Habitat Mapping and Monitoring Project
Classification and Description of Southern Iraqi Marshlands
(National Park Area)

by

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Revised 10 October 2009
January, 2009
Nature Iraq
Sulaimani, Kurdistan, Iraq

NATURE IRAQ REPORT

Sulaimani, Kurdistan, Iraq

This report is prepared to summarize and inform partner agencies on the status and progress of the biodiversity initiatives of Nature Iraq. For more information please refer to Nature Iraq's web site: www.natureiraq.org or write to info@natureiraq.org

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List of abbreviations

HHA	Habitat Hectare Assessment
WQ	Water Quality
PTI	Pollution Tolerance Index
VCP	Vegetation Cover Percentage
CM	Central Marshes (Chibaish area)
AZ	Central Marshes (Abu Zirig area)
DO	Dissolved Oxygen
ppt	part per thousand

Acknowledgement

This report is based on the results of the survey that was done in June 2008 as well as a review of past work and was conducted with the efforts and support of many people. Nature Iraq would like to thank the following people who participate directly or indirectly in bringing out this report: Anna Bachmann, Christine dela Cruz, Azzam Alwash, Samad Ali, Adel Al Hillawi, Richard Porter, Haider Abid, Saman Rahman, Basim Mohammed, Korsh Ararat, Mohammed Turkey and Kadhim Jawad. Also we'd like to thank our partners in the project: the Italian Ministry of Environment, Land and Sea, particularly SGI Studio Galli Ingegneria and MED Ingegneria staff of Italy for their technical support. Thanks also go to the Iraqi Ministry of Environment and BirdLife International.

Special thanks also to the local people who made our work easier with their logistic support and Nature Iraq staff for their overall support.

For this project, the Habitat team consisted of: Mudafar A. Salim (Birds), Muzher Sh. Minjil (Macrophytes), Ghasak S. Al-Obaidi (Phytoplankton), Suaad K. Salman (Phytoplankton), Mohammed A. T. Al-Saffar (Benthic Macroinvertebrates), Ali Sadiq (Benthic Macroinvertebrates), Hussam J. Ali (Water Quality), Haider A. Falih (Lab Tests), Hussain Sh. Minjil (assistant) and Nabeel A. Abdulhasn (Habitat Assessment & Project Manager).

This project is funded by The Italian Ministry of Environment, Land and Sea and supervised by Mia Fant (senior environmental engineer) from SGI in Italy.

Introduction

The Habitat Project started as an idea from Nature Iraq's Italian partners. The goal of the project was to monitor the Iraqi marshlands in a new way by applying remote sensing and satellite imaging technology. This would lessen the efforts and exorbitant outlay of monitoring trips and subsequently decrease the need to conduct a field work except in cases where satellite images indicate that there was a change in the site or area. A first exploratory trip (see Step II below) was conducted in November 2007, from which an unpublished report was produced by Nature Iraq (Abid, 2007). A second trip (see Step III below) was conducted in June 2008.

To carrying out this project, the work was divided into three steps. Step I: Discussions and Planning; Step II: Land cover survey (Using satellite images taken 2006 and surveying in areas covered by these images, an exploratory trip was designed to explore land cover classes in the Central Marshes at Chibaish area (CM) and Abu Zirig area (AZ) in order to study water quality for nine (9) candidate NP sites in these marshes); and Step III: Description or definition of habitats (determining specific sites as habitats of specific species and describing their environments according to WQ, fish, birds, zooplankton & phytoplankton, plants and habitat assessment) and follow-up survey. By the end of the project, an Iraqi Marshland Habitat Classification Scheme would be available and ready for further development in the future. The surveys covered the environmental parameters that provide an idea or indication of the environmental or economical values of each habitat type and these would help decision-makers to prepare plans for restoration and conservation of those areas that are important from environmental and socio-economic point of view.

The Habitat project is interrelated with two other projects that Nature Iraq is carrying out (the Mesopotamian Marshlands National Park and the Ramsar project in Hawizeh Marsh), so an additional objectives was to provide specific data that could support these activities as well as to use standard criteria for describing the status of the marshes in terms of water quality and biodiversity and for conserving these sites. Finally the project would help to identify the relation between biota and their habitats. For example: which habitat is critical? And for whom? This could was in essence the overarching purpose of developing the habitat classification.

Step I

Briefly, Step I can be described as follows: It commenced by exchanging opinions and notions about the goals of the project, procedures and methods that should be followed to execute the project and how to apply these methods. The discussions started between NI staff and then included Italian experts and advisers. After the discussions, an investigative survey for all Iraqi southern marshlands was made. The survey was at most a test for the places to be studied in the forthcoming habitat project. This stage was plotted to include three synchronous stages: field surveys, remote sensing and satellite mapping. Nature Iraq took the opportunity of the KBA (Key Biodiversity Areas) teams escorting its summer survey in

southern Iraq to try out the tools to be used in the hereafter habitat survey. Habitat surveyors, data sheets, and apparatus were tested in these KBA trips. This is a report which describes the habitat types covered during these trips and provided site descriptions, probable habitat classification, field observations, and four-direction photos for each KBA site visited. The chief source of information was the field habitat data sheets and photos taken by surveyors during this survey. Surveyors were also drawing sketches for each site that depicts the main features of the land cover as well as the path followed to achieve the site. It is supposed to provide worthwhile means for the appraisal of the procedures used to study the habitat types in southern Iraq. The 66 survey sites for the KBA southern Survey were the same sites in this preliminary survey (Abdulhasan, 2007).

Step II

Satellite maps were prepared for the land cover classes of the Central Marshes - Chibaish area (CM) and Abu Zirig area (AZ) based on data from a SPOT 5 satellite image acquired July 2006 and a proposed habitat classification scheme for the Iraqi marshlands was prepared (Abid, 2007). Habitat field data sheets were prepared and these sheets included basic information on the sites along with the important information such as habitat classification, site description, and plant cover percentage. Field work began with a preliminary survey that occurred on the 7th of November 2007 and continued for 6 days. This first survey visited 20 sites in the Central Marshes (CM) and four sites in Abu Zirig (AZ) marsh. Water quality parameters were also incorporated into this data sheet. Water was brackish in most areas of the CM while it was fresh in AZ sites.

