³)	Percentage of species dominance
	The Marshes of Basrah				
St.1	Al-Nasrania	*Brachiouns urceolaris* *	20/12/2003	33	100%
St.2	Al-Masehab	*Keratella tropica* *	20/12/2003	23	100%
St.3	Al-Depon	*Lepadella Patella*	20/12/2003	1.9	45%
		Asplanchna priodonta			55%
	Al-Depon	*Brachiouns urceolaris* *	3/8/2004	16.6	75.9%
		B. quadridentatus (1) *			12.6%
		Colurella obtuse			12%
St.4	Al-Dawoody	*Brachiouns urceolaris* *	20/12/2003	5.2	40%
		B. quadridentatus (1) *			35%
		Keratella quadrata			25%
St.5	Al-Nakara	*Brachiouns urceolaris* *	20/12/2003	1.1	50%
		B. quadridentatus (1) *			50%
St.6	Al-Barka	*Brachiouns urceolaris* *	20/12/2003	1	100%
	Al-Barka	*Brachiouns urceolaris* *	3/8/2004	22.9	86%
		Gastropus hyptopus			14%
St.7	Al-Salal	*Keratella tropica* *	3/8/2004	31.5	33.3%
		Brachiouns urceolaris *			33.3%
		B. quadridentatus (1) *			23.8%
		B. quadridentatus (2)			9.52%

*Dominant species

Table 3. Check list of taxa-composition of Brachionid rotifers in Shatt Al-Arab river system-Iraq, during the period from January to August 1987.

The Species of Rotifera	**Occurrence**
Genus : *Brachionus* *Brachionus angularis* *B. calyciflorus*	Outlet canals
B. calyciflorus amphiceros *	Organic polluted outlet canals
B. calyciflorus calyciflorus	Outlet polluted canals (Ashar)
B. quadridentatus (short spines form)	Polluted canals
B. quadridentatus (long spines form)	Main river
B. urceolaris *	Open water and outlet canals
Genus: Keratella *Keratella cochlearis* * *K. quadrata* *	Open water and polluted canals
K. tropica	Upstream of Basrah city center
Genus: Notholca *Notholca acuminata* *N. squamula* *	Upstream of Basrah city center Open water
Genus: Platyias *Platyias quadricornis*	Open water of the main river
Genus: Trichoteria *Trichoteria pocillum*	Open water of the main river

*Dominant species

Table 4. The checklist, taxa-composition and the density of rotifers in Shatt Al-Arab river between Al-Dair and Al-Sindibad, South of Iraq, during the period from May to October-2000.

	The Species of Rotifera
1	*Ascomorphella* sp. *
2	*Ascomorpha* sp. *
3	*Keratella tropica* *
4	*Synchaeta* sp.
5	*Epiphanes* sp.
6	*Gastropus* sp.
7	*Resticulas* sp.
8	*Aspianchnopus* sp.
9	*Brachionus urcelaris*
10	*B. quadridutatus.*
11	*Colurella* sp.
12	*Notholca squamula*

13	*Trichocerce* sp.
14	*Filina* sp.
15	*Notomata* sp.
16	*Asplanchna* sp.
17	*Cephalodella* sp.
18	*Monostyla* sp.
19	*Lecane* sp.
20	*Cupelopagis vorax*
21	*Pseudoharringia* sp.
22	*Dipleuchlanis* sp.
23	*Keratella quadrata*
	Mean of Rotifera density (ind./m^3/month) =1806

*Dominant species

Table 5. The checklist, taxa-composition and density of rotifers in Shatt Al-Arab river between Al-Chibassy and Al-Kohra, south of Iraq, during the period from June-1997 to February-1998.

GENERA OF ROTIFERA
Notholica *
Keratella
Brachions
Trichotria
Lecane
Filinia
Platyias

*Dominant genera

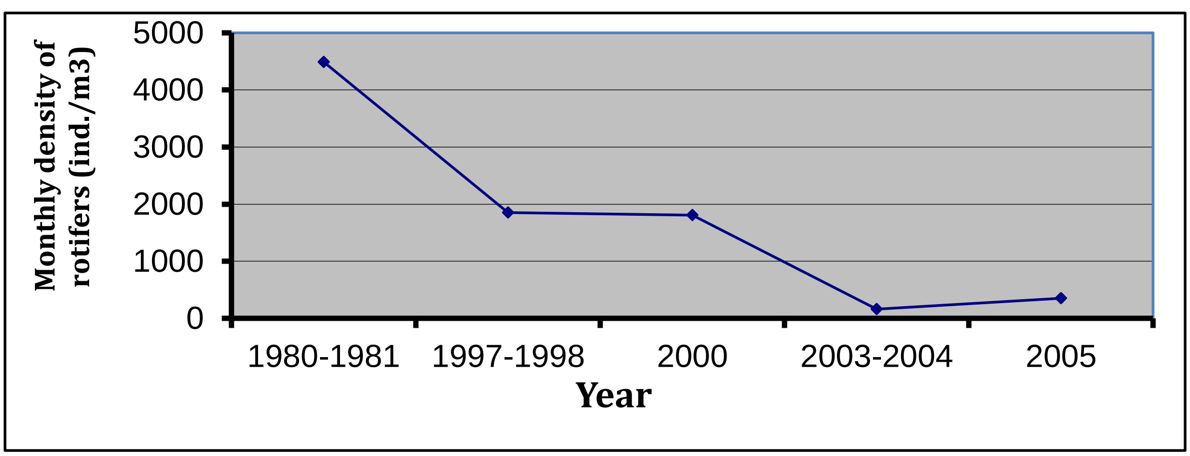

Fig.1. Changes rotifers density (ind./m^3) during the period from 1980-2005 (general estimation)

Table 6. The taxa-composition and density of rotifera community at a different regiones of Shatt Al-Arab River, Basrah –Iraq

Stations	Location of the Stations	The species	Date of collection	Rotifera density (ind./m3)	Percentage of species (dominance)
St.1	Al-Qurna	*Brachiouns urceolaris ** *Euchlanis dilatata*	10/5/2005	3.5	50% 50%
St.2	Al-Hartha	*Brachiouns urceolaris ** *B. angularis*	9/5/2005	134.3	75% 25%
St.3	Al-Masehab	*Brachiouns urceolaris **	9/5/2005	63.7	100%
St.4	Al-Kournish	*Brachiouns urceolaris **	10/5/2005	6.8	100%
St.5	Al-Seeba	*Brachiouns urceolaris**	10/5/2005	17.4	75%
St.6	Shatt Al-Basrah	*B. quadridentatus* (long spines form)	11/5/2005	1.1	25%
St.7	Al-Fao	*Brachiouns urceolaris **	12/5/2005	---------	100%
St.8	Kour Al-Zobeir	---------	11/5/2005	---------	
St.9	Kour Abdulla	----------	12/5/2005	---------	
St.10	Al-Kandag	*B. calyciflorus*	16/6/2005	---------	100%

*Dominant species

CONCLUSION

Rotifers are a microzooplankton organismes and therefore they very sensitive to the environmental changes. Morover, they are very easily transported by water and therefore their distibution is usually regarded as cosmopolitan, particularly in the tropical and subtropical regions. These characters make them, i.e. their species composition and their density (or in general their biodiversity) a very good indicator of different environmental parameters changes, water quality and pollutants. Furthermore, their exsistance usually highly related the nuterients, chlorophyll and the phytoplankton.

Actually, the ecosystems of the Southren Iraqi marshes and Shatt Al-Arab River System showed a dramatic change due to the drying of the marshes after the year 1990 and thus it's more appropriate to compare the biodiversity data between the periods before and after that year. The investigation recognized the following main points: -

First of all, the comparison between these studies reveal a real problem because of the studies were done at quite different sites and seasons. Morover, the sampling techniques were different.

Second, the comparison between the species composition of rotifers in the Basrah marshes before drying off (1980-1981) and after a short time of the marsh's restoration evident a high decline in species numbers, from 19 to only 8 species (Tables 1 and 6).

Furthermore, the dominance and the species composition of the rotifer's community is very different. Most of the species which had recongized in 1980-1981 (Table 1) can not be found in the present time (Table 6). This could be an indication of a high environmental changes.

Third, As the marshes, originally, is a freshwater body and after the drying off the Basrah marshes,the water quality mainly in Garma were highly effected by the breackish water of Shatt Al-Arab.Therefore ,the species composition of the rotifers community of Basrah marshes before was more or less represent a freshwater habitat,whereas after the marshes drying off it became as that of Shatt Al-Arab River. This is very clear when we compair in the results of Tables 1 and 2 with Tables 3, 5 and 6.

Fourth, for Shatt Al-Arab River, the list of 1987 constitutes 12 species of rotifers and the community dominated by 5 species belong to 3 gerenra (Table 3).Whereas, at 1997-1998 and at 2005 the community either dominanted by one of the *Notholica* species or the *Brachiouns urceolaris* (Table 5 and 6).Actually these data are represents the part of the river located between Al-Chibassy and Seeba. However, this comparision indicate that species richness is declined.

Fifth, the highest number of species were found in Shatt Al-Arab River between Al-Dair and Al-Sindibad during October-2000 (Table 4). This part of the River is highly effected by the freshwater influnce of the River Tiger. Whereas the lower part of the Shatt Al-Arab River, from Al-Chibassy to Seeba is more influenced by the tidal marinewater of the Gulf.

Sixth, by following the density values of the rotifers given by for the different studies from the period 1980 to 2005, the overall or the general estimations (Fig.1), the data shows great decrease in populations density.

Seventh, the existence of some species or when dominating the sample indicate some sort of pollution. For example, the presence of *Brachiouns calyciflorus* in Al-Kandag creek (2005) reveal an organic pollution in that creek.

In general,

1- The species composition of the rotifer's community became different and the dominance is changed,
2- Species richnees declined,
3- Density decreased,
4- Biodiversity decreased,
5- The presence of a particular species in a high density reflects a water pollution.

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CHAPTER FIVE

ZOOPLANKTON

Hanaa H. Mohammed[1], Salman D. Salman[2], and Mohammed F. Abbas[2]

[1]Dept. Biological Development in Shatt Al-Arab & NW Arabian Gulf, Marine Science Center, Univ. of Basrah, Iraq.

[2]Dept. Marine Biology, Marine Science Center, Univ. of Basrah, Iraq

Introduction

The first scientific records of zooplankton in the southern of Iraq was that of Gurney (1921), who works on freshwater Copepoda, Cladocera and other Crustacea, collected by Dr. P. A. Buxton from the Tigris River between Amara and Basrah marshes. Mohammed (1965) studied the Cladocera from Qurna to Fao (Basrah) and Al-Saboonchi *et* al. (1986) studied the zooplankton of Garma marshes. Regarding Shatt Al-Arab River systems, Salman *et al*. (1986) reported the results of 18 months monitoring of zooplankton of Mhejran site (nearly in the middle of shatt Al-Arab River). Further studies on the distribution abundance, biomass and dynamics were done by Al-Zubaidi (1998), Ajeel (2004), Ajeel *et al*. (2006). The life cycles of many species of copepods had been studied during 1999-1998 by Mohammed *et al.* (2008).

It is important note that there are dramatic changes in the water quality of the Shatt Al-Arab River occurred from year to year depending on the water budget set by Turkey to the Tigris and Euphrates Rivers. Ultimately the Zooplankton community undergoes great fluctuation in numbers of species and in the abundance of each species. Therefore, continuous monitoring of zooplankton community in this region is of utmost importance in monitoring the changes in this important group of organisms in the Marshes and Shatt Al-Arab Rivers

Materials and Methods

Zooplankton occupy various sub habitats with in the Basrah inland waters like marshes, rivers and ponds. These habitats were sampled using habitats- specific methods to obtain an accurate estimate of abundance of zooplankton. The marsh study was based on materials collected from two sites of Al-Hammar marshes, Al- Barga and Al-Nagara during the period from November 2005 – January 2007. sampling was carried out by 200-micron plankton net, with 40 cm mouth aperture. A hydrobios flow was mounted to the mouth of the net. The towing time was 10 minutes. Samples were fixed in 4% formalin for further laboratory examination.

For Shatt Al-Arab River, zooplankton samples were taken by using a plankton net of 120-micron mesh-size, 40 cm mouth aperture and a digital flow meter mounted in the middle of the mouth. Three replicates of 10 ml each of the 500 ml diluted samples were counting by using Bogorov Chamber with the aid of a dissecting microscope. Samples were collected from shallow pool by using a plastic cylinder (13.0 cm dimeter X 10 cm high). With a capacity / 1 liter. Samples were collected from four regions of the Shatt Al-Arab River, Al-Korneesh, Abo-flos, Al-Seba and Al-Fao.

Results

Species composition of Cladocera in Al-Hammar Marsh

At Al-Hammar marshes only Simocephalus was present throughout the year. *Diphonosoma, Ceriodaphnia, Moina, Macrothrix, Ilyocryptus, Camptocercus, Alona, Pleuroxus and Chydorus* were very common (Table 1). *Dunhevedia* was present in 9 months out of 15 months. Whereas, *Pseudosida*, *Latonopsis, Scapholeberis, Bosmina* and *Leydigia* were present from 4-8 months only. *Graptoleberis* sp. was recorded on one occasion only (April 2006). *Daphnia, Kurzia* and *Alonella* sp. were reported on three months (March, July and September 2006 for *Daphnia*, April, December 2006 and January 2007 for *Kurzia* and January, February and October for *Alonella*).

In the following is a List of the Cladocera encountered in Al-Hammar Marsh:

Diphanosoma brachyurum
D. orgidani
D. leuchtenbergianum
Pseudosida sp.
Lato*nopsis accidentalis*
Daphnia hyaline
D. laevis
Bosmina longirostris
Camptocercus uncinatus
Kurzia longirostris
Graptoleberis sp.
Leydigia acanthocercoides
Alona cambouei
Simocephalus vetulus
S. expinosus
Scapholeberis kingi
Ceriodaphnia regaudi
Moina brachiata
M. micrura
Macrothrix rosea
*Macrothrix sp.*1
Macrothrix spinosa
Ilyocryptus agilis
I. spinifer
I. sodidus
Alonella exigua

A. carua	*Pleuroxus hastatus*
A. rectangularn	*P. trigonellus*
A. guttata	*P. aduncus*
A. quadrangularis	*P. denticulatus*
A. costata	*Dunhevedia crassa*
A. intermedia	*Chydorus sphaericus*

The density of Cladocera in Al-Hammar Marsh

The Cladocera in Al-Hammar Marshes exhibited a general rise in number in the Spring (March and May) and in late Summer and Autumn (August and October). This is likely following the Phytoplankton blooms and probably related to the abundance of detritus in the water. Species richness at Al-Burga is in many instances higher than that at Al-Nagara site (Fig.1).