Four directional photos were taken for each site as well as other photos that represented some features of the site. These photos were taken from a high position by using a ladder (although a hot air balloon was intended to be used in order to take aerial photographs, this was not possible in the field). Furthermore, videos were taken to represent different features of habitats in the marshes. A color sketch was drawn for each site to describe the features and location of the site. Photographs for existing plants in each site were taken by the plant specialists on the team. A GPS unit was used to make mark roads and other habitat features in the marsh. Coordinates tracks were taken of features such as Sibil (a water pathway with reed or Typha beds on either side), Barga (a large open water area surrounded by plant beds with smaller plant beds scattered inside the Barga) and other features such as individual reed and typha beds, submerged plants and dry land. Tracks produced different shapes for these features in the GPS, which were transferred to a computer (Abid, 2007)

The first habitat classification system was used in this survey and applied in the CM & AZ marsh sites to see if this classification system was applicable in these marshes or if it needed modification. This classification put particular emphasis on the selection of important habitat classes. Iraqi marshes have some common habitat classes that can be easily identified in a variety of different marshes such as: Open water, Sibil, Permanent Marsh Vegetation, and Submerged Vegetation. Other types of habitats can only be found beyond the borders of the marsh.

Step III

After the land cover survey in Step II was completed, the collected data were analyzed and compared with previous data. The sites chosen on the 2006 maps differed slightly from the actual status of these sites in 2007. Furthermore, the habitat classification system was not 100% applicable for the survey areas and needed modifications. These issues were taken into consideration before the field surveys of Step III could be initiated. Therefore, the satellite images of survey areas were updated (ASTER images acquired on August 2007) and a new habitat classification system (further refined for the Iraqi marshlands) was developed based on the data of Step II.

Step III was the last stage in the project and aimed to apply the new (modified) habitat classification system in a final survey. The survey focused on the characterization of the various types of habitats that can be gained in a limited series of monitoring sites. Describing biodiversity as well as water quality in each site and each habitat class was required in order to elucidate and define these habitat classes. The monitoring of these parameters helped in the understanding of habitat characteristics, how these parameters or components interact and how these components are necessary for each other. Some points were taken into consideration before starting the survey which included the following:

1) A **general description of the sites** and this included a description of the general characteristics of the site; identifying the main habitat types that are recognizable at the site; recording the coordinates of the area to be surveyed (this process was flexible since the extension was different for all sites. Rather, it depended on the accessibility and on the variety of habitat features that were present at each site); sketch drawings of the sites representing the map of the habitats distribution in the survey area (the HHA Methodology was used, see Materials and Methods section below) that was compared with the situation represented in the land cover maps. When there was stratification of different habitat types (for example in a pond there was the coexistence of rooted submerged vegetation and floating vegetation), they were listed in the sheet and indicated on the map.

2) **Habitat assessments** included the identification of each habitat feature where plant species were present, according to the habitats classification scheme, and provision of quantitative estimation of the dominant species (%); description of the plant communities (the association of species that occur in the particular physical conditions of the site); performing all the required field sampling and biological surveys; noting the relation between the habitat types and the WQ parameters, determining the presence of certain fauna species; noting the development of vegetation; evaluating the overall quality of the site (very good, good, poor) and writing down all the observations about these issues.

3) **Habitat variability and continuity** meant that along the way from one site to the next one, the main changes were observed and notes were taken on the overall extent of the main habitat features (for example reed beds: did they extend as far as the eye could see or where they like a

mosaic of patches with different density? How was their variability or continuity? How was the transition between the reed beds and different habitats?). In addition, notes were taken on the activities of locals within the area.

Materials & Methods

Habitat assessment (Habitat Hectare Assessment HHA) method

If the objective is to characterize a single vegetation type of high conservation priority and quantitative data on species richness is desired then plot studies are necessary (Sayre, *et al,* 2000). The habitat hectares assessment approach involves assigning a habitat score to a habitat zone that indicates the quality of the vegetation relative to the benchmarks. This habitat score can then be multiplied by the area of the habitat zone (in hectares) to determine the quality and quantity of vegetation (in habitat hectares). The components are divided into two groups, reflecting assessments of both 'site condition' and 'landscape context'. It is a good method for habitat assessment – ground truthing (DSE, 2004). Since the full HHA method is much more complicated, we only did the "first step"of this approach. See the plate below.

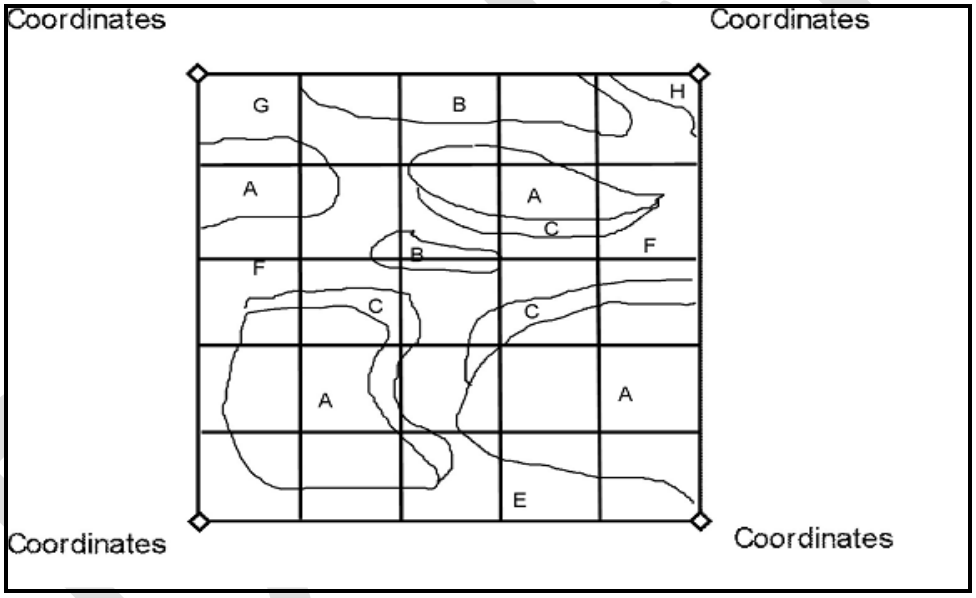


Plate 1: Explains how to apply HHA method in the field data sheet for describing of the habitat. A, B, C, D,....etc are codes for habitat classes (designed by Medingegneria team).

This is the basic principle of the HHA although a modification was made to include the largest area and number of the different types of habitats where it was used by fixing the benchmarks in the corners of site and dividing this area (the area between the benchmarks) into equal squares (about 25 squares) and then describing the vegetation in each square.

Water Quality

Physical and chemical measurements were taken of water at each site, which were as follows:

- Temperature: Air and water temperature were measured in the field by using a thermometer.
- Transparency: measured in the water column by Secchi disk.

- Turbidity: Turbidity meter (WTW Turb 430) was used for measuring turbidity in the field.
- Salinity, Conductivity and Total Dissolved Solids (TDS): were measured in the field by portable digital conductivity meter (WTW330i/SET).
- pH: It was measured in the field by a pH meter. (WTW330i/SET).
- Dissolved oxygen (DO): It was measured in the field by portable digital oxygen meter (WTW315i/SET).
- Water depth: It was measured in the field using a metric measuring rod.
- Total Organic Carbon (TOC) in particulates: The procedure to determine TOC involves the reduction of potassium dichromate (K2Cr2O7) by OC compounds and a subsequent determination of the unreduced dichromate by oxidation-reduction titration with ferrous ammonium sulfate, according to Rian, Astafan and Abdulrasheed (2003) and Gupta (1999).
- Chlorophyll-a: Extraction of chlorophyll-a pigment was done with an organic solvent (90% acetone) and measured using a spectrophotometric method (Eaton, AD, Clesceri, LS, Rice, EW, & Greenberg, AE, 2005).

Plant

Botany methodology included:

1. Plant genera and species were identified by using special botanical keys (Townsend and Guest, 1966, 1968, 1974, 1980, and 1985) and then checked with the description of aquatic plants in other Iraqi references such as Saadi and Al Mayah (1983). Internet botanical resources were also used to double check indentifications (www.image.google.com). Some species were directly identified in the field, while others were collected in nylon bags, pressed in a plant press and transferred to the lab for identification using the keys. Photographs of fresh plants were also useful for identification in addition to a the keys.
2. An approximate estimation of vegetation cover percentage (VCP) for each plant species found in the site was made (depending on the HAA method which was described above), and then the total vegetation cover percentage was calculated for each site. Estimating percentage cover was done by direct observation where each plant was given a % or a "+" signal indicating that it was present at a very low percentage in the site.

Fish

Fishing methods were different from site to site but all fish were collected from local fishermen. Fishing methods can be summarized as:

- Seine nets were used to collect fish sample in northern lakes and open marsh. The mesh size was approximately 1cm;

- Hand nets with fine mesh size (1cm) were used specially in the northern small canals with rocky beds;
- Some of samples were obtained from fishermen who were using cast nets with mesh size ranging from 2-5cm;
- Fish samples were sometimes obtained from local fishermen who employ locally-made, electro-shock devices that shocked the fish with 250 volts, which is no longer Nature Iraq policy.

Fish samples from any of the above methods were then brought to the lab to perform morphological measurements and take photos using a digital camera (Sony S90). Notes were written in the field directly. The team also visited local fish markets and fishermen in order to obtain additional detailed information by interviews. The references for identification were Al Deham (1982) and Mahdi (1962).

Birds

Recording of individuals or flocks of birds was done using point count; transect count, or whole-area count counting methods. In a few cases more than one method was used during the surveys over areas of special interest (The main surveying method that was used was the Whole-area Count, but in a few cases, the Transect-count method in addition to the Point-count method were both used according to the nature of the area and the necessity of the situation). More focus on breeding sites and nesting locations was given during breeding season over the summer surveys. Bird recordings were conducted by direct observation, either from a motor-canoe that was used for moving over distant or "relatively deeper" water areas, or by wading within reed beds. Also, cars were used to cover the more accessible terrestrial areas. A 12x30 mm binocular was used to identify bird species. A map of 1:100000-scale was used to trace the fieldwork path and to locate the selected sites.

The following field guides were used during the fieldworks: Mullarney, Svensson, Zetterström & Grant (2001); Porter, Christensen & Hansen (1996); and Salim, Porter, Christensen, Hanses and Al-Jabour (1996). Also, the following main references were used to review and compare the bird status over the area as a whole: Allouse (1953 and 1962).

The time that was spent during observation varied according to the observation method, the area of the site, the logistic plan and the security conditions.

Phytoplankton

For the phytoplankton quantitative sampling, water samples from the study sites were collected by a 1000ml polyethylene bottle after washing it with sample water. The samples were preserved by adding 1 ml Lugol solution per 100 ml of the sample, (Lugol solution is made by mixing 10 gm Iodine and 20 gm Potassium Iodide with 200 ml H2O and then 20 gm of Glacial Acetic Acid is added, and left several days before use).

For the qualitative study of phytoplankton, samples were collected by a phytoplankton net of 20 micron mesh size. The captured phytoplankton samples (250 ml) were transferred to a 500 ml polyethylene container. Samples used for qualitative analysis were preserved with 4% formalin solution (10ml of formaldehyde 37% and 90ml of distilled water) with a ratio of 1:100.

Several references were used for the Phytoplankton identification (Prescott, 1954 and 1982; Thompson, 1959; and Smith, 1950) in addition to several Iraqi papers. Phytoplankton also was used for estimating the water quality.

Benthic Macroinvertebrates

Samples were collected from the study sites using a biological dredge (50*20*50 cm) and a cylinder sampler (50 cm diameter). Cylinder samples were obtained 1-3 meters from the banks or along site edges and the biological dredge samples were obtained from the middle of the water body. In each station, four replicates were collected in order to take a representative sample of the area. The samples were washed immediately with marsh water, sieved using a 0.5 mm mesh size, and later were washed in the lab using the same sieve. Benthic macroinvertebrates were sorted by means of a dissecting microscope (BioVision 103B) and preserved in specific glass containers using 70% ethanol (Wetzel and Likens, 2000).

Benthic macroinvertebrate species were identified using dissecting and compound microscopes, with the aid of many references (Ahmed, 1975; Oliver and Roussel, 1983; Peckarsky *et al*, 1990; Merritt and Cummins, 1996; Westfall and May, 1996; Wiggins, 1996; Needham *et al*, 2000; Thompson, 2004; Plaziat and Younis, 2005). Results were expressed by the density of individuals in m^2 and the results were used to apply the Pollution Tolerance Index (PTI) described in the Field Manual for Water Quality Monitoring by Mitchell and Stapp (2000).

Habitat classification scheme for Iraq's southern marshlands

Classification systems have been developed in order to categorize habitats into groups with similar features or functions. This is important for identifying and describing habitats in order to assess the biodiversity status and habitat functions and then establish conservation plans for the environmentally important habitats. As in many classification systems especially the European classification system (Davies, Moss and Hill, 2004), the classification of Iraq's habitats is organized hierarchically, and it includes a description of the types of classified units. The recent habitat classification system is ongoing and still remains a proposal that could be updated or modified in the future. The following is the proposed Habitat classification scheme for the marshlands of Iraq and the surrounding terrestrial habitats:

WATER

1- Inland running water/ river, canal

1.1 Un-vegetated rivers and canals

1.2 Submerged river and canal vegetation

1.3 Riparian vegetation

2- Inland standing waters

2.1 Ponds or lakes – Un-vegetated standing water habitats

2.2 Un-vegetated muds – Un-vegetated mudflats, temporarily submerged and subjected to water level fluctuations)

2.3 Amphibious communities (Periodically or occasionally flooded land with phanerogamic communities adapted to aquatic environments that are subjected to water level fluctuations and even temporary desiccation (*Cyperus difformis*, *C. michelianus*, *C. laevigatus*)

2.4 Aquatic communities/ aquatic vegetation communities formed by free floating vegetation, rooted submerged vegetation, rooted floating vegetation

2.4.1 Free-floating vegetation-floating communities (*Lemna* sp., *Salvinia natans*, *Spirodela polyrhiza*) including also *Ceratophyllum demersum* and *Hydrocharis morsus-ranae* communities.