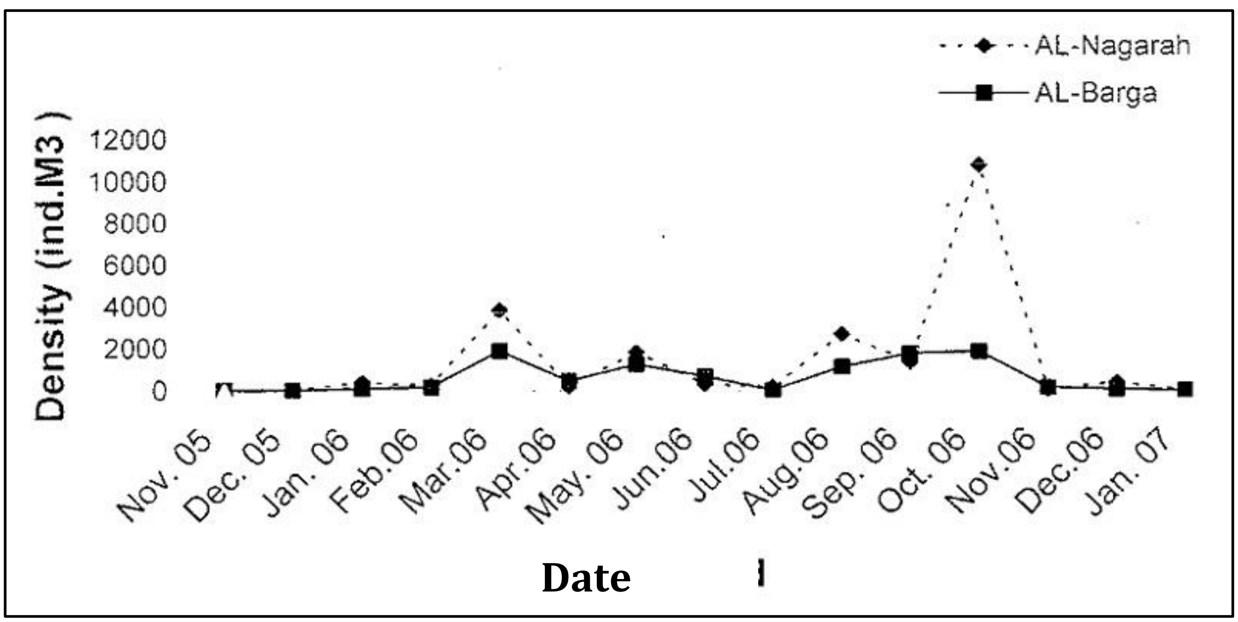

Fig.1. Total density index of Cladocera (ind./m^3) in tow sites for Al-Hammar marsh (Al-Burga and Al-Nagara) during the period from Nov. 2005–Jan. 2007.

Species composition of Copepoda in the Al-Hammar Marsh

A preliminary examination of the collected samples from two sites of Al-Hammar Marsh (Al-Burga and Al-Nagarah) during the period from November 2005-January 2007, showed that the community of copepods include at least 27 species (Table 1).

Table 1. Species of Copepoda of Al-Hammar Marsh throughout the period from December 2005– January 2007.

Species	Des.05	Jan.06	Feb.06	Mar.06	Apr.06	Mayo6	Jun.06	Jul.06	Aug.06	Sep.06	Oct.06	Nov.06	Des.06	Jan.07
Mesocyclops sp.1	-	-	-	-	-	-	+	-	+	+	-	+	-	-
Mesocyclops sp.2	-	-	-	-	-	-	-	-	-	+	-	+	-	-
Mesocyclops sp.3	-	-	-	-	-	-	+	-	-	+	-	+	-	-
M. arcanus	+	-	-	-	-	-	-	-	-	-	+	-	+	-
Thermocyclops sp.1	-	-	-	-	-	+	+	-	+	+	+	+	-	-
Termocyclops sp.2	-	-	-	-	-	+	-	-	+	+	+	+	-	-
Termocyclops sp.3	-	-	-	-	-	-	-	-	-	-	+	-	+	-
Microcyclops sp.	-	+	-	-	+	+	+	+	+	+	+	+	+	-
Macrocyclops albidus	-	+		+	+	+	-	-	-	+	-	-	-	-
Cryptocyclops sp.	-	-	-	-	-	-	+	-	+	+	+	+	+	-
Acanthocyclops sp.	+	+	+	+	+	+	-	-	+	+	+	-	+	+
Eucyclops sp.	+	+	+	+	-	-	+	-	+	-	-	-	+	+
E. speratus	-	-	-	-	-	-	-	-	-	-	-	+	+	+
Tropocyclops sp.	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Halicyclops sp.1	-	-	-	-	+	+	-	-	+	-	-	+	-	-
Halicyclops sp.2	-	-	-	-	+	-	-	-	+	-	+	-	+	-
Onychocamptus mohammed	+	+	-	+	+	+	+	+	+	-	+	+	-	+
Onychocamptus sp.	+	-	+	+	+	+	-	+	+	+	+	+	+	-
Nannopus palustris	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Cletocamptus spp.	-	+	-	-	-	-	+	+	+	-	+	+	+	+
Delavalia longifurca	-	-	-	-	+	+	+	+	+	-	-	+	+	+
Nitocra lacustris	-	-	-	-	-	-	-	+	+	-	+	-	+	-
N. spinipes	+	+	+	-	+	+	+	+	+	-	+	-	-	+
Nitocra sp.1	-	-	-	-	+	-	+	-	+	-	-	-	+	-
Acanthodiaptomus denticornis	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Phyllodiaptomus irakiensis	-	-	-	+	-	+	+	-	-	+	-	+	+	-
Arectodiaptomus (*Rh.*) *salinus*	+	+	-	-	-	-	-	-	+	-	+	-	-	-

Table 2. Relative occurrence of Copepoda in Al-Hammar marsh (1-4 months 25%, 5-8 months 50%, 9-12 months 75%, 10-14 months 100%), During December 2005–January 2007.

SPECIES	OCCURRENCE %
Mesocyclops sp. 1	50
Mesocyclops sp. 2	25
Mesocyclops sp. 3	25
M. arcanus	25
Thermocyclops sp.1	50
Thermocyclops sp.2	50
Thermocyclops sp.3	25
Microcyclops sp.	100
Macrocyclops albidus	50
Cryptocyclops sp.	50
Acanthocyclops sp.	100
Eucyclops speratus	25
Eucyclops sp.	75
Tropocyclops sp.	25
Halicyclops sp.1	50
Halicyclops sp.2	50
Onychocamptus mohammed	100
Onychocamptus sp.	100
Cletocamptus sp.	50
Delavelia longifurca	75
Nitocra spinipes	100
Nitocra lacustris	50
Nitocra. Sp. 2	50
Nitocra sp. 3	25
Acanthocyclops denticornis	25
Phyllodiaptomus irakiensis	50
Arectodiaptomus (Rh.) salinus	25

Although, the identification is incomplete due to shortage of literatures and they need for furthers examination, most of the copepods reported here have not been recorded before in the Iraqi Marshes and Shatt Al-Arab River, except *Macrocyclops albidus* which were recorded by Gurney (1921). Generally, the zooplankton is dominated by Cyclopoida (16 species). Moreover, the percentage occurrence of species of copepods in Al-Hammar marsh is having 7 dominant species (75-100%) throughout the entire sampling period (from December 2005-January 2007) (Table 2). These are: *Microcyclops* sp., *Acanthocyclops* sp., *Eucyclops sp.*, *Onychocamptus* sp., *Onychocamptus mohammed*., *Delavelia longifurca* (Mohammed, 2018) and *Nitocra spinipes.*

However, Eucyclops sp., *E. speratus, Mesocyclops arcanus, Acanthocyclops* sp., *Cryptocyclops* sp. were recorded in the two sits: Al-Burga and Al-Nagrah. Whereas, *Microcyclops* sp. and *Acanthocyclops* sp. were the most frequently recorded species of Cyclopoida. Meanwhile, Harpacticoida represented by:

Delavalia longifurca, *Onychocamptus mohammed, Nitocra spinipes* and some other five species.

However, *Onychocamptus* mohammed, *Cletocamptus* spp. and *Delavelia longifurca* were the most frequently encountered species in the samples.

Three calanoid species *Acanthodiaptomus denticornis, Phyllodiaptomus irakiensis* and *Arectodiaptomus (Rh.) salinus* were recorded in Al-Hammar Marsh (Mohammed and Salman, 2009).

The peak of abundance was recorded in March in both sites, another peak was reported in September in Al-Barga site whereas, in Al-Nagara site was reported in October. The abundance in Al-Nagara was more than that of Al-Barga (Table 3). The major constituents of the peaks are of Copepoda nauplii. Higher numbers of individuals were recorded in March, April, September and October 2006, which were in good coincide with the rise of temperature and the bloom of phytoplankton.

Table 3. Total density of Copepoda (ind./ m^3) in the two sites of Al-Hammar marsh (Al-Burga and Al-Nagara) during the period from December 2005 – January 2007.

DATE	AL-HAMMAR MARSH	
	Al-Barga	**Al-Nagarah**
Dec. 2005	133	51
Jan. 20006	159	291
Fab. 2006	244	313
March 2006	3899	4490
April 2006	1687	108
May 2006	178	353
Jun.2006	332	429
July 2006	356	433
Aug. 2006	2182	1541
Sep.2006	2446	2549
Oct. 2006	1104	3706
Nov.2006	2204	781
Dec.2006	443	323
Jan.2007	791	420
Total	16158	368435
Average	**1154.14**	**26316.78**

The average numbers of the total zooplankton for the whole sampling period are shown in Table 4. The zooplankton is represented by Copepoda, Cladocera, Cirriped larvae, Foraminifera, mysis of shrimps, Ostracoda and zoea of crabs at both sites, a peak was occurred in March with the highest numbers 3899 ind./m^3 and 4490 ind./m^3 in Al-Barga and Al-Nagarah respectively. There is other peak (2446 ind./m^3) reported in September in Al-Barga whereas the highest number (3706 ind./m^3) was recorded in October at Al-Nagarah site.

Table 4. Total density of Zooplankton (Copepoda, Cladocera and others) (ind./m^3) at the two sites 0f Al-Hammar marsh (Al-Burga and Al-Nagara) during the period from Dec. 2005–Jan. 2007.

DATE	AL-HAMMAR MARSH	
	Al-Barga	Al-Nagarah
Dec. 2005	449	342
Jan. 20006	476	1218
Fab. 2006	630	881
March 2006	7934	12951
April 2006	6616	8643
May 2006	3495	4596
Jun.2006	2079	1435
July 2006	593	1559
Aug. 2006	4813	9419
Sep.2006	6654	5935
Oct. 2006	5889	28802
Nov.2006	4118	1751
Dec.2006	793	1211
Jan.2007	746	513
Total	45335	79256
Average	**3238.21**	**5661.14**

Zooplankton of the Shatt Al-Arab River

The averages density of various groups of zooplankton at four regions along the Shatt Al-Arab River (Al-Korneesh, Abo-floos, Al-Seeba and Al-Fao), are given in Table 5.

Table 5: Average density (ind./m^3) of various groups of zooplankton at the Shat Al-Arab River during May 2005.

Groups of Zoo-plankton.	Al-Korneesh	Abo-Flos	Al-Seba	Al-Fao
Cladocera	210	92.2	1195.1	1107
Copepoda	23	71.6	364	663.9
Other Groups	7	25	17.4	4.8
Total	**240**	**188.8**	**1576.5**	**1775.7**

Higher zooplankton abundance was observed at Al-Fao station (average 1776 ind./m^3), then at Al-Sebah station were recorded 1577 ind./m^3. The numerical abundance of total zooplankton was increasing downstream toward the sea and coincident with increased phyto-plankton biomass due to higher mean value of salinity. In this region the zooplankton was dominant by Cladocera and Copepoda.

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CHAPTER SIX

 

CRUSTACEA

Malik H. Ali[1], Huda K. Ahmed[1] and Hanaa H. Mohammed[2]

[1]Dept. Marine Biology, Marine Science Center, Univ. of Basrah, Iraq.
[2]Dept. Biological Development in Shatt Al-Arab & NW Arabian Gulf, Marine Science Center, Univ. of Basrah, Iraq.

Introduction

Several macrocrustacean species are widely distributed in the Shatt Al-Arab River system and Basrah marshland as well. Some species are inhibited the intertidal zone of the estuarine ecosystem, and the others are subtidal species live in and/ or between the high density macrophytes. The list of common macrobenthic crustacea found in Shatt Al-Arab and Basrah marshland are given in table (1).

The purpose of this investigations was to document the existing macrobenthic crustacean in the Shatt Al-Arab River system and the Basrah marshes, two years after marsh restorations i.e. the year 2005. Its well known that > 90% of the Southern Iraqi marshes were drained during the period 1991 to 2003 (Partow, 2001). There was great damage to the marshes as well as a rising of water salinity and the detorating of the water quality in general. The influence of these changes lead to an effective impact on the funa and flora of Shatt Al-Arab and the partially reflooded marshes. However, from the ecological point of view, macrobenthic crustacean represent one of the main essential functional components of Shatt Al-Arab Delta.

Fortunately, most of these species were well studies during the period 1975 - 1990, i.e., before the marsh destruction (Salman *et al*., 2004; Abdul-Saheb *et al*., 2003; Ali, 2001 ; Ali *et al*., 2000; Salman *et al*., 1990). However, although the actual assessment of the environmental impact on these species need more intensive investigations and examination of the biophysiology, abundance and the distribution components the short notes and the documents given in this study (Table. 1) could be very useful for further studies.

The species given in the list of Tables (1) represent the most common macrobenthic crustacea observed in this investigation. The barnacle, *B. amphitrite* is well known marine and estuarine species, but was gradually penetrated up stream since 1980 and its harmful effect on the power plants were increasingly recorded in Basrah and Nasserya, southern Iraq (Abdul-Sahib *et al.,* 2003).