2.4.2 Rooted, submerged vegetation - rooted submerged communities (*Potamogeton* sp., *Vallisneria spiralis*, *Myriophyllum* sp., *Najas* sp., *Hydrilla verticillata*)

2.4.3 Rooted, floating vegetation - rooted formations with floating leaves (*Nymphaea* sp., *Nuphar luteum*, *Nymphoides indica*)

2.5 Salt water vegetation - salt ponds and lakes with phanerogamic communities

MARSHES

3-Marshes Vegetation

3.1 Permanent Marsh Vegetation

3.1.1 Helophytic vegetation

3.1.1.1 Reed beds (*Phragmites australis* beds)

3.1.1.2 Reed mace beds (*Typha domingensis* beds)

3.1.1.3 *Schoenoplectus litoralis* beds.

3.1.1.4 *Cladium mariscus* vegetation - *Cladium mariscus* beds

3.1.2 Woody vegetation-tree formations of willows and poplars within the marshes, excluding the tree riparian formations having a linear structure

3.1.2.1 Riparian willow formation - willow formation (*Salix* sp.)

3.1.2.2 Riparian poplar formation - poplar formation (*Populus* sp.)

3.2 Brackish or saltwater marsh vegetation– brackish or salt marshes with halophytic vegetation

3.2.1 Salt pioneer swards - pioneer communities growing on salt or brackish mud's (*Salicornia* sp. community)

TERRESTRIAL HABITATS

4 Deserts

4.1 desert shrub

4.2 unvegetated desert

4.3 unvegetated saline lands

5 Woodlands

5.1 woodland, forest and other wooded land

5.2 shrub

6 Herbaceous vegetation

6.1 grasslands

6.2 steppe

6.3 sparsely vegetated land

Habitat Type Definitions

1 Inland running water:

1.1 river, canal - unvegetated rivers and canals

1.2 submerged river and canal vegetation

1.3 Riparian vegetation

The current of running water ranges between low or almost stagnant especially in the canals located inside the marshes (some canals are part of the water body of the marshes but work as canals locally called Sibil) and medium to high current. The latter is always seen outside the marshes, i.e., in the rivers and canals which feed the marshes (the inlets) and also those which work as outlets of these marshes. Most of these canals located inside the marshes are walled by aquatic or terrestrial plants (terrestrial plants that can grow close to water bodies or in high soils that can be frequently inundated) on both sides and also contain some submerged plants close to the margins where emergent plants are located, as well as the floating plants which spread close to the margins in specific seasons. These vegetated canals inside the marshes are applicable to habitat type No. 1.2. However, some rivers and canals do not contain submerged vegetation. This may be caused by the high current and turbid water but they may be represented in some inlets or outlets of marshes and have not been seen yet in the study areas (CM & AZ sites). Subsequently this type of river or canal is designated as habitat type 1.1. There is another type of riverine habitat which is called Riparian Vegetation and is considered habitat type No. 1.3. This is a river or canal with trees or shrubs on the two margins (Groves or sparsely distributed low trees or tall shrubs to small to medium-sized trees and this habitat is found adjacent to permanent surface water).

2 Inland standing waters

2.1 Ponds or lakes – Un-vegetated standing water habitats.

Deep water (water depth about 2.5m) without vegetation. The water transparency is different and it can be clear or turbid according to the other features of the sites themselves. Usually this type of habitat is not surrounded from all directions by plants, which make it exposed to wind effects which could in turn enhance the wave action and make these areas inappropriate for the growing of submerged plants. They vary in size and can be small areas or ponds or can be large lakes.

2.2 un-vegetated muds

Un-vegetated mudflats are temporarily submerged and subjected to water level fluctuations. This type of habitat is scarce in the marshes (study area) and usually exists in the coastal zones where there are many areas subjected to tidal action. Sometimes it is found where there is livestock which trample the soil and wade in the water close to these mudflats.

2.3 amphibious communities- seasonally wet

Periodically or occasionally flooded land with phanerogamic communities adapted to aquatic environments that are subjected to water level fluctuations and even temporary desiccation (*Cyperus difformis*, *C. michelianus*, and *C. laevigatus*). It is found on the edges of marshes and is seasonally wet. The vegetation is different according to the season and may grow for one season or throughout the year. At winter and spring when the water column tends to increase and the area of marshes expands to adjacent areas or floods the edges, some plants can be found there that have tolerated the previous dry season. In summer and autumn when the water decreases and the marshes shrink, some terrestrial plants grow in these areas, especially those that can grow in or tolerate wet soils. Also there are plants which grow only in the wet season and disappear in the dry season.

2.4 aquatic vegetation communities

2.4.1 Free-floating vegetation

Usually this type of habitat exists in specific wetlands where the water current is undetectable and there are surrounding emergent or terrestrial plants supporting the existence and stability of floating plants in the area. Some of these floating plants grow seasonally in the marshes and some of them exist year round. Floating communities include *Lemna* sp., *Salvinia natans*, *Spirodela polyrhiza* as well as *Ceratophyllum demersum* and *Hydrocharis morsus-ranae* communities.

2.4.2 Rooted submerged vegetation

This habitat is an open area with stagnant water or undetectable current. The surrounding or marginal zone is usually composed of high emergent plants or terrestrial plants which in turn prevent wind from causing wave action, and support the growth of submerged plants by providing a stable environment. Also these surrounding plants support the growth of submerged plants through their role in imporiving water quality and making it more transparent. Submerged rooted communities include *Potamogeton* sp., *Vallisneria spiralis*, *Myriophyllum* sp., *Najas* sp., and *Hydrilla verticillata*

2.4.3 Rooted floating vegetation

It often exists in narrow extent or rare in the marshes. This may be due to the drying of marshes which lasted for more than 10 years. It also exists in areas where the water is stagnant and clear. These rooted floating plants usually exist close to emergent plants where the current is low. Examples on these rooted formations with floating leaves are *Nymphaea* sp., *Nuphar luteum*, and *Nymphoides indica.*

2.5 Salt water vegetation

Salt or very brackish ponds and lakes with phanerogamic communities. This habitat type did not exist in the study area (CM & AZ) however it can exist in the coastal regions.

3 Marshes Vegetation

3.1 Permanent Marsh Vegetation

3.1.1 Helophytic vegetation

3.1.1.1 Reed beds, 3.1.1.2 reed mace beds, 3.1.1.3 *Cladium mariscus* beds, and 3.1.1.4 *Schoenoplectus* beds

High- density plant communities. The plant cover percentage sometimes reaches 100% making it inaccessible or in other places can exist at lower densities. The

majority of these types of habitat exist at the borders of the marshes or as boundaries surrounding the open areas where the water is shallower than the middle because these plants need to fix their roots in the soil. As well as the surrounding vegetation, there are many groups of reed or typha in the middle of the open areas and the locals call these groups Tahala (when only a reed bed). This type of habitat may be composed of *Phragmites australis* (reed bed), *Typha domingenesis* (reed mace bed) or *Schoenoplectus littoralis* (*schoenoplectus* bed). This habitat class plays an important role in improving water quality of water coming to the marshes and also supports many forms of life inside the marshes. Also it has an important economic role in the life of people living in the marshes or close to them, because these people use reed and typha in manufacturing, feed or fodder. As for *Cladium mariscus* beds, they were not observed in the survey areas. But instead of *Cladium mariscus* there was *Schoenoplectus littoralis* which also was distributed in the same way as the reed & typha.

3.1.2 Woody vegetation

Tree formations of willows and poplars within the marshes, excluding the tree riparian formations having a linear structure include riparian willow formation (*Salix* sp.) and riparian poplar formation (*Populus* sp.). This habitat type did not exist in the survey area (CM & AZ sites).

3.2 very brackish and salt water marsh vegetation

Very brackish or salt marshes with halophytic vegetation/salt pioneer swards - pioneer communities growing in salt or brackish muds (*Salicornia* sp. community). This habitat type did not exist in the survey area (CM & AZ sites).

4 Terrestrial Vegetation

4.1 terrestrial vegetation- shrubs (low shrubs)

4.2 herbaceous vegetation

4.2.1 grasslands, 4.2.2 steppe, and 4.2.3 sparsely vegetated land

These habitat types consists of dry land with low shrubs (4.1) or grasses (4.2.1), or open area as a steppe (4.2.2) or with plants distributed in a sparse way (4.2.3). These habitat types did not exist in the survey area (CM & AZ sites).

5 Deserts

5.1 un-vegetated desert

5.2 un-vegetated saline lands

This habitat types include dry land without plants (5.1 unvegetated desert) or saline area where the salt content is high and prevents the growth of plants (5.2 saline lands). Neither habitat type existed in the survey area where this classification system was applied (CM & AZ sites). Though this survey could not provide details about the characteristics of these habitat classes, there are some other areas which may contain these habitat types around or inside the marshes.

6 Woodlands

Woodland, forest and other wooded land. Area with high or medium density of vegetations that in most cases are trees (forest and other wooded land) or shrubs (high shrubs). These habitat types did not exist in the survey area where this classification system was applied (CM & AZ sites).

Survey Area

The field surveys were conducted for the investigation of the ecologic characteristics and habitat structure at representative sites. All the selected sites were in the Central Marshes, some of them were in Chibaish area (CM sites) and the others were in Abu Zirig area (AZ sites). The following table includes the site names and site codes with GPS coordinates. Maps of these sites are shown in the plates that follow.

Table 1: Site names, site codes and GPS coordinates of the selected sites during the June 2008 habitat survey (14-18/6/2008) in CM & AZ.

Area(Central Marshes)	Name of Site	Code #	GPS Coordinate					
			N				E	
Chibaish	Al Baghdadia	HAB_CM_2	47	0	48.3	31	1	26.4
	Al Baghdadia	HAB_CM_5	47	0	52.5	31	2	50.6
	Al Baghdadia	HAB_CM_10	47	2	13.0	31	2	21.0
	Um Lilo	HAB_CM_11	47	2	16.9	31	1	28.7
	Eishan Al-Gubba	HAB_CM_13	47	1	3.6	31	4	10.8
	Core Area	HAB_CM_12	46	59	58.8	31	4	32.2
	Core Area	HAB_CM_25	46	59	53.9	31	7	49.2
	Core Area	HAB_CM_26	46	58	13.7	31	9	44.4
	Zichri	HAB_CM_27	47	13	18.5	31	2	50.3
	Central Marshes (Al Hamar)	HAB_CM_28	46	49	37.3	30	59	21.0
Abu Zirig	Close to Al-Fuhood Town	HAB_AZ_1	46	46	30.1	30	59	4.8
	Close to Al-Fuhood Town	HAB_AZ_3	46	41	18.4	31	0	53.5