The stock of migratory commercial shrimp *M. affinis* shows apparent decline in the inland water. The caridean shrimp *M. nipponense* is an exotic species that how become seen in Shatt Al-Arab during the year 2002 (personal observation) and was gradually dispersed in the area. The grapsid crab *Sesarma boulengeri* shows great decline in their population density.

In general, there is apparent decline in population density of the other species and many of them had never seen in many sites in the marsh area and the Shatt al-Arab River system (see remarks in table 1).

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Table 1. Species list of common Macrobenthic Crustacea found in Shatt al-Arab River and Basrah Marshes during 2006.

ORDER	FAMILY	GENUS AND SPECIES	REMARK	REFERENCES
Thoracica		*Balanus amphitrite amphitrite*	Subtidal & intertidal cirriped	Abdu AlSaheb, I.M., Salman, S.D. and Ali, M.H. The biology of *Balanus amphitrite amphitrite* at Garmat- Ali River, Basrah, Iraq. Marina Mesopotamica, 18(1): 55-76. 2003.
Isopoda		*Sphaeroma annandalei annandalei* *Annina mesopotamica*	Intertidal Isopoda	Ecological energetics of the isopod *Sphaeroma annandalei annandalei* in the Garmat Ali region. Marina Mesopotamica 15(1):183-205. 2000. Life cycle and population dynamics of *Annina mesopotamica* (Ahmed), (Isopoda: flabellifera) in the Shatt Al-Arab Region Basrah, Iraq. Hydrobiologia 330: 119-130. 1996.
Amphipoda	Talitridae	*Parhyale basrensis* *Platorchestia monodi*	Intertidal Amphipod Supratidal Amphipod	The energy gains and energy losses by the intertidal Amphipod *Parhyale basrensis* from the Shatt Al-Arab region. Marina mesopotamica 16(1): 141-159. 2001.
Decapoda Macrura	Atyidae	*Atyaephyra desmaresti mesopotamica* *Caridina babaulti basrensis* *Metapenaeus affinis* *Exopalaemon styliferus* *Macrobrachium nipponense*	Subtidal Subtidal caridean shrimp Penaeud shrimp Caridean shrimp Invasion caridean shrimp	
	Brachyura Grapsidae	*Sesarma boulengeri* *Potamon fluviatile* *Elamenopsis kempi*	Intertidal crab In the bank of the river Subtidal crab	Larval development of *Elamenopsis kempi* (Chopra and Das) (Brachyora: Hymenosomatidae) reard in laboratory Sci. Mar.,60 (2-3) : 407-416. 1996.

CHAPTER SEVEN

MOLLUSCA

Ibtisam M. Abdul Sahib

Dept. Marine Biology, Marine Science Center,
Univ. of Basrah, Iraq.

Introduction

Molluscs (bivalves and gastropods) are major macrobenthic funa of various inland aquatic ecosystem in Basrah.

Gastropoda is a major group of molluscs in Shatt Al-Arab and it's branches (Al-Azzawi, 1986). Modern classification breaks them into three primary subclasses: Prosobranchia, Opisthobranchia and Pulmonata. The Prosobranchia are the most numerous, widely distributed and diverse, and are mainly marine, The free-living prosobranchs may be herbivores, carnivores, deposit feeders, omnivores or suspension-feeders depending upon the species (Pechenik,1985).

Previous studies on the Gastropoda were on the classification, population dynamic, density, reproduction, feeding and respiration (Ahmed,1975; Lucka,1982; Rabie,1986; Shihab *et al*.,1989; Al-Bassam,1990; Abdul-Sahib, 1996; 2001).

The Second class of Mollusca is the Bivalves, have a shell of two valves joined by internal adductor muscles and opening on a hinge, usually formed of interlocking hinge teeth, which are often used in identification, most of them are filter-feeders, drawing currents of water over the gills, which are modified to act as filter, many are of economic importance, either as food organisms or as fouling or destructive burrowing pests (Jones,1986), and it is less number and distribution from the gastropods and had a relatively short fossil history, appearing in the estuarine faunas in the middle to late Jurassic (Keen and Casey,1969).

The ecological aspects of some bivalves in Shatt Al-Arab region (the classification, population dynamic, density, reproduction, feeding and respiration) have been studied by different authors. (Ahmed,1975; Abdul-Sahib,1989; Abdul-Sahib *et al*.,1995; Abdul- Sahib *et al*.,1999).

Materials and Methods

There were ten sampling area, all of them were affected by high and low semi diurnal tide. Physical parameters were measured in every sampling area (air temperature, water temperature, PH, Dissolved oxygen (DO), Depth, Salinity and Total dissolved solids (TDS).

Collecting the specimens were done by three ways: first, by direct collecting by hands from the shore and the community which is living on the under side of rocks we found them by turning over the rocks, then record the nature of the shore and its regression. Secondly, by collecting specimens from fishermen nets as gastropods and crustacean are usually found. The third way is by collecting the aquatic plants from the shore and the water to research for egg capsules or some small gastropods adhesive on it. All specimens were brought to the laboratory, then classified and stored in deep freezing.

Results and Discussion

Air and water temperatures in the sampling sites ranged between 30-42 C and 22.93-30.5 C respectively, Salinity ranged from 0.64 %o to 31.15 %o, TDS from 0.832 g/l to 31.19 g/l, dissolved oxygen from 5.5 – 10.5 mg/l and pH from 7.7 to 7.9. The nature of the substratum of the station vary considerably among differentstations, and the same could be seen for the slope of the shore (Table 1). Table 2 shows the groups of the gastropoda in the stations and the abundance of each group. Table 3 shows the groups of the Bivalve that found in the stations and the abundance of each group.

Table 1. Physical parameters in the stations with description of the nature of the shore at May 2005.

Stations	Depth (m)	texture of the substratum	The slope of substratum
Qurna	8.5	Muddy to silt	Less regress
Zwian		Clay	Hard
Mashab		Clay	Hard
Ashar	12	sandy Clay	Less
Siba	6	Clay	Hard
Om-Qasser		Rocks	Hard
Khour Al-Zubir		Rocks	Less
Shatt Al-Basrah	9	Clay	Less
Fao	8	Muddy to silt	Less
Khour Abdulla	2	Hard clay	Hard

Table 2. Gastropods species Basrah stations in May 2005.

Species of Gastropods	Stations									
	Qurna	Zwian	Mashab	Ashar	Siba	Om-Qasser	Khour Al-Zubir	Shatt Al-Basrah	Fao	Khour Abdulla
Thodoxus jordani	***	***	***	***	*			*		
Viviparus benalensis	***	*	***	***	*			*		
Melanopsis nodosa	***	***	***	***	**					
Melanodies tuberculata	***	***	***	***						
Neritina violacea	**	**	**	*	*	*	**	*	***	**
Cerithidea fluviatilis						***	***			***
Murex tribulus						***	***			***
Murex anguliferus						***	***			***
Lymnea auricularia	***	***	***	***						
Odostomia laevis						***	***		***	***
Thais carinfera						***	***			***
Gibbula kotschyi						***	***			
Nassarius arcularius plicatus						***	***		***	***

* Rare. ** Middle. *** Abandance.

Table 3. Bivalves species Basrah stations in May 2005.

Species of Bivalves	Stations									
	Qurna	Zwian	Masihab	Ashar	Siba	Om-Qasser	Khour Al-Zubir	Shatt Al-Basrah	Fao	Khour Ab-dul-lah h
Arca holoserica						***	***			***
Placenta placenta	***	***	***	***	***	***	***	***	***	***
Crassostrea cucullata						***	***			***
Unio tigridis	***	***	***	***						
Pseudodontopsis eu-phraticus	***	***	***	***						
Corbicula fluminalis	***	***	***	***	***	***	***	***	***	***
Corbicula fluminea	***	***	***	***	***	**	**	***	**	**
Caryactis cor						***	***	***	***	***
Abra cadabra							***			***

* Rare ** Common *** Abundant

Benthic macroinvertebrate has been recognized as sensitive indicators for aquatic environmental perturbations. In fact, several countries (USA, Canada, U.K., India and France) have incorporated measures of the benthic community into their water and sediment quality.

Benthic macroinvertebrates are susceptible to local environmental perturbation, which are also effective integrators of environmental contamination, that is, they respond to all contaminates in the environment not necessarily only those measured in conventional water or sediment quality monitoring program (Karr,1986).

Table 4. Comparison between the two groups of Mollusca in Shatt Al-Arab region

Groups of Mollusca	Qurna	Mashab	Siba	References
Gastropods	2		7	Saad, M.A.H. & Arlt, G. (1977)
Bivalves	18	14	6	
Gastropods	6	6	4	Present study
Bivalves	5	5	3	

It is obviously seen that the groups of gastropods different in the station, while the bivalves were less in the present study in comparing with that study in 1977 (Table4). This is may be related to the changes in the environment or to the industrial or organic pollutions.

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CHAPTER EIGHT

PISCES (Fish) & Ichthiology

Mustafa A. Al-Mukhtar[1] and Thamir S. Ali[2]

[1]Dept. Marine Vertebrates, Marine Science Center, Univ. of Basrah, Iraq.

[2] Department of Natural Resources and Environment, College of Graduate Studies, Arabian Gulf University, Bahrian.

Introduction

Basrah is characterized by different aquatic ecosystems represented by Marsh, River, lagoon, estuary and marine environment, which are different basing on salinity gradient. This is apparently reflected on ichthyofauna occupied these habitats.

These water bodies witnessed fishing activities practiced by different fishing gears specific to each region. Generally, freshwater fishes are predominated marshes and rivers, however marine species are the dominants in marine environment. Estuary and lagoon distinguished by both freshwater and marine fishes with tendency to marine ones. Some species migrate through marine environment NW Arabian Gulf up to the upper reaches of marshes. Others are well distributed among all these water bodies.

The previous studies on fish species composition were focused only on one water body with no attempt for comparison among each other. But these studies provided considerable data on species composition of fish assemblage and some diversity indices for each region.

Bio-diversity is an identity tool provides information on systematic, habitat and distribution of flora and fauna existence under interaction of eco-biological effects may caused any endangered and threatened species. Fish represent the top of the Pyramid of the living water resources. Natural or man-made instant and/or chronic environmental changes may have speedy or postponed effect on fish diversity. Consequently, a list of threatened fishes under different categories of threatened status could be drawn. It is necessary to cover abiotic factors to be integrated with the fish bio-diversity. Many factors contribute to the loss of fish species and degradation of their habitat. These include:

- Dams and impoundment
- Water pollution (by oil and petroleum products, industrial acids, pesticides and fertilizers)
- Sedimentation from agriculture and construction
- Introduction of exotic species, and
- Overfishing.

Water bodies in Basrah province had witnessed several environmental changes. These changes took place particularly during three decays ago:

- Construction of Shatt Al-Basrah as joint canal between marshes and marine environment.
- Drainage of marshes.
- Transformation of part of Karon River discharge.
- Decline in water discharge of Tigris-Euphrates basin as a result of dam constructions in the upper reaches outside Iraqi borders.

Stations

Six stations were selected for sampling of fish specimens (Fig. 1). Some of these stations were already represent study areas of stock assessment project undertaken by staff of Marine Vertebrates Department at Marine Science Centre. Site visit for fish auction in Fao, Shatt Al-Basrah and Basrah Centre and interview with fishermen were carried out during May-June 2005. Brief description on sampling sites is given below.

1- Shatt Al-Arab River

This river is considered as a major freshwater discharge into Arabian Gulf. Its length, which extends southeasterly from the joint point of Tigris and Euphrates North Basrah toward the Arabian Gulf is about 116 km with slope of 1-1.5 cm/km. The depth is varied from site to site according to the shape of the river and its twist and winding and tide state with range of 8-15 m. The width range is 0.5-2 km. The difference between high tide and low tide is about 1.5 m in summer and drop to 0.25 m in flood season (March-May). Fishing activities are mainly scattered in Garmat Ali, Abul-Khaseeb and Fao using drift gill net.

2- Khor Al-Zubair

Khor Al-Zubair is an estuarine lagoon representing marine arm into Iraqi land Southwest Basrah. The lower reaches of the Khor are near Warba Island 8 km far from Southeast Umm Qasr. The length of Khor Al-Zubair is about 40 km with width range of 1-2 km at high tide. The depth range of the navigation channel is between 10-20 m with an average tidal range of 3.2 m. The total area at spring high tide is about 60 km^2. Fixed and drift gill nets are the main fishing gears used by small boats mainly in front of the Khor Al-Zubair and Umm Qasr Ports.

3- Shatt Al-Basrah

This man-made canal was constructed in 1983 to join Euphrates (after penetration Al-Hammar Marsh) with Khor Al-Zubair. The length of the canal is about 37 km of south-easterly direction, which constructed to by pass the fresh-water during devastating floods to the sea. The depth of the canal is about 4.5 m at the north part and 7.5 m at the south part. Almost fishing is exerted at south part mainly by drift gill net and with lesser extent by fixed gill net.

4- Marshes

Before their near-total destruction between 1991-2002, the 15,000 km^2 Mesopotamian marshlands formed one of the most extensive wetland ecosystems in western Eurasia. It comprised a complex of interconnected freshwater lakes, marshes and inundated floodplains following the Tigris and Euphrates rivers extending from Baghdad in the north to Basrah in the south. Approximately, 50 km^2 may remain. These remnants would have the potential to help restore the marshlands. There were heavily degraded by 1980-1988 Iran-Iraq war. Much of the fighting took place in and around these wetlands resulting in extensive burning and heavy bombing. The main marshes corresponding to Basrah province are Middle marshes, Basrah marshes and part of Huwaiza marshes. These habitats are seemed to be great fishpond. The main fishing gears used are seine nets, drift gill nets and unlawful fishing by electricity, bombing and pesticides.

5- Shatt Al-Arab Estuary

Shatt Al-Arab estuary represents the northwestern tip of the Arabian Gulf. The substratum of this region differs from other parts of the Arabian Gulf, due to terrigenous sediments brought by Shatt Al-Arab River. The average depth of the estuary is 4 m. The estuary is an extension of tidal flats surrounding the estuary characterized by gentle slope toward the open sea with an approximately area of

10,000 km^2. Shatt Al-Arab river penetrates the estuary at which the depth is about 8 m known Al-Rouka canal, which give the advantage to the big ships to enter the Shatt Al-Arab. At the north of the estuary there is sand bar known out bar of Shatt Al-Arab. However, on the sides there are shallow water regions locally known "Maraqat" as Maraqat Abadan and Maraqat Abdullah. Draft nets are the only fishing gear used in the Shatt Al-Arab estaury.

6- Khor Abdullah

Khor Abdullah is a shallow funnel shape of depths more than 10 m with about 1 km intertidal zone. The substratum is mainly muddy at the southern entrance and sandy-silt at the northern tip. The depths at the southern entrance are between 7-10 m, which gradually increase toward Bubyan Island. The length of the Khor is about 60 km from Umm Qasr to Khor Al-Amaya with width range of 1-4 km. Khor Abdullah is classified as open marine lake. The main fishing gears used in Khor Abdullah are fixed and draft gill nets, traps, and trawl net.

Abiotic Factors

Some abiotic factors measured in May 2005 are presented in Table (1). The most interest one is the salinity gradient on which the distribution of freshwater and marine fish species is depending.

Table 1. Some Abiotic fators in different water bodies in Basrah during May 2005.

Stations	Water temperature (^oC)	Salinity (ppt)	Dissolved Oxygen (mg/l)	PH
Shatt Al-Arab	26	2.3		
Shatt Al-Basrah	26.5	3.1	6.12	7.82
Marshes	17	2.2		7.9
Khor Al-Zubair	27	12.05	5.5	7.71
Estuary	23.8	0.64	10.92	7.74
Khor Abdullah	30.5	31.15	10.5	7.9

The more saline water is Khor Abdullah and the lowest is Marshes, estuary and Shatt Al-Arab. However, Khor Al-Zubair and Shatt Al-Basrah could be categorized as brackish water. It should be referred that the lowest salinity of estuary represents the lowest seasonal value normally recorded at this time due to the high freshwater discharge of Tigris, Euphrates and Karon during March-May.

Species Composition

Eighty-six fish species were recorded in the six stations during May-June 2005 (Table 6.2). Basing on these data one could concludes:

- Freshwater species (25 species) comprised more than 25%.
- Chondrichthyes were represented by 6 species.
- *A. latus*, *L. subviridis*, *S. sihama*, *T. ilisha* and *T. mystax* are well distributed species found throughout the studied stations.

- The highest number of species were recorded in Shatt Al-Arab Estuary followed by Khor Abdullah, Marshes, Khor Al-Zubair, Shatt Al-Basrah and Shatt Al-Arab.

Table 2. Species composition of ichthyofauna in Basrah during May-June 2005.

Species	Shatt Al-Arab River	Shatt Al-basrah	Marshes	Khor Al-Zubair	Khor Abdullah	Shatt Al-Arab Estuary
*Acanthobrama marmid**			+			
Acanthopagrus latus	+	+	+	+	+	+
Acanthopagrus berda						+
*Alburnus capito**	+		+			
*Alburnus coeruleus**			+			
*Alburnus sellal**			+			
*Aphanias dispar**	+	+	+			
*A. sophia**	+	+	+			
Apogon aureus						+
Argyrops spinifer						+
Arius thalassinus				+	+	
*Aspius vorax**			+			
Atropus atropus						+
*Barbus grypus**			+			
*B. luteus**			+			
*B. sharpeyi**			+			
*B. xanthopterus**			+			
*Bathygobius fuscus**			+			+
Caranx kalla					+	+
Caranx leptoepis						+
*Carassius auratus**	+		+			
*C. carassius**	+		+			
*Carcharhinus dussumieri**				+	+	+
*C. limbatus***					+	
*Chiloscyllium arabicum***		+			+	+

Chirocentrus nudus		+		+	+	+
*Cholcalburnus mossulensis**			+			
Cynoglossus arel		+		+	+	+
*Cyprinion tenuiradius**			+			
*Cyprinus carpio**			+			
*Dasyatis imbricatus***					+	
*Dasyatis sephen***					+	
Eleutheronema tetradactylum		+		+	+	
Euryglossus orientalis		+		+	+	+
*Gambusia affinis**	+	+	+			
*Garra rufa**			+			
*Gymnura poecilura***					+	
Helotes sexlineatus						+
Hemirhamphus marginatus						+
*Heteropneustus fossilis**	+		+			
Ilisha megaloptera		+		+	+	+
I. melastoma		+		+	+	+
Jhoneiops sina	+	+		+	+	+
Jhonius belangerii		+		+	+	+
Leiognathus bindus					+	+
Leptocynanceja melanostigma					+	
*Liza abu**	+	+	+			+
Liza carinata			+		+	
Liza macrolepis			+	+	+	
Liza subviridis	+	+	+	+	+	+
**Mastacembelus mastacembelus*			+			
Minous monodactylus					+	
Muraenesox cinereus						+
*Mystus pelusius**			+			
Nematalosa nasus	+	+		+	+	+
Nemipterus japonicus						+
Otolithes ruber		+		+	+	+
Pampus argenteus					+	
Platycephalus indicus				+	+	+
Polydactylus sextari-					+	+

us						
Pomadasys argenteus				+	+	
Protonibea diacanthus						+
Pseudapocryptes dentatus		+		+	+	+
Pseudorhombus arsius				+	+	+
*Rhinobatus granulatus***					+	
*Rhynchobatus djiddensis***						+
Sardinella albella						
S. perforata					+	+
S. sirm					+	+
Saurida tumbil						+
S. undosquamis						+
Scartelaos tenius		+		+	+	+
Scatophagus argus		+		+	+	
Scomberomorus guttatus						+
Sillago sihama	+	+	+	+	+	+
*Silurus triostegus**			+			
Sparidentex hasta						+
Solea bleekerii						+
S. elongata						+
Tenualosa ilisha	+	+	+	+	+	+
Thryssa hamiltoni	+	+		+	+	+
T. mystax	+	+	+	+	+	+
Triacanthus biaculeatus					+	
Trichiurus haumela						+
Tylosurus strongylurus		+		+	+	
Upeneus sulphureus						+

* freshwater fish species ** Chondrichthyes

Some freshwater fish species are the most endangered species namely: *B. sharpeyi, B. xanthopterus, B. grypus, A. Vorax, C. carpio*. Moreover, *B. subquincunciatus*, *B. scheich* disappeared from However, no risk on marine species due to no considerable naturally or man-made changes affect this environment as those characterized the freshwater ecosystems, particularly Shatt Al-Arab River and Marshes.

The most diverse families are Cyprinidae, Clupeidae, Sparidae and Carangidae. Shatt Al-Basrah, Estuary and Khor Al-Zubair occupied by both freshwater and marine species.

The ratio of number of fish species to land area is one of the units used to identify the status of fish biodiversity as well as for other organisms. For Iraqi ichthyofauna, number of freshwater fish species is about 90. In relation to land area of Iraq the ratio obtained is about 0.205 fish species/km^2, which surely being more when based on actual freshwater area. This ratio is higher than those allocated for China (0.10) and closed to those of India and Pakistan (0.20).

A preliminary list of fish species of the studied stations was prepared in May-June 2005. Changes could be concluded in fish species composition of Shatt Al-Arab and Marshes due to disappearing of many *Barbus* spp., and Shatt Al-Basrah and Khor Al-Zubair as a result of occurrence of freshwater species.

Fish Larvae

Ichthyoplankton samples were collected from the investigated stations to depict their reproductive biological importance for the Iraqi fisheries. Table (6.3) summarized the results of fish larvae recorded by family in the six stations.

Nine families were recorded. It should be emphasized that these results represent only one month (May). Generally, Khor Abdullah and Khor Al-Zubair seemed to be the most diverse area by fish larvae, which mostly are marine species.

Table 3. Occurrence of fish larvae in different water bodies in Basrah during May 2005.

Fish larvae	**Shatt Al-Arab**	**Shatt Al-Basrah**	**Marshes**	**Khor Al-Zubair**	**Estu-ary**	**Khor Ab-dullah**
Mugilidae	+		+			
Cyprinidae	+		+			
Gobiidae				+	+	+
Sparidae		+				
Engraulidae				+		+
Clupeidae				+	+	+
Sciaenidae				+		+
Sillaginidae						+
Synognothidae					+	

Cyprinidae larvae recorded in Shatt Al-Arab and Marshes are mostly belong to *Carp* spp. and those of mugilidae may often of *Liza* spp.

Fish of the Marsh Area

The wetlands of Lower Mesopotamia provide important habitat for a wide range of fish species, many of which are of economic importance, and several of which are endemic. The presence of the Tigris-Euphrates confluence has resulted in a mingling of fauna derived from western or Syrian sources (via the Euphrates) and eastern or Zagrosian sources (via the Tigris and its tributaries). This unusually rich fish fauna has recently been summarized by Banister (1994). Cyprinids are the dominant element in the marshes, and include species such as *Acanthobrama marmid*, *Barbus canis*, *B. esocinus*, *B. grypus*, *B. longiceps*, *B. luteus*, *B. subquincunciatus*, *B. xanthopterus*, *Capoeta* spp., *Chondrostoma nasus*, *C. regium*, *Cyprinion macrostomum*, four species of *Garra*, *Leuciscus cephalus* (an endemic subspecies *orientalis*) and *L. lepidus*. Particularly noteworthy are *Barbus sharpeyi*, an endemic species which, unlike others of the genus, spawns only in the marshes in areas of shallow open water less than 75 cm deep, and two blind cave-dwelling species, *Caecocypris basimi* and *Typhlogarra widdowsoni*, known only from a sink hole close to the Sheik Hadid shrine near Haditha. Other indigenous freshwater fishes include *Glyptothorax cous* (Sisoridae), *Mystus pelusius* (Bagridae), *Silurus glanis* (Siluridae) and *Mastacembelus mastacembelus* (Mastacembelidae).

Many marine fish regularly enter the rivers and marshes of Lower Mesopotamia to feed, and form an important part of the commercial fish catches. These include *Nematalosa nasus* (Clupeidae), *Thryssa setirostris*, *T. purava* and *T. hamiltoni* (Engraulidae), *Arius thalassinus* (Ariidae), *Plotosus lineatus* (Plotosidae), *Rhynchorhamphus* sp. (Hemirhamphidae), *Strongylura strongylura* (Belondidae), *Acanthopagrus berda* and *A. latus* (Spasidae), *Aryiosomus amoyensis* and *Otolithes ruber* (Sciaenidae), *Scatophagus argus*, *Liza* spp. and *Mugil cephalus* (Scatophagidae), *Eleutheronema tetradactylum* (Polynemidae), *Acentrogbius dayi*, *Scartelaos tenuis*, *Periophthalmus waltoni* and *P. weberi* (Gobiidae), and *Cynoglossus arel* and *C. lingua* (Cynoglossidae). The Bull Shark *Carcharinus leucas* (Carcharinidae) commonly enters fresh water, and has been recorded as far upstream as Baghdad.

About 12 species of fish have been deliberately introduced into the wetlands of Mesopotamia, including five species of Cyprinidae (*Acanthalburnus microlepis*, *Carassius auratus*, *Ctenopharyngodon idella*, *Cyprinus carpio* and *Hypophthalmichthys molitrix*), *Ictalurus nebulosus* (Ictaluridae), *Esox lucius* (Esocidae), *Gambusia affinis/holbrooki* (Poecilidae), *Micropterus salmoides* (Centrarchidae), *Stizostedion lucioperca* (Percidae) and *Oreochromis niloticus* (Cichlidae). *Heteropneustes fossilis* (Heteropneustidae) seems to have been a natural colonist in recent times; it appeared in the marshes for the first time in 1960 (Khalaf, 1962), and subsequently spread throughout the system.

Environmental Changes

As mentioned in the introduction that the aquatic ecosystems in Basrah suffered several environmental changes. Those changes reflect partially or entirely on fish species composition.

1- Introduction of exotic species:

Some species were introduced to the Iraqi waters in the mid of last century for different purposes, such *Heteropneustes fossilis* and *Gambusia affinis* which were introduced in 1950s as biological indicators for belharzia and malaria diseases. The common carp is another exotic species introduced in 1960s to support closed fish culture systems. But this species then released to the natural waters. These exotic species heavily influenced the native cyprind species particularly *Barbus xanthopterus*, *B. sharpeyi, B. grypus, B. subquincunciatus* and *B. scheich* in marshes and Shatt Al-Arab, which being very rare species. Currently, after marsh drainage the common carp being of less abundance replaced by other cyprinid species such as silver carp, *Carrassius auratus* and *C. carassius*.

2- Dams construction:

Several dams were constructed on Tigris and Euphrates in side and out side Iraq for irrigation purposes. Those dams were constructed with no attention for impacts may extent to fisheries resources. Several cyprinid species in Basrah marshes, which exert up stream migration during spawning season suffered due to no access to attain their spawning grounds particularly in upper parts of Euphrates.

Those dams have also another effect on the NW Arabian Gulf fisheries due to a decline in freshwater discharge. This point was discussed in the 8^{th} session of the Committee for Development and Management of the Fishery Resources of the Gulfs in Oman 1994 and recommended the necessity to monitor the possible effect of reduction of freshwater from Shatt Al-Arab on marine environment of the Arabian Gulf.

3-Pollution:

Many types of pollutants are dumped to water bodies in Basrah. Due to urbanization and development, Shatt Al-Arab suffer as a result of Hydrocarbon, pesticides, heavy metals, sewage pollutants dumped to the river.

However, hydrocarbons are the main pollutant in other water bodies due to unlawful exporting of crude oil. Several studies indicated the levels of these pollutants in fishes.

4-Drainage of Marshes:

The effect of drainage was not restricted for marsh fisheries but also extend for fisheries in other water bodies. Marshes are typical habitat for fish as well as other aquatic fauna. Several fish species were disappeared as a result of that. Moreover, marshes acted as a sink for sediments and its associated pollutants. The drainage process significantly increased the sedimentology rates and changes the hydrodynamic regime in Shatt Al-Arab estuary.

5-Overfishing:

This factor heavily affected fisheries resources specially those designed to collect target fish species. The effect of overfishing is either by using unlawful gears or by fishing exerted during closed season. One of the commonest cases is the deterioration of Hilsa shad *Tenualosa hilsa* stocks in 1970s, which took several years to restore.