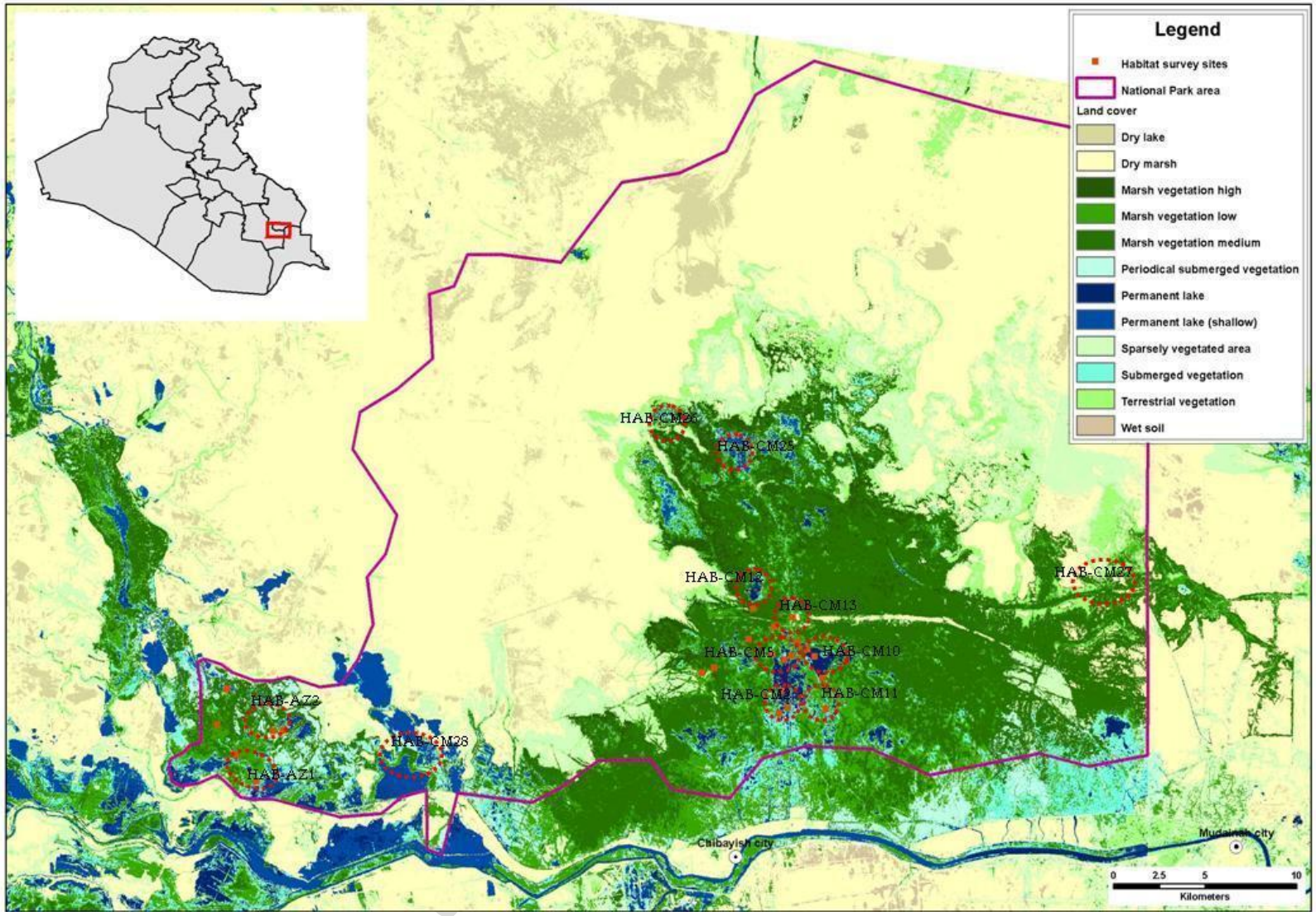
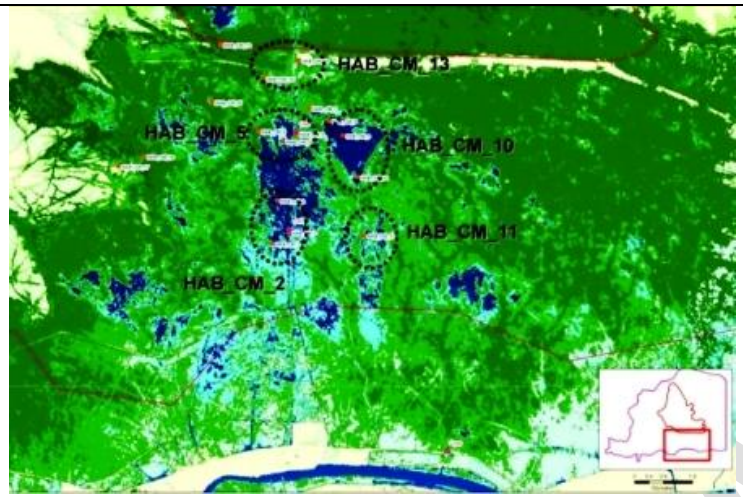
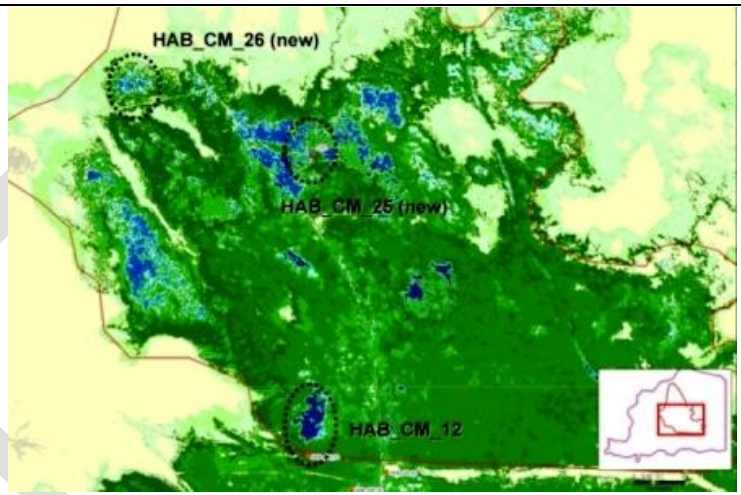


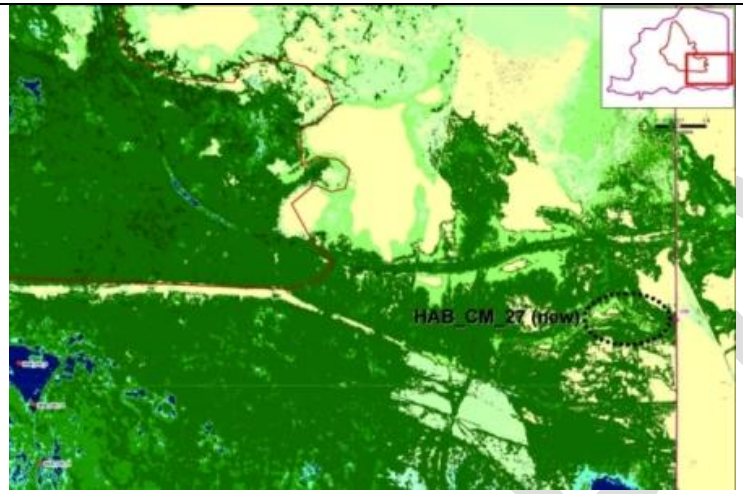
Plate 2: Satellite-based Land Cover Classification of Central Marsh showing the Selected Survey Sites (circled areas). Prepared by the SGI team.



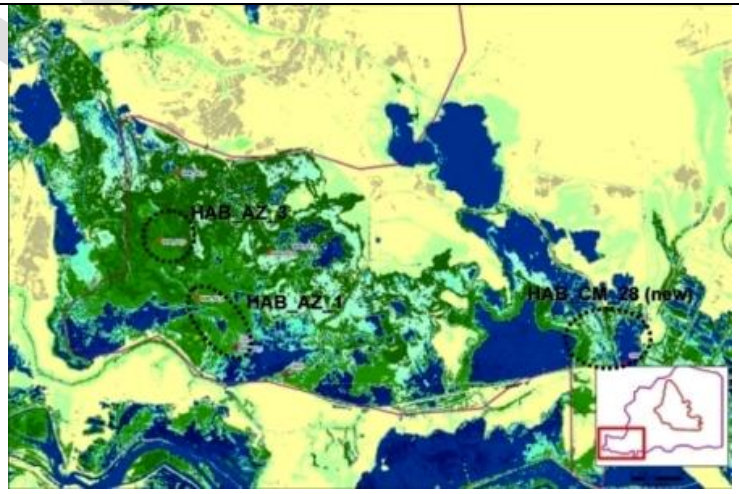
Al-Baghdadia area



Core area



Zichri area



Abu Zirig area

Plate 3: The satellite images of Central Marshes (Chibaish & Abu Zirig) showing the selected sites.