6-Salinity Fluctuation:

Due to construction of Shatt Al-Basrah canal and drop of freshwater levels in Tigris and Euphrates basin in addition to devastating floods seemed to occurred every 20 years (the last one in 1987-1988), the salinity was significantly varied particularly in Shatt Al-Arab, Shatt Al-Basrah and Khor Al-Zubair. The later was classified as hyper saline lagoon (salinity = >40 ppt) before construction of Shatt Al-Basrah, however at the end of 1980s this Khor transformed to estuarine lagoon (salinity = 15-20 ppt) and then brackish water (salinity = <5 ppt). Currently, the Khor returned as estuarine lagoon. Such fluctuations temporarily reflect on fish species composition.

Fish biodiversity is not presence-absence methodology. The biological diversity of fish groups as well as other organisms means the variability among species composition and the ecological complexes of which they are part. This includes different levels: diversity within species, between species and of ecosystems. Consequently, long-term study should be designed to provide valuable information on fish biodiversity in Basrah through comprehensive fishery survey associated with environmental monitoring of limiting factors to identify:

- Extinction, endangered and threatened species
- Endemic species
- Richness and evenness status
- Distribution maps and is it of fish species.

CHAPTER NINE

BIRDS

Nadir A. Salman

Department of Fisheries & Marine Resources,
College of Agriculture, Univ. of Basrah, Iraq.

Introduction

Most of the birds entering Iraqi boarders are reproduce in the warm wetland habitats of Basra. Most of them came seasonally to such habitat for breeding and nesting during the warm months of the year (Spring and early Summer) (Allouse,1960 and 1961). Some came for wintering, leaving the cold habitats in Europe to the warm winter months in Basra marshes (Al-Robaae, 1994).

No major ornithological surveys have been carried out in the marshes of Iraq except the waterfowl surveys which provide very little information on waterfowl numbers.During the seventies of the last century Georgae and Vielliard (1970); Koning and Dijksen (1973); Carp (1975); Scott and Carp (1982), Scott (1995) surveyed extensively the middle and southern marshes of Iraq. Al-Robaae (1986 & 1994) showed the observation and abundance of water birds in the vicinity of Basrah. Some waterfowl counts were made at a number of localities around Haur Al Hammar in autumn 1979 (Al-Robaae and Kingswood, 2001). Anatidae were counted at several marshes in Basrah area in 1993 and 1994, and waterfowl hunting was also investigated in this region (Al-Robaae and Salem, 1996; Al-Robaae, 2006).

Birdlife International has identified the Mesopotamia marshes of Iraq as an "Endemic Bird Area". This means that they are considered as an important concentration of bird biodiversity where habitat destruction would cause disproportionately large number of species extinctions (ICBP, 1992). Birdlife International also has identified Huwayzah and Hammar marshes as "Important Bird Areas" and as sites 36 and 39 respectively (Evans, 1994). These habitats have suffered destroying process because of the draining of wetlands and dissertation status occurred after that. Such process had a significant bad effect on bird life in Basra. Migratory swamps, used to be seen in the sky Basra, have disappeared. After desiccation of the marshes during the early nineties Salem (1995) and Al-Robaae and Salem (1996) were surveyed three swamps in Basrah, and Razzaza lake in middle of Iraq for ducks during 1993-1994 migratory season.

Waterfowl of the Marshy Area

The Southern marshes of Iraq are one of the most important wintering areas for migratory waterfowl in western Eurasia. Allouse in (1960, 1961 and 1962) mentioned that the total number of bird species in Iraq was 375 of these 134 species were water birds. Georgae and Vielliard, (1970) believed that the marshes of Haur Al Hammar and Haur Al Hawizeh together "probably provide habitat for two-thirds of the wintering wildfowl of the Middle East". Carp (1975) conducted waterfowl count in Iraq. Fifteen species were observed during the waterfowl survey in 1979 which was recorded in the study of Scott and Carp (1982). Other species of birds which utilize the Mesopotamian marshlands as wintering habitat include a variety of passerines such as *Motacilla alba*, *Anthus spinoletta*, *Lanius isabellinus*, *Luscinia svecica*, *Saxicola torquata*, *Emberiza schoeniclus*, *Passer* *hispaniolensis*, *Sturnus vulgaris* and *Corvus frugilegus* (Carp, 1080).

The marshes are also an extremely important staging area for a number of species of waterfowl on their way between breeding grounds in Western Siberia and Central Asia and winter quarters in eastern and southern Africa. Such passage migrants include a variety of herons and egrets (*e.g. Egretta garzetta*, *Ardeola ralloides* and *Ixobrychus minutus*), *Anas querquedula*, and a number of shorebirds (*e.g. Charadrius hiaticula*, *Numenius phaeopus*, various *Tringa* species, *Calidris ferruginea* and *Philomachus pugnax*) (Evans, 1994). No systematic attempt has ever been made to document the migration of waterfowl through the Mesopotamian marshes, and it is impossible to provide an estimate of the total number of birds which might be involved. The Mesopotamian marshes are of considerable importance for breeding waterfowl Porter, et al., (1996). Al-Rubaee (2006), has described the breeding habits of 59 species. Of special interest, a substantial proportion of the world population of the rare Marbled Teal *Marmaronetta angustirostris* Al-Robaae, (1998). The marshes also support isolated populations of two other primarily Afro-tropical species: The Goliath Heron *Ardea goliath* and Sacred Ibis *Threskiornis aethiopicus*.

Waterfowl recorded during four IWRB mid-winter waterfowl surveys in the marshes of lower Mesopotamia. The first survey occurred in January 1968, the second survey was in December 1972 (Koning and Dijksen,1973) and the third one was in January/ February 1975. The most recent mission, in January 1979, was much the most extensive, visiting 46 sites in the southern marshlands including various sections of Haur Al Hammar, Haur As Sa'adiyah, Haur Uwainah, Haur Al Shuwaija and a number of small wetlands around Basrah. Over 324,000 waterfowl of 79 species were recorded, including 3,300 pelicans, 1,850 flamingos, 2,340 geese, 155,000 ducks, 128,000 coots, 16,600 shorebirds and 13,400 gulls and terns (Scott & Carp, 1982). Of the 278 species of birds which have been recorded in Southern Iraq, 134 are species which are to some extent dependent on the wetland habitats and occur in Iraq in significant numbers. Two of these species, the Iraq Babbler *Turdoides altirostris* and Basrah Reed Warbler *Acrocephalus griseldis*, are known to breed only in this area. *Turdoides altirostris* is confined to the lower Tigris and Euphrates valleys of central and southern Iraq. Its distribution is centered on the reed-beds of the marshes (Al-Dabbagh & Bunni, 1981).

Check List

The check list (Table 1) has been prepared from information recorded by Allouse (1953), Al-Dabbagh (1998), a survey by Scott and Carp (1982) and data from international bird websites such as Birdlife International and International council of Bird Preservation ICBP.

Table 1. Check list of bird species recorded in Basra habitats along with their ecological status. Recorded species: 245, Number of families: 52

English Name **Scientific Name**	**Ecological Status**
No. of species 2	Family: GREBES Podicipedidae
Little Grebe *Tachybaptus ruficollis*	Scarce winter visitor. Scarce passage migrant. Scarce resident. Has bred.
Black-necked Grebe *Podiceps nigricollis*	Uncommon passage migrant. Uncommon winter visitor.
2	CORMORANTS Phalacrocoracidae
Cormorant *Phalacrocorax carbo*	Very common winter visitor. Common passage migrant.
Socotra Cormorant Phalacrocorax nigrogularis	Uncommon dispenser in spring, summer and autumn. Has bred.
8	HERONS & EGRETS Ardeidae
Little Bittern *Ixobrychus minutus*	Uncommon passage migrant. Scarce summer visitor. Rare winter visitor. Breeds.
Squacco Heron *Ardeola ralloides*	Uncommon passage migrant. Rare summer visitor.
Cattle Egret *Bubulcus ibis*	Uncommon disperser in autumn, winter and spring.
Western Reef Egret *Egretta gularis*	Very common resident. Breeds.
Little Egret *Egretta garzetta*	Uncommon passage migrant. Uncommon winter visitor.
Great Egret *Egretta alba*	Uncommon passage migrant. Uncommon winter visitor.
Grey Heron *Ardea cinerea*	Very common winter visitor. Common passage migrant. Common resident. Breeds.
Purple Heron *Ardea purpurea*	Uncommon passage migrant. Rare summer visitor. Rare winter visitor.

1	STORKS Ciconiidae
White Stork *Ciconia ciconia*	Rare passage migrant.
2	IBISES & SPOONBILLS Threskiornithidae
Glossy Ibis *Plegadis falcinellus*	Uncommon passage migrant.
Spoonbill *Platalea leucorodia*	Common resident. Breeds.
1	FLAMINGOS Phoenicopteridae
Greater Flamingo *Phoenicopterus roseus*	Very common resident. Very common disperser in all seasons. Has bred.
8	WILDFOWL Anatidae
Shelduck *Tadorna tadorna*	Common winter visitor. Uncommon passage migrant.
Wigeon *Anas penelope*	Uncommon winter visitor. Uncommon passage migrant.
Gadwall *Anas strepera*	Scarce winter visitor. Uncommon passage migrant.
Teal *Anas crecca*	Common passage migrant. Scarce winter visitor.
Mallard *Anas platyrhynchos*	Scarce passage migrant. Scarce winter visitor.
Pintail *Anas acuta*	Uncommon winter visitor. Uncommon passage migrant.
Garganey *Anas querquedula*	Common passage migrant.
Shoveler *Anas clypeata*	Uncommon winter visitor. Uncommon passage migrant.
16	HAWKS & EAGLES Accipitridae
Honey Buzzard *Pernis apivorus*	Scarce passage migrant.
Crested Honey Buzzard *Pernis ptilorhynchus*	Scarce passage migrant..
Black Kite *Milvus migrans*	Common passage migrant. Uncommon winter visitor.

Egyptian Vulture *Neophron percnopterus*	Scarce passage migrant.
Griffon Vulture *Gyps fulvus*	Scarce disperser in spring, autumn and winter.
Short-toed Eagle *Circaetus gallicus*	Uncommon passage migrant.
Marsh Harrier *Circus aeruginosus*	Uncommon passage migrant. Scarce winter visitor. Rare summer visitor.
Pallid Harrier *Circus macrourus*	Common passage migrant.
Montagu's Harrier *Circus pygargus*	Uncommon passage migrant.
Sparrowhawk *Accipiter nisus*	Uncommon passage migrant. Uncommon winter visitor.
Shikra *Accipiter badius*	Scarce passage migrant and winter visitor.
Common Buzzard *Buteo buteo*	Common passage migrant. Scarce winter visitor.
Long-legged Buzzard *Buteo rufinus*	Uncommon passage migrant. Scarce winter visitor.
Spotted Eagle *Aquila clanga*	Uncommon passage migrant. Scarce winter visitor.
Steppe Eagle *Aquila nipalensis*	Very common passage migrant. Scarce winter visitor.
Imperial Eagle *Aquila heliaca*	Uncommon passage migrant. Rare winter visitor.
1	OSPREY Pandionidae
Osprey *Pandion haliaetus*	Scarce passage migrant. Rare winter visitor.
3	FALCONS Falconidae
Lesser Kestrel *Falco naumanni*	Common passage migrant. Rare winter visitor.
Kestrel *Falco tinnunculus*	Uncommon passage migrant. Uncommon winter visitor. Uncommon resident. Has bred.
Hobby *Falco subbuteo*	Uncommon passage migrant.

1	PHEASANTS & PATRIDGES Phasianidae
Quail *Coturnix coturnix*	Common passage migrant. Has bred.
8	RAILS Rallidae
Water Rail *Rallus aquaticus*	Uncommon passage migrant. Scarce winter visitor. Uncommon resident. Has bred.
Spotted Crake *Porzana porzana*	Uncommon passage migrant. Uncommon resident. Rare winter visitor.
Little Crake *Porzana parva*	Uncommon passage migrant. Rare winter visitor. Uncommon resident. Breeds.
Baillon's Crake *Porzana pusilla*	Scarce passage migrant.
Corncrake *Crex crex*	Uncommon passage migrant. Rare winter visitor.
Moorhen *Gallinula chloropus*	Uncommon resident. Scarce winter visitor. Scarce passage migrant. Breeds
Purple Gallinule *Porthyrio porthyrio*	Scarce resident. Has bred.
Coot *Fulica atra*	Uncommon passage migrant. Uncommon winter visitor. Scarce summer visitor. Breeds.
1	BUSTARDS Otididae
Houbara Bustard *Chlamydotis undulata*	Irregular winter visitor. Has bred.
1	OYSTERCATCHER Haematopodidae
Oystercatcher *Haematopus ostralegus*	Common passage migrant. Common winter visitor. Rare summer visitor.
2	STILTS & AVOCETS Recurvirostridae
Black-winged Stilt *Himantopus himantopus*	Common passage migrant. Scarce winter visitor. Uncommon summer visitor. Has bred.
Avocet *Recurvirostra avosetta*	Uncommon passage migrant. Common winter visitor.
1	CRAB PLOVER Dromadidae
Crab Plover	Very common summer visitor. Common

Dromas ardeola	resident. Breeds.
1	THICK-KNEES Burhinidae
Stone Curlew *Burhinus oedicnemus*	Uncommon passage migrant. Rare winter visitor.
3	COURSERS PRATINCOLES Glareolidae
Cream-coloured Courser *Cursorius cursor*	Common disperser in spring, summer and autumn. Breeds.
Collared Pratincole *Glareola pratincola*	Common passage migrant. Scarce summer visitor.
Black-winged Pratincole *Glareola nordmanni*	Uncommon passage migrant.
13	PLOVERS Charadriidae
Little Ringed Plover *Charadrius dubius*	Uncommon passage migrant. Scarce winter visitor. Scarce summer visitor.
Ringed Plover *Charadrius hiaticula*	Common passage migrant. Common winter visitor. Rare summer visitor.
Kentish Plover *Charadrius alexandrinus*	Very common resident. Breeds.
Lesser Sand Plover *Charadrius mongolus*	Common passage migrant. Common winter visitor. Scarce summer visitor.
Greater Sand Plover *Charadrius leschenaultii*	Common passage migrant. Common winter visitor. Uncommon summer visitor. Has bred.
Caspian Plover *Charadrius asiaticus*	Uncommon passage migrant.
Pacific Golden Plover *Pluvialis fulva*	Scarce passage migrant and winter visitor.
Grey Plover *Pluvialis squatarola*	Uncommon passage migrant. Common winter visitor. Scarce summer visitor.
Red-wattled Plover *Hoplopterus indicus*	Scarce disperser in autumn, winter and spring. Rare summer visitor. Has bred.
White-tailed Plover *Chettusia leucura*	Uncommon passage migrant.
Lapwing *Vanellus vanellus*	Scarce passage migrant and winter visitor.
24	SANDPIPERS Scolopacidae

Great Knot *Calidris tenuirostris*	Uncommon winter visitor.
Sanderling *Calidris alba*	Common passage migrant. Common winter visitor.
Little Stint *Calidris minuta*	Very common passage migrant. Common winter visitor.
Temminck's Stint *Calidris temminckii*	Uncommon passage migrant. Uncommon winter visitor.
Curlew Sandpiper *Calidris ferruginea*	Common passage migrant.
Dunlin *Calidris alpina*	Very common passage migrant. Common winter visitor.
Broad-billed Sandpiper *Limicola falcinellus*	Uncommon passage migrant. Uncommon winter visitor.
Ruff *Philomachus pugnax*	Uncommon passage migrant. Rare winter visitor.
Jack Snipe *Lymnocryptes minimus*	Scarce passage migrant. Scarce winter visitor.
Snipe *Gallinago gallinago*	Common passage migrant. Uncommon winter visitor.
Black-tailed Godwit *Limosa limosa*	Uncommon passage migrant. Rare winter visitor.
Bar-tailed Godwit *Limosa lapponica*	Common passage migrant. Uncommon winter visitor.
Whimbrel *Numenius phaeopus*	Common passage migrant. Rare winter visitor.
Curlew *Numenius arquata*	Common passage migrant. Very common winter visitor.
Spotted Redshank *Tringa erythropus*	Scarce passage migrant. Rare winter visitor.
Redshank *Tringa totanus*	Very common passage migrant. Very common winter visitor.
Marsh Sandpiper *Tringa stagnatilis*	Common passage migrant. Uncommon winter visitor.
Greenshank *Tringa nebularia*	Common passage migrant. Uncommon winter visitor.
Green Sandpiper *Tringa ochropus*	Uncommon passage migrant. Uncommon winter visitor.
Wood Sandpiper *Tringa glareola*	Common passage migrant. Rare winter visitor.

Terek Sandpiper *Xenus cinereus*	Common passage migrant. Common winter visitor.
Common Sandpiper *Actitis hypoleucos*	Uncommon passage migrant. Scarce winter visitor.
Ruddy Turnstone *Arenaria interpres*	Common passage migrant. Uncommon winter visitor.
Red-necked Phalarope *Phalaropus lobatus*	Uncommon passage migrant.
3	SKUA Stercorariidae
Pomarine Skua *Stercorarius pomarinus*	Uncommon passage migrant. Scarce winter visitor. Rare summer visitor.
Arctic Skua *Stercorarius parasiticus*	Uncommon passage migrant. Scarce winter visitor. Rare summer visitor.
6	GULLS Laridae
Pallas's Gull *Larus ichthyaetus*	Uncommon passage migrant. Common winter visitor.
Black-headed Gull *Larus ridibundus*	Abundant passage migrant. Abundant winter visitor Uncommon summer visitor.
Slender-billed Gull *Larus genei*	Abundant passage migrant. Common resident. Breeds.
Lesser Black-backed Gull *Larus fuscus*	Common passage migrant. Common winter visitor.
Caspian Gull *Larus cachinnans*	Very common passage migrant. Very common winter visitor.
Siberian Gull *Larus heuglini*	Common passage migrant. Uncommon winter visitor.
12	TERNS Sternidae
Gull-billed Tern *Sterna nilotica*	Very common resident. Common passage migrant. Breeds.
Caspian Tern *Sterna caspia*	Common passage migrant. Uncommon resident. Breeds
Swift Tern *Sterna bergii*	Common summer visitor. Scarce resident. Breeds.
Lesser Crested Tern *Sterna bengalensis*	Common summer visitor. Scarce resident. Breeds.

Sandwich Tern *Sterna sandvicensis*	Uncommon passage migrant. Uncommon winter visitor. Scarce resident.
Common Tern *Sterna hirundo*	Uncommon passage migrant. Rare winter visitor. Scarce summer visitor.
White-cheeked Tern *Sterna repressa*	Very common summer visitor. Rare resident. Breeds.
Bridled Tern *Sterna anaethetus*	Very common summer visitor. Scarce resident. Breeds.
Little Tern *Sterna albifrons*	Common passage migrant. Rare summer visitor.
Saunders's Tern *Sterna saundersi*	Uncommon passage migrant.
Whiskered Tern *Chlidonias hybridus*	Uncommon passage migrant. Scarce summer visitor.
White-winged Tern *Chlidonias leucopterus*	Uncommon passage migrant. Scarce summer visitor. Breeds.
2	SANDGROUSE Pteroclididae
Spotted Sandgrouse *Pterocles senegallus*	Irrregular (has been common) summer visitor. Uncommon disperser in autumn, winter and spring. Has bred.
Pin-tailed Sandgrouse *Pterocles alchata*	Irrregular (has been common) summer visitor. Uncommon passage migrant. Uncommon winter visitor. Has bred.
5	PIGEONS & DOVES Columbidae
Rock Dove *Columba livia*	Abundant resident. Breeds.
Collared Dove *Streptopelia decaocto*	Very common resident. Common passage migrant. Uncommon winter visitor. Breeds.
Turtle Dove *Streptopelia turtur*	Very common passage migrant. Rare summer visitor. Rare winter visitor. Has bred.
Laughing Dove *Streptopelia senegalensis*	Abundant resident. Breeds.
Namaqua Dove *Oena capensis*	Uncommon resident. Scarce disperser in spring and autumn. Breeds.
1	PARROTS Psittacidae

Ring-necked Parakeet *Psittacula krameri*	Common winter visitor. Uncommon resident. Has bred.
1	Cuckoos Cuculidae
<u>Cuckoo</u> *Cuculus canorus*	Uncommon passage migrant.
3	OWLS Tytonidae & Strigidae
Scops Owl *Otus scops*	Common passage migrant.
Eagle Owl *Bubo bubo*	Scarce resident. Breeds
Little Owl *Athene noctua*	Uncommon resident. Breeds.
2	NIGHTJARS Caprimulgidae
Eurpean Nightjar *Caprimulgus europaeus*	Uncommon passage migrant. Rare summer visitor.
<u>Egyptian Nightjar</u> *Caprimulgus aegyptius*	Uncommon passage migrant. Rare summer visitor. Rare winter visitor.
3	SWIFTS Apodidae
Common Swift *Apus apus*	Abundant passage migrant. Rare winter visitor.
Pallid Swift *Apus pallidus*	Very common passage migrant. Common summer visitor. Common winter visitor. Breeds.
Alpine Swift *Apus melba*	Scarce passage migrant.
2	KINGFISHERS Alecdinidae
<u>White-throated Kingfisher</u> *Halcyon smyrnensis*	Uncommon winter visitor. Scarce resident. Breeds.
<u>Common Kingfisher</u> *Alcedo atthis*	Scarce winter visitor. Scarce passage migrant.
2	BEE-EATERS Meropidae
<u>Blue-cheeked Bee-eater</u> *Merops persicus*	Abundant passage migrant. Rare summer visitor. Has bred.

Bee-eater *Merops apiaster*	Abundant passage migrant.
1	ROLLERS Coraciidae
Roller *Coracias garrulus*	Uncommon passage migrant.
1	HOOPOES Upupidae
Hoopoe *Upupa epops*	Common passage migrant.
1	WOODPECKERS Picidae
Wryneck *Jynx torquilla*	Uncommon passage migrant.
13	LARKS Alaudidae
Black-crowned Finch Lark *Eremopterix nigriceps*	Common resident. Breeds.
Dunn's Lark *Eremelauda dunni*	Uncommon disperser in all seasons.
Bar-tailed Lark *Ammomanes cincturus*	Uncommon resident. Breeds.
Desert Lark *Ammomanes deserti*	Uncommon resident. Has bred.
Hoopoe Lark *Alaemon alaudipes*	Common resident. Uncommon disperser in spring and autumn. Breeds.
Thick-billed Lark *Ramphocoris clotbey*	Rare disperser in winter and spring. Has bred.
Bimaculated Lark *Melanocorypha bimaculata*	Uncommon passage migrant. Rare winter visitor. Rare summer visitor. Has bred.
Short-toed Lark *Calandrella brachydactyla*	Abundant passage migrant. Common summer visitor. Scarce winter visitor. Breeds.
Lesser Short-toed Lark *Calandrella rufescens*	Very common passage migrant. Very common winter visitor. Common summer visitor. Breeds.
Crested Lark *Galerida cristata*	Very common resident. Breeds.
Skylark *Alauda arvensis*	Uncommon passage migrant. Uncommon winter visitor.

Temminck's Lark *Eremophila bilopha*	Uncommon disperser in autumn, winter and spring. Has bred.
5	SWALLOWS & MARTINS Hirundinidae
Sand Martin *Riparia riparia*	Abundant passage migrant. Uncommon summer visitor. Rare winter visitor.
Barn Swallow *Hirundo rustica*	Abundant passage migrant. Uncommon winter visitor. Scarce summer visitor.
Red-rumped Swallow *Hirundo daurica*	Common passage migrant.
House Martin *Delichon urbica*	Abundant passage migrant. Rare winter visitor.
8	PIPITS & WAGTAILS Motacillidae
Tawny Pipit *Anthus campestris*	Very common passage migrant. Uncommon winter visitor.
Tree Pipit *Anthus trivialis*	Common passage migrant. Rare winter visitor.
Meadow Pipit *Anthus pratensis*	Scarce passage migrant and winter visitor.
Red-throated Pipit *Anthus cervinus*	Very common passage migrant. Uncommon winter visitor.
Water Pipit *Anthus spinoletta*	Common passage migrant. Common winter visitor.
Yellow Wagtail *Motacilla flava*	Very common passage migrant. Scarce summer visitor. Rare winter visitor.
Grey Wagtail *Motacilla cinerea*	Uncommon passage migrant. Scarce winter visitor.
Pied Wagtail *Motacilla alba*	Abundant passage migrant. Abundant winter visitor.
2	BULBULS Pycnonotidae
White-cheeked Bulbul *Pycnonotus leucotis*	Abundant resident. Breeds.
Red-vented Bulbul *Pycnonotus cafer*	Common resident. Breeds.
1	WAXWINGS & HYPOCOLIUS Bombycillidae
Grey Hypocolius	Uncommon passage migrant. Scarce win-

Hypocolius ampelinus	ter visitor.
20	THRUSHES & CHATS Turdidae
Rufous Bush Robin *Cercotrichas galactotes*	Common passage migrant. Uncommon summer visitor. Breeds.
Robin *Erithacus rubecula*	Uncommon winter visitor.
Thrush Nightingale *Luscinia luscinia*	Uncommon passage migrant.
Nightingale *Luscinia megarhynchos*	Uncommon passage migrant.
Bluethroat *Luscinia svecica*	Common passage migrant. Common winter visitor.
White-throated Robin *Irania gutturalis*	Uncommon passage migrant. Rare winter visitor.
Black Redstart *Phoenicurus ochruros*	Uncommon passage migrant. Scarce winter visitor.
Redstart *Phoenicurus phoenicurus*	Very common passage migrant. Scarce winter visitor.
Whinchat *Saxicola rubetra*	Uncommon passage migrant. Rare winter visitor.
Stonechat *Saxicola torquata*	Common passage migrant. Uncommon winter visitor.
Isabelline Wheatear *Oenanthe Isabellina*	Very common passage migrant. Common winter visitor.
Nothern Wheatear *Oenanthe oenanthe*	Common passage migrant.
Pied Wheatear *Oenanthe pleschanka*	Very common passage migrant. Scarce winter visitor.
Black-eared Wheatear *Oenanthe hispanica*	Uncommon passage migrant.
Desert Wheatear *Oenanthe deserti*	Very common passage migrant. Common winter visitor.
Mourning Wheatear *Oenanthe lugens*	Uncommon disperser in autumn, winter and spring.
Rock Thrush *Monticola saxatilis*	Uncommon passage migrant. Rare winter visitor.
Blue Rock Thrush *Monticola solitarius*	Uncommon passage migrant. Scarce winter visitor.

Blackbird *Turdus merula*	Scarce winter visitor.
Song Thrush *Turdus philomelos*	Common passage migrant. Common winter visitor.
26	WARBLERS Sylviidae
Cetti's Warbler *Cettia cetti*	Uncommon disperser in autumn, winter and spring.
Graceful Warbler *Prinia gracilis*	Common resident. Breeds.
River Warbler *Locustella fluviatilis*	Uncommon passage migrant.
Savi's Warbler *Locustella lusciniodes*	Uncommon passage migrant.
Moustached Warbler *Acrocephalus melanopogon*	Uncommon passage migrant. Uncommon winter visitor. Uncommon resident. Breeds.
Sedge Warbler *Acrocephalus schoenobaenus*	Common passage migrant.
Marsh Warbler *Acrocephalus palustris*	Common passage migrant.
Reed Warbler *Acrocephalus scirpaceus*	Very common passage migrant. Uncommon summer visitor. Rare winter visitor. Breeds.
Clamorous Reed Warbler *Acrocephalus stentoreus*	Uncommon passage migrant. Scarce resident.
Great Reed Warbler *Acrocephalus arundinaceus*	Common passage migrant. Uncommon summer visitor. Has bred.
Basra Reed Warbler *Acrocephalus griseldis*	Common passage migrant. Scarce summer visitor.
Eastern Olivaceous Warbler *Hippolais pallida*	Very common passage migrant. Common summer visitor. Rare winter visitor. Breeds.
Upcher's Warbler *Hippolais languida*	Common passage migrant.
Menetries's Warbler *Hippolais mystacea*	Common passage migrant. Uncommon winter visitor.
Desert Warbler *Sylvia nana*	Common passage migrant. Common winter visitor.
Eastern Orphean Warbler	Uncommon passage migrant.