Site Review

The survey sites included two major marshes in the proposed Mesopotamian Marshlands National Park area. The first area was the Central Marshes, Chibaish area (CM) and ten (10) sites were chosen in this area. The second region was the Central Marshes, Abu Zirig area (AZ) and two (2) sites were chosen in this area. There were specific activities for each site such was described in the introduction and methodology sections of this report. For the purpose of comparison, a description of all habitat classes identified in each site can be found in Index I at the end of this report. In addition, water quality parameter results for all sites in the first and second surveys can be found in Index II & III respectively. All Biota data from the 2008 survey can be found in Index IV (Phytoplankton), Index V (Benthic Macroinvertebrates), Index VI (Fish) and Index VII (Plants). The following are detailed findings for each site:

Central Marsh (Al-Baghdadia) HAB_CM_2

N 31˚01'26.4" E **47˚0.0'48.3"**

Plate 4: Survey Site HAB_CM_2

Site description:

This was an open water area adjacent to a street from the east (there is paved street inside the Central Marshes that was constructed by the old regime as a military road and as a strategy for drying the marshes) and surrounded by reed bed (*Phragmites australis)* on the other directions. There were also groups of reed which were distributed randomly inside the area and small groups of *Typha domengensis* (reed mace bed) and *Schoenoplectus litoralis* (*Schoenoplectus* bed) close to the street (in the east side of the area). The depth of water was low. The substrate in the open water area was covered by submerged plants and most of them were decayed at the surface. The weather was sunny and the wind was medium and northerly. There were no people living in this area and no buffalo were seen, but there was evidence of grazing and reed cutting.

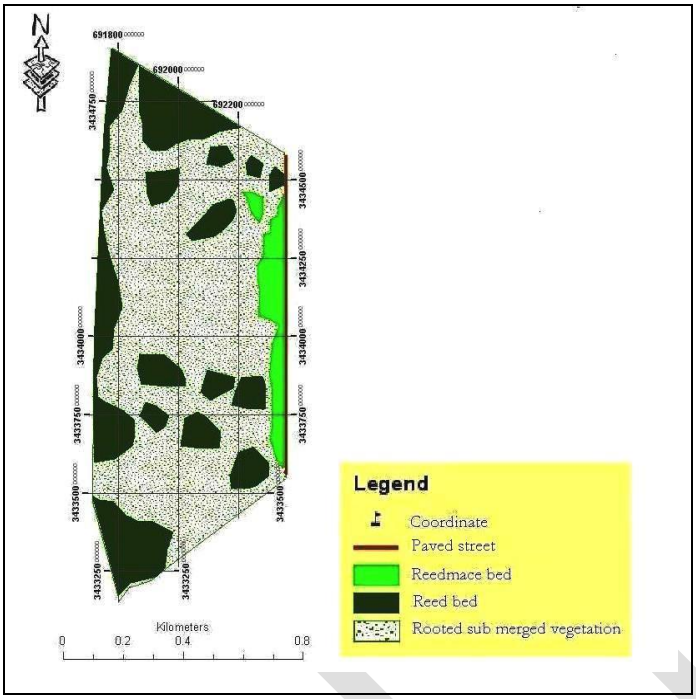


Figure 1: Sketch shows the features of surveyed site HAB-CM2.

Water Quality:

The measurements were done at 6:15 am on 14/6/2008. The air temperature was 24.5˚C and the water temperature was 24.1˚C. Water temperature was not high though it was summer season because measurement was taken in the morning where the water depth was only 0.96 m. The electrical conductivity was 2980 µs/cm and the salinity was 1.4 ppt. As for dissolved oxygen, it was 2.37 mg/l which is low and that might be due to the increases in salinity (Al-Saadi et al., 1989). The pH was slightly alkaline (pH 8.06) which is a common feature in Iraqi waters, this might be attributed to their high ability to neutralize changes in pH as a result to the presence of carbonates and bicarbonates (Stirling, 1985; Al-Zubeidy, 1985; Al-Ghafly, 1992; Al- Mousawi and Hussain, 1992; Ghani, 1996) The turbidity was 0.78 NTU, TOC 1.88 % and chlorophyll-a 3.55 (mg/m^3).

Phytoplankton:

Total phytoplankton count: 502.8 x 10^3 cell/L. Species number: 54

The dominant phytoplankton group was Bacillariophyta 334.7 x 10^{3}cell/L, followed by Chlorophyta 107.6 x 10^{3}cell/L. Bacillariophyta was represented by 33 species (6 taxa central and 27 taxa pennate). The centric diatoms were dominated by *Cyclotella meneghiniana*, *Cyclotella striata*, and *Cyclotella atomus*. This result was similar to previous results in Iraqi aquatic ecosystems (Talling, 1980; Al-Lami et al., 1996; Kassim et al., 1997; Al-Saadi et al., 2000). The pennate diatoms were dominated by *Navicula cuspidate, Cymbella affinis, Epithemia zebra* and *Achnanthes minutissima.*

Phytoplankton taxa within the *Cyclotella* group were recognized as important environmental indicators in a broad range of environments especially species occurred under ecological conditions ranging between oligotrophic to hypereutrophic (Wehr and Sheath, 2003).

Cymbella is a distinctly freshwater genus, although a few species are found in brackish waters (Smith, 1950).

Achnanthes minutissima was found to be a dominant species in most sites and this might be due to their small cells making them more physiologically active than larger diatom cells, partly due to their large surface to volume ratios (Wehr and Sheath, 2003).

Chlorophyta, on the other hand, was represented by 10 species dominated by *Kirchneriella irregularis*.

Macroinvertebrate:

Total density of benthic macroinvertebrates in this site was 178 individual/m². According to the Pollution Tolerance Index (PTI) water quality in this site was poor. This result could be confirmed by the recorded dominance of the blood midge larvae *Paratendipes albimanus* (See Index V, Table 2) and the relatively moderate diversity for the whole site (See Index V, Table 3 and Figure 13).

Plants:

The site included eight plant species; three of them are emergent including *Typha domingensis* with the largest percentage cover (20%), *Phragmites australis* (10%) and *Schoenoplectus litoralis* (+). Other species were submerged plants and the dominant plants in this site were rooted submerged plants especially *Potamogeton lucens* (40%) with another species of *Potamogeton* with less percentage cover (*Potamogeton pectinatus),* also there were *Ceratophyllum demersum*, *Hydrilla verticillata*, and *Myriophyllum* sp. Total approximate vegetation cover was 110% which exceeded 100% because the stratification phenomena (growth of some plant species in many layers).