Sylvia crassirostris	
Barred Warbler *Sylvia nisoria*	Uncommon passage migrant.
Lesser Whitethroat *Sylvia curruca*	Common passage migrant. Rare winter visitor.
Desert Lesser Whitethroat *Sylvia minula*	Uncommon passage migrant. Scarce winter visitor.
Whitethroat *Sylvia communis*	Very common passage migrant.
Garden Warbler *Sylvia borin*	Uncommon passage migrant.
Blackcap *Sylvia atricapilla*	Very common passage migrant.
Yellow-browed Warbler *Phylloscopus inornatus*	Rare passage migrant and winter visitor.
Wood Warbler *Phylloscopus sibilitrax*	Scarce passage migrant.
Chiffchaff *Phylloscopus collybita*	Abundant passage migrant. Abundant winter visitor.
Willow Warbler *Phylloscopus trochilus*	Abundant passage migrant.
2	FLYCATCHERS Muscicapidae
Spotted Flycatcher *Muscicapa striata*	Very common passage migrant.
Semi-collared Flycatcher *Ficedula semitorquata*	Uncommon passage migrant.
1	PENDULINE TIT Remizidae - - -
Penduline Tit *Remiz pendulinus*	Uncommon passage migrant. Uncommon winter visitor.
1	ORIOLES Oriolidae
Golden Oriole *Oriolus oriolus*	Common passage migrant. Has bred
7	SHRIKES Laniidae
Isabelline Shrike *Lanius isabellinus*	Common passage migrant. Uncommon winter visitor. Scarce summer visitor.

Red-backed Shrike *Lanius collurio*	Very common passage migrant.
Lesser Grey Shrike *Lanius minor*	Uncommon passage migrant.
Southern Grey Shrike *Lanius meridionalis*	Common passage migrant. Uncommon winter visitor.
Steppe Grey Shrike *Lanius pallidirostris*	Uncommon passage migrant. Uncommon winter visitor.
Woodchat Shrike *Lanius senator*	Common passage migrant. Rare winter visitor. Has bred.
Masked Shrike *Lanius nubicus*	Common passage migrant. Rare winter visitor.
2	CROWS Corvidae
House Crow *Corvus splendens*	Uncommon passage migrant and summer visitor. Breeds.
Brown-necked Raven *Corvus ruficollis*	Scarce resident. Scarce summer visitor. Has bred.
3	STARLINGS Sturnidae
Starling *Sturnus vulgaris*	Very common passage migrant. Very common winter visitor.
Bank Mynah *Acridotheres ginginianus*	Uncommon resident. Breeds.
Common Myna *Acridotheres tristis*	Very common resident. Breeds.
5	SPARROWS Passeridae
House Sparrow *Passer domesticus*	Abundant resident. Breeds.
Spanish Sparrow *Passer hispaniolensis*	Very common winter visitor. Common resident. Breeds.
Pale Rock Sparrow *Petronia brachydactyla*	Uncommon passage migrant. Rare summer visitor. Has bred.
Yellow-throated Sparrow *Gymornis xanthocollis*	Uncommon passage migrant. Scarce summer visitor. Breeds.
1	WAXBILLS Estrildidae
Indian Silverbill *Euodice malabarica*	Uncommon resident. Has bred.

2	FINCHES Fringillidae
Trumpeter Finch *Bucanetes githagineus*	Uncommon disperser in all seasons.
Common Rosefinch *Carpodacus erythrinus*	Scarce passage migrant.
2	BUNTING Emberizidae
Cinereous Bunting *Emberiza cineracea*	Scarce passage migrant.
Ortolan Bunting *Emberiza hortulana*	Common passage migrant. Rare winter visitor.

Abundant: 10000, Very Common: 1000-9999, Common: 100-999, Uncommon: 10-99, Scarce: 1-9

Southern Marshes as Bird Habitats

1. Wintering Species

No accurate estimate will ever be available for the number of waterfowl which once wintered in the Mesopotamian marshlands. In addition to providing regular wintering habitat for waterfowl, the wetlands of Mesopotamia serve as a vitally important refuge for waterfowl during periods of exceptionally severe weather further north. The populations of two species of waterfowl, almost confined to the Southern marshes, have been described as distinct subspecies: the Little Grebe *Tachybaptus ruficollis iraquensis* and African Darter *Anhinga rufa chantrei*. *T. ruficollis iraquensis* is known to occur only in the Southern marshes of Iraq and is probably close to extinction.

The Dalmatian Pelican *Pelecanus crispus* is a common winter visitor, and probably also a resident breeding species. Pelicans are known to have bred in the marshes, but it is not known which of the two species is involved, although *Pelecanus crispus* is the more likely. The Pygmy Cormorant *Phalacrocorax pygmaeus* was formerly a common resident, breeding in some of the marshes and moving out locally to the rivers and other marshes in winter. The waterfowl surveys between 1968 and 1979 confirmed that the species remained fairly common in winter, with up to 100 being recorded at one locality, and it seemed likely that the total number in the marshes at that time exceeded 500.

The Lesser White-fronted Goose *Anser erythropus* was formerly a regular winter visitor, although always less common than *A. albifrons*, but none was recorded in Mesopotamia during the four IWRB surveys between 1968 and 1979, or since then. The Marbled Teal *Marmaronetta angustirostris* is known to breed widely in Basra mardhes. The species remained a common summer visitor to wetland. The White-headed Duck *Oxyura leucocephala* appears to be only a very scarce winter visitor. The Pallas's Fish-Eagle *Haliaeetus leucoryphus* was formerly a scarce winter visitor to the southern marshes. The Imperial Eagle *Aquila heliaca* is a fairly common winter visitor to the Mesopotamian plains.

The Sociable Plover *Vanellus gregarius* was formerly believed to be a locally common passage migrant and winter visitor in Mesopotamia, and was known from a number of localities The Slender-billed Curlew *Numenius tenuirostris* was first recorded wintering in Iraq in the early part of this century. In view of the vast extent of the habitat suitable for *N. tenuirostris* in southern marshes and the very poor coverage of these wetlands by ornithologists, there is a distinct possibility that a significant wintering population of this endangered species continues to survive there.

2. Breeding Species

Species which are known to have bred in the Mesopotamian marshes (Fig. 1) include *Tachybaptus ruficollis*, *Phalacrocorax pygmaeus*, *Ardea purpurea*, *Ardeola ralloides*, *Nycticorax nycticorax*, *Ixobrychus minutus*, *Ciconia ciconia*, *Platalea leucorodia*, *Anser anser*, *Anas querquedula*, *Porphyrio porphyrio*, *Gallinula chloropus*, *Fulica atra*, *Himantopus himantopus*, *Recurvirostra avosetta*, *Glareola pratincola*, *Charadrius dubius*, *C. alexandrinus*, *Vanellus indicus*, *V. leucurus*, *Larus genei*, *Chlidonias hybridus*, *C. leucopterus*, *Gelochelidon nilotica*, *Sterna caspia*, *S. hirundo* and *S. albifrons*. There are about eight other species, including conspicuous birds such as *Podiceps cristatus*, *Egretta garzetta* and *Plegadis falcinellus*, which might be expected to breed in the marshes, but which have never been proven to do so. On the other hand, old reports of breeding by *Glareola nordmanni* now seem likely to have been erroneous.

Fig.1. Juvenile White-crowned Wheatear, southern Iraq as first breeding records of warblers, wheatear in Iraq. (Laith Al-Obeidi, Nature Iraq – Bird life International)

Environmental Hazards

1. Drainage

Drainage of southern marshes imposed an adverse effect on the populations of about 40 species of birds which occur in the marshes in internationally significant numbers, and would cause major declines in the regional populations of *many species such as Pelecanus onocrotalus*, *Ardea purpurea* , *Ixobrychus minutus*, *Plegadis falcinellus*, *Aythya fuligula*, *Circus aeruginosus* , *Porphyrio porphyrio* and *Fulica atra* . Migratory populations of waterfowl would be affected over a very wide area from the West Siberian tundra to southern Africa, as one of the major staging and wintering areas in the West Siberian/Caspian/Nile flyway is lost.

Clearly, as far as wildlife is concerned, the ongoing drainage of the wetlands of southern marshes constitutes an ecological catastrophe of unpreceden Noteworthy fauna: The southern marshes are sufficiently large and have been isolated from other comparable wetland areas for a sufficient length of time to allow for the evolution of several forms of animals which are unique to these wetlands. These include two species of birds (*Turdoides altirostris* and *Acrocephalus griseldis*), two subspecies of birds (*Tachybaptus ruficollis iraquensis* and *Anhinga rufa chantrei*).

2. Hunting

Waterfowl hunting occurs commonly at southern marshes gave some indication of the massive scale of the hunting. A wide variety of species were killed by the Marsh Arabs for food including not only huge numbers of ducks and Coots (*Fulica atra*), but also Little Grebes (*Tachybaptus ruficollis*), Pygmy Cormorants (*Phalacrocorax pygmaeus*), African Darters (*Anhinga rufa*), Goliath Herons (*Ardea goliath*), Sacred Ibises (*Threskiornis aethiopicus*), Common Cranes (*Grus grus*), Purple Swamphens *(Porphyrio porphyrio*) and godwits (*Limosa* sp.). Pelicans, although regarded as inedible, were shot or speared for their gular pouches which were used in drum-making. As many as 30 geese or 120 ducks and shorebirds could be trapped in the clap-nets at a single pull. Several of the resident breeding species such as *Anhinga rufa*, *Ardea goliath* and *Threskiornis aethiopicus* were already becoming very scarce, probably because of direct persecution and increased disturbance.

Considerable numbers of wildfowl are still taken every year, mainly by netting. There are reasons to believe that netting has now become an organized business, approved by the Government. About 30,000 ducks and geese were being sold each season in the Basrah market alone. The commonest species on sale were *Anas platyrhynchos*, *Aythya ferina*, *Anas crecca*, *A. Strepera*, *Aythya fuligula*, *Anas acuta* and *A. Clypeata*. The isolated Mesopotamian population of *Threskiornis aethiopicus* seems to have followed a similar fate to that of *Ardea goliath*. However, the ibis was a favourite quarry species of the local hunters and was very wary. The species appears to have become quite scarce.

Vulnerable & Threatened Species

Among the species of birds previously reported to occur in Iraq as a whole and in Basrah habitats in special, many species have been recorded vulnerable, threatened or rare in the present survey. Eleven species of birds listed in the 1994 IUCN Red List of Threatened Animals (Groombridge, 1993) have occurred in the marshes of Southern Iraq. Following the discussion on impacts of drainage and hunting, a list is prepared for the threatened, vulnerable, rare and accidental species which need conservation as seen in Table 2.

Table 2. list of vulnerable, threatened and rare bird species in Basra habitats

Species	Status
Phalacrocorax pygmaeus	Near-threatened
Phalacrocorax nigrogularis	Vulnerable
Anhinga melanogaster	Near-threatened
Ardeola grayii	Rare/Accidental
Geronticus eremita	Critically endangered
Oxyura leucocephala	Endangered
Anser erythropus	Vulnerable
Branta ruficollis	Vulnerable
Anas falcata	Rare/Accidental
Marmaronetta angustirostris	Vulnerable
Aythya nyroca	Near-threatened
Haliaeetus leucoryphus	Vulnerable
Haliaeetus albicilla	Near-threatened
Aegypius monachus	Near-threatened
Circus macrourus	Near-threatened
Aquila clanga	Vulnerable
Aquila heliaca	Vulnerable
Falco naumanni	Vulnerable
Crex crex	Vulnerable
Tetrax tetrax	Near-threatened
Otis tarda	Extirpated Vulnerable
Chlamydotis undulata	Near-threatened
Gallinago media	Near-threatened
Numenius tenuirostris	Critically endangered
Vanellus gregarius	Vulnerable
Apus affinis	Rare/Accidental
Dendrocopos medius	Rare/Accidental

Cinclus cinclus	Rare/Accidental
Saxicola caprata	Rare/Accidental
Oenanthe monacha	Rare/Accidental
Pycnonotus xanthopygos	Rare/Accidental
Acrocephalus griseldis	Near-threatened
Phylloscopus sindianus	Rare/Accidental
Anthus similis	Rare/Accidental
Serinus syriacus	Near-threatened
Carduelis flammea	Rare/Accidental
Rhodopechys sanguinea	Rare/Accidental
Emberiza cineracea	Near-threatened

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CHAPTER TEN

REPTILES & AMPHIBIANS

Nadir A. Salman

Dept. of Fisheries & Marine Resources, College of Agriculture, Univ. of Basrah, Iraq

Introduction

Iraq's reptiles and amphibians (herpetofauna) were studied extensively during the 1920s when British troops were in Iraq. Earlier studies were summarized by Allouse (1955) and Mahdi & Georg (1969). The few scattered studied that were published (Haas 1952, Reed & Marx 1959, Haas & Werner 1969) added little to the understanding of the herpetofauna of Iraq. Maxwell (1957) commented on the extreme abundance of frogs, but did not indicate species. He concluded that there were several species in the marshes. A significant series of articles on Iraqi herpetofauna was published in the late 1950s and early 1960s by Khalaf (1959), (1960), and (1961). They include a general account, without mentioning localities. The most comprehensive list of the reptiles and amphibians of Iraq was derived by den Bosch (2003) from older publications. So far, about 96 species of reptiles and amphibians have been recorded from Iraq (in den Bosch 2003), but only a relatively small proportion of them occur in the Marshes. A detailed bibliography of reptiles and amphibians of Iraq was included in the comprehensive treatise on the reptiles of the Middle East by Leviton et al. (1992).

Amphibians and Reptiles of the Southern Marshes

The contribution of the herpetofauna to the biodiversity values of the Marshes can be summarized by the following key points:

1. Key habitat for globally endangered species:

The globally endangered Euphrates Softshell Turtle *Rafetus euphraticus may* have one of its key strongholds in the Marshes.

2. Potential for as yet unexplored amphibian diversity:

The almost complete lack of information about the amphibians of the Marshes leaves open the general possibility of the occurrence of additional species in the Marshes. They may include endemic or semi-endemic species that are unique to Basrah regional ecosystem and species which are endangered, threatened, or vulnerable to extinction.

Amphibians

Little information is available on the amphibians and reptiles of the Southern Iraqi marshes. Notably the extreme abundance of frogs, and concluded that there were several species in the marshes. A toad (*Bufo viridis*), a tree frog (*Hyla arborea*) and two marsh frogs (*Rana ridibunda* and *R. esculenta*) (Fig. 9.1) are listed for Iraq by Mahdi and Georg (1969). Since data about the amphibians of the Marshes are extremely scarce, further field studies may yield additional species. However, the few recent molecular studies on herpetofauna in the Tigris-Euphrates basin outside the Marshes yielded exclusively species already known from other areas, rather than new species (Stoeck *et al*. 2006). This would be consistent with the fact that the Marshes in their current location only formed after the last postglacial transgression (not more than 4,300 years ago (Sanlaville, 2004) and hence have not offered a constant habitat for species evolution over an evolutionary significant time span.

Fig. 9.1. The marsh frog *Rana ridibunda*

Reptiles

Common reptiles in the marshes include the Caspian Terrapin (*Clemmys caspia*), a soft-shell turtle (*Trionyx euphraticus*), the softshell turtle (*Rafetus euphraticus*) (Fig. 9.2), geckos of the genus *Hemidactylus*, two species of skinks (*Mabuya aurata* and *M. vittata*), and a variety of snakes including the Spotted Sand Boa (*Eryx jaculus*), Tessellated Water Snake (*Natrix tessellata*) and Gray's Desert Racer (*Coluber ventromaculatus*). The Desert Monitor (*Varanus griseus*) was formerly common in desert areas adjacent to the marshes, but this species has been heavily persecuted and is now rare.

Fig. 9.2. The softshell turtle (*Rafetus euphraticus*) a common reptile in Iraqi marshes.

Typical reptiles of the Marshes include the Caspian Terrapin *Mauremys caspica*, the Euphrates Soft-shelled Turtle *Rafetus euphraticus*, several geckos of the genus *Hemidactylus*, two species of skinks (*Trachylepis aurata* and *Mabuya vittata*), and a variety of snakes of the genus *Coluber*, the Sand Boa *Eryx jaculus*, the Tessellated Water Snake *Natrix tessellata* and Gray's Desert Racer *Coluber ventromaculatus*. The Desert Monitor (*Varanus griseus*) was formerly common in deserts near the Marshes, but is now rare due to heavy persecution (Scott 1995). The Spiny-tailed Lizard *Uromastyx aegyptia* probably occurs in or near the Marshes, but there are no definite records. Despite the lack of precise localities, the Tree Frog *Hyla savignyi*, the Marsh Frog *Rana ridibunda* and the Green Toad *Bufo viridis* are found in the Marshes (Leviton et al. 1992). Table (1) shows the reptiles recorded from the vicinity of the southern marshes of Iraq.

Table 1. Reptiles recorded from the vicinity of the southern marshes of Iraq (Haas & Werner (1969) and Scott (1995).

Family Bufonidae	
The Green Toad	*Bufo viridis*
Family Hylidae	
The Tree Frog	*Hyla savignyi*
Family Ranidae	
The Marsh Frog	*Rana ridibunda*
Family Gekkonidae	
Keeled Rock Gecko	*Cyrtopodion scaber*
Asia Minor Thin-toed Gecko	*Cyrtopodion heterocercum*
Doria's Thin-toad Gecko	*Stenodactylus doriae*
Slevin's sand gecko	*Stenodactylus sleveni*
Branford's Rock Gecko	*Bunopus tuberculatus*
Persian Gecko	*Asaccus elisae*
Yellow-bellied House Gecko	*Hemidactylus flaviviridis*
Persian Leaf-toed Gecko	*Hemidactylus persicus*
Family Lacertidae	
Snake-eyed Lizard	*Ophisops elegans*
Family Scincidae	
Golden Grass Mabuya	*Mabuya aurata septemtae-niata*
The Bridled Mabuya	*Trachylepis vittata*
Family Boidae	
Javelin sand boa	*Eryx jaculus*
Family Colubirdae	
Glossy-bellied Racer	*Platyceps ventromaculatus*
Tessellated Water Snake	*Natrix tessellata*
Family Trionychidae	
Euphrates Soft-shelled Tur-tle	*Rafetus euphraticus*
Family Bataguridae	
Caspian Terrapin	*Mauremys caspica*

Threats to Herpetofauna Biodiversity

In general, the threats to biodiversity of Herpetofauna in southern part of Iraq might be a direct result of the effects of climate changes and effects of other environmental changes such as shortage of freshwater and rising of water salinity levels in recent years.

The IUCN Red List provides a list of terrestrial Herpetofauna species that have been assessed on the basis of their conservation status. The numbers of assessed species are listed below by class:

CLASS	NO. OF ASSESSED SPECIES
AMPHIBIA	6
REPTILIA	23

The IUCN Red List provides a list of freshwater species that have been assessed on the basis of their conservation status. The numbers of assessed species are listed below by class:

CLASS	NO. OF ASSESSED SPECIES
AMPHIBIA	6
REPTILIA	1

IUCN Red List of critically endangered, endangered, vulnerable, near-threatened & extinct freshwater species of Iraq includes six species of Amphibians, two of them are of conservation concern species.

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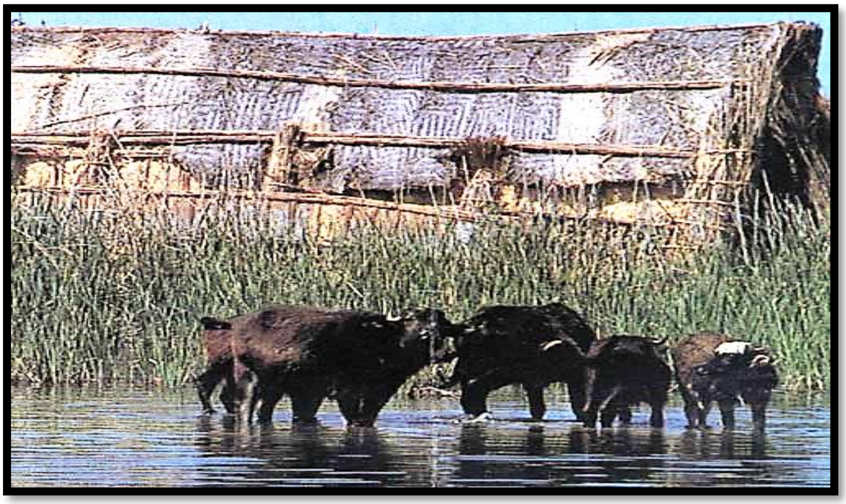
CHAPTER EIEVEN



Mammals

Nadir A. Salman

Dept. of Fisheries & Marine Resources, College of Agriculture, Univ. of Basrah, Iraq.

Introduction

Since Hatt (1959) little was known about the mammals of Iraq. Mahdi & George (1969) prepared their checklist of the vertebrates of Iraq, which included wild and domesticated mammals. They listed 88 mammalian species according to the systematic arrangement of Ellerman & Morrison-Scott (1951)., The mammals in Basra, however, are relatively well known. Maxwell (1957) made numerous references to the mammals which they encountered in the marshes, but gave few specific details. More recently, mammalogists at the Iraq Natural History Museum in Baghdad and Museum of Natural History at the University of Basra have conducted investigations on small mammals in the Mesopotamian Marshes (Al-Robaae, 1977; Al-Robaae & Felten, 1990). Researchers of the biological research centre have also published few papers on the mammals of Iraq in the 1970s (Nader, 1971; Niazi, 1976). Information available on the mammals of Iraq has recently been summarized by Harrison and Bates (1991).

Mammals of the Southern Marshes

The southern marshes of Iraq are sufficiently large and have been isolated from other comparable wetland areas for a sufficient length of time to allow for the evolution of several forms of animals which are unique to these wetlands. These include two species of mammals (*Erythronesokia bunnii* and *Gerbillus mesopotamiae*), one subspecies of mammal (*Lutra perspicillata maxwelli*). Mammals of the southern marshes can be categorized into:

1. Unique species:
Eurythroneskia bunni, Gerbillus mesopotamiae and *Lutra persspicillata maxwelli*
2. Commonly occurred species:
Wild Boar *Sus scrofa,* Common Otter *Lutra lutra*
Smooth coated Otter *Lutra perspicillata,* Asiatic jackal *Canis aureus,* Red Fox *Vulpes vulpes,* Small Indian Mongoose *Herpestes auropunctatus*
3. Abundant throughout the marshes: Domestic water Buffalo.
They can also be categorized as:

1. Large Mammals

Rather few species of mammals occur commonly in Basrah marshes. One of them is the Wild Boar (*Sus scrofa*) which is abundant throughout the marshlands. However, the boar has been heavily hunted by the Marsh Arabs, and although the species is still the most abundant large mammal in the marshes, numbers have declined noticeably in recent years. Two species of otters have been recorded in the marshes, the Common Otter *Lutra lutra* and the Smooth-coated Otter *Lutra perspicillata*, but were finally exterminated due to hunting. The Leopard (*Panthera pardus*) is likewise extinct in lower Mesopotamia. Large mammals which are still regularly encountered in the marshes include the Asiatic Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*) and Small Indian Mongoose (*Herpestes auropunctatus*). Various other mammals, notably Grey Wolf (*Canis lupus*), Honey Badger (*Mellivora capensis*), Striped Hyaena (*Hyaena hyaena*), Jungle Cat (*Felis chaus*), Goitred Gazelle (*Gazella subgutturosa*) and Indian Crested Porcupine

(*Hystrix indica*), have been recorded in and around the marshes in the past, but all had become rare by the 1980s, and it is thought likely that most are now extinct in the area.

2. Small Mammals

Small mammals recorded in and around the marshes include a recently described species of bandicoot rat *Erythronesokia bunnii*, an endemic species of gerbil *Gerbillus mesopotamicus*, a hedgehog, three species of shrews, eight to 11 species of insectivorous bats, a jerboa, four other species of rats and mice, and three other species of gerbils and jirds. The commonest rodent in the area is the Short-tailed Bandicoot *Nesokia indica*, a species which is particularly associated with the banks of wetlands. The bandicoot rat *E. bunnii* was discovered as recently as the late 1970s in the Central Marshes at Qurna (Khajuria, 1981). Little is known about the species, but it would appear to be confined entirely to the marshlands of southern Iraq. Harrison's Gerbil *G. mesopotamiae* is known only from the vicinity of southern marshes and adjacent Khuzestan in south-western Iran. Formerly thought to be a subspecies of *G. dasyurus*, this highly colonial gerbil exhibits a marked degree of water-dependence for a gerbil, and is not able to survive without it. The gerbil appears to be not uncommon in the uncultivated, sparsely-vegetated fringe of the marshes and along the banks of the Euphrates. Notable among the bats is the rare and declining Long-fingered Bat (*Myotis capaccinii*), recorded at Kish on the edge of the wetlands. This species is considered to be globally threatened (IUCN-List). A list of small mammals recorded in and around the marshes is presented in Table 1.

3. Water Buffalo

Domestic water buffalo are abundant throughout the marshes and are of considerable importance in the local economy. According to Maxwell (1957), there is evidence to suggest that these animals were first introduced into marshes in about 3500 BC. It is believed however that the species was formerly wild in the marshes, before domestication. Number of cows and buffalo in the marshes at present are much lower than before, as seen in Table 2.

Table 1. List of small mammals occurred in Basra habitats.

Animal Type	No. of Species	Status
Hedgehog	1	
Shrews	3	
Insectivorous Bats	8-11	
Gerboa	1	
Rats and Mice	4	
Bandicoot Rat, *Erythronesokia bunnii* not threatened		Endemic sp.
Short-tailed Bandicoot, *Nesokia indica* not threatened		Endemic sp.
Gerbils and Jirds	3	

Table 2: Number of buffalos in Basra Marshes before and after devastation.

Region	Before	After
Hareer	420	200
Alhafar	670	320
Almasahab	290	150
Alshakata	860	455
Abumuhamer	220	100
Almisrah	187	90
Alkait	170	45
Alkora	720	350
Aldawoodi	210	95
Abumilih	89	40
Algatrah	570	256

Environmental Impacts

1. Hunting Pressure

There has been a long history of heavy hunting pressure in the marshes. Wild Boar (*Sus scrofa*) are relentlessly persecuted by the Marsh Arabs because of the damage which they cause to crops, and for religious reasons. Although the Wild Boar is still the most abundant large mammal in the marshes, numbers have declined noticeably, presumably because of this high level of hunting. The otters (*Lutra* spp.) were widely hunted for their skins and the populations were becoming much depleted by the hunters.

2. Drainage pressure

Loss of the marshes habitats would cause catastrophic declines in the world populations of some unique mammals species such as Turdoides *altirostris* and *Acrocephalus griseldis* and in the regional population of *Pelecanus crispus*, possibly threatening them with extinction, and would cause perhaps as much as a 50% reduction in the world populations of other mammals such as *Gerbillus mesopotamiae*, *Tachybaptus ruficollis iraquensis* and *Marmaronetta angustirostris*. Scott and Evans (1993) concluded that drainage of the wetlands of Lower Mesopotamia on this scale would almost certainly result in the global extinction of *Lutra perspicillata maxwelli* and *Erythronesokia bunnii*, the extinction in the Middle East of *Anhinga rufa* and *Threskiornis aethiopicus*, and the extinction in Iraq of *Phalacrocorax pygmaeus* and *Ardea goliath*. Table 3. shows some of the extinct species which were present in Basra in the past.

Table 3. Impact of hunting and devastation on marsh mammals.

A. Globally threatened or extinct but formerly present in Basra Marshes

Cheetah	*Acinomyx jubatus*
Lion	*Panthera leo*
Persian fallow Deer	*Dama dama spp. Mesopotamica*
Arabian oryx	*Oryx leucoryx*
Syrian Wild ass	*Equus hemionus spp. hemippus*
Saudi Gazelle	*Gazella saudiya*

B. Recorded in the past but are Rare species now.

Grey	*Mellivora capensis*
Grey Wolf	*Canis lupus*
Stripped Hyena	*Hyaena hyaena*
Jungle Cat	*Felis chaus*
Goitred Gazelle	*Gazella subgutturosa*
Indian Crested porcupine	*Hystrix indica*

C. Globally threatened.

Indian smooth coated Otter	*Latrogale perspicillata*
Common Otter	*Lutra lutra*
Sind Bat	*Eptisicus nasutus*
Long-fingered Bat	*Myotis capaccinni*
Mediterranean horseshoe Bat	*Rhinolophus Euryale*
Lesser horseshoe Bat	*Rhinolophus hipposideros*
Methelys horseshoe Bat	*Rhinolophus methylyi*
American mouflon	*Ovis orientalis ssp. Gmelinii*
Wild Goat	*Capra aegagrus*
Sind Ibex	*Capra aegagrus spp. Blythi*
Arabian goitred Gazelle	*Gazella subgutturosa marica*

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