Fish:

With a low water depth (0.75-1.25 m) high vegetation cover and water current that was undetectable or near to stagnant, this site provided a good nourishing ground for many fish especially carp (*Cyprinus carpio*). Also other fish represented in the site were *Acanthobrama marmid, Aspius vorax, Barbus luteus, Carassius carassius* (from the family Cyprinidae), *Heteropneustus fossilis* (from Heteropneustidae), *Silurus triostegus* (from Siluridae, in terms of biomass, this fish appeared to dominate the site), and *Liza abu* (from Mugilidae).

Birds:

This site was already an Important Bird Area (namely: Chibaish Marshes) (Evans, 1994), as well as an area of regional and global importance for wintering birds (Scott and Carp 1982 and Scott, 1995). It was noticed that the diving and birds that feed under the surface of the water were rather common in this site. The occurrence of the Pygmy Cormorant *Phalacrocorax pygmaeus* and Little Grebe *Tachybaptus ruficollis* might indicate the relatively high transparency of the water (i.e. less turbidity). Also, it was noticed that no Waders were observed in the site because the area does not support a suitable habitat for this bird group, as there were no areas of really shallow water or mudflats.

Although the site was generally good habitat for ducks and other migrant species, none of them were recorded at the site because it was not the natural season for them to be found in this site. Also, the absence of the birds of prey during this time of the year might affect noticeably the occurrence and distribution of other birds. Only one duck species was recorded in this area, which is a resident and regular breeder for the Central Marshes: the Marbled Duck (or Marbled Teal). This bird found suitable habitat for breeding in this area since the plant cover provides suitable shelter to build the nest and raise chicks.

The occurrence of some specific groups of birds (like Terns, Gulls and Grebes) indicates the availability of food resources, which are small fish.

Relationships among the organisms and their environments:

The water quality is considered poor because of the low oxygen levels and the water was considered brackish (Oligosaline) because the salinity was more than 0.5 ppt (Cowardin *et al* cited in Tiner, 1999, p 273) and there was no circulation or mixing of the water as well due low water depth, low water discharges and high evaporation rates found in summer. Additionally poor water quality was indicated by

the low phytoplankton count and the type of dominate species present such as *Cyclotella meneghiniana, Cyclotella atomus, Cymbella affinis,* and *Achnanthes minutissima* that are known to favor the conditions present at the site.

Also, the results of chlorophyll-a show that the environment is mesotrophic, this may be due to the decomposition of the existing plants (which was noted in the site description). The plant cover is dense, particularly the submerged plants, due to the low current of water, the shallow water which supports light penetration, and the high transparency of water (low turbidity). The presence of dense submerged plant can be correlated to the low numbers of phytoplankton. The calcareous layer present on the surface of *P. illucenc* that was dominant in this site is also consistent with the low phytoplankton density, as this calcareous layer prevents the adherence of phytoplankton on the leaves surface. From the benthic macroinvertebrates view, the water quality is poor as well since the dominant species was *Paratendipes albimanus* which can live in low oxygen concentrations. Also the Pollution Tolerance Index (PTI) and the low diversity of benthics indicate that the water quality was poor. The majority of the existing species in this site were from the order Odonata and this order has a characteristic of affixing onto the submerged plants which in turn provide shelter for these invertebrates. Additionally, the water quality was considered poor and the dominance of the predatory fish (Silurus triostegus) as well as the absence sensitive fish species such as *Barbus sharpeyi* (locally called Bunni) indicate this as well**.** These marshes play an important role as spawning grounds, nurseries and feeding place for fish, through the availability of food resources, which accelerate the growth of fish in comparison with other Iraqi water bodies (Hussain and Ali, 2006). The disappearance of sensitive species such as *Barbus sharpeyi*, which require good water quality and the exiguity of phytoplanktons resulting in fewer food resources available for supporting fish, as well as the density of plants (particularly submerged plants) and their decomposition resulting in decreased dissolved oxygen appears to be in agreement with the appearance of more tolerant fish species such as *Heteropneustes fossilis*. Such results have been mentioned by Hussain et al. (2008). As for birds, they were less sensitive to water quality than the other organisms discussed in this report. However the low turbidity/high transparency and low water depth encourage the existence of diving birds which feed on juvenile fish. But the numbers appeared low possibly due to low food resources for birds as well.

Conservation status:

All identified Phytoplankton species in this site are common in Iraq despite the fact that they may indicate relatively poor water quality due to their dominancy. The identified macroinvertebrates are common in Iraq particularly in the southern marshland. This site contains common plants in Iraq but *Hydrilla verticillata* is an exotic species that has appeared in the marshes after they were re-flooded in 2003 which resulted in general ecological changes that may have stimulate this species to grow and spread because of the new environmental conditions that might be more suitable for this species. This species has a competition effect with the natural plant in the marshes, however it is considered as a food resource for some fish. *Myriophyllum* sp. belongs to one of the missing families in the Flora of Iraq book and thus it iss difficult to know much about the conservation status of this plant in Iraq. This site contains fish common to Iraq. Some fish have economical importance such as *Aspius vorex*; *Carassius carassius* and *Cyprinus carpio* and most dwellers of the marshes and surrounding areas depend on fishing for food and trade. This site is important for some bird species (Threatened/Conservation concern) such as:

The Iraqi subspecies/race of the Little Grebe which is endemic for the Lower Mesopotamian marshlands, the core population of the Pygmy Cormorant (conservation concern), which is increasing in the area and the Globally threatened Marbled Duck/Teal that used to breed regularly in the site.

Management requirements:

To return these marshes to their pre-drying condition, it would require the restoration of their original ecological conditions and functions. Water quality and quantity has been the most effected and these in

turn are affecting the biodiversity. The area probably needs an increase of water and a re-established connection to the fresh water from the Tigris River (currently this marsh is fed from the more saline Euphrates River). This would improve circulation, decrease salinity and likely improve water quality at the site. One of the suggested ways to increase the water level and improve the water quality, is to adopt the plan (and encourage the government to adopt such plan) that aims to create an inlet to the area from the northeastern area of the Central marshes, from Al Btaira River (a branch of the Tigris River in Missan Governorate). The current source of pollution to the site is sewage coming with Euphrates River water, which then accumulatea in this area (closed area) leading to the concentration of pollutants. An additional suggestion to decrease the pollutants and contamination in this area is to establish water treatment plants at the points of sewage discharging from the cities upstream. The increasing of water level or depth can limit the increased growth of reed (*Phragmites australis*) and retain some open water areas in addition to encouraging the original flora and fauna to return to this area.

Also it is recommended to reduce human disturbance at the site and target the local community with educational and awareness programs.

Central Marsh (Al-Baghdadia) HAB_CM_5

N 31˚02'50.6" E **47˚0.0'52.5"**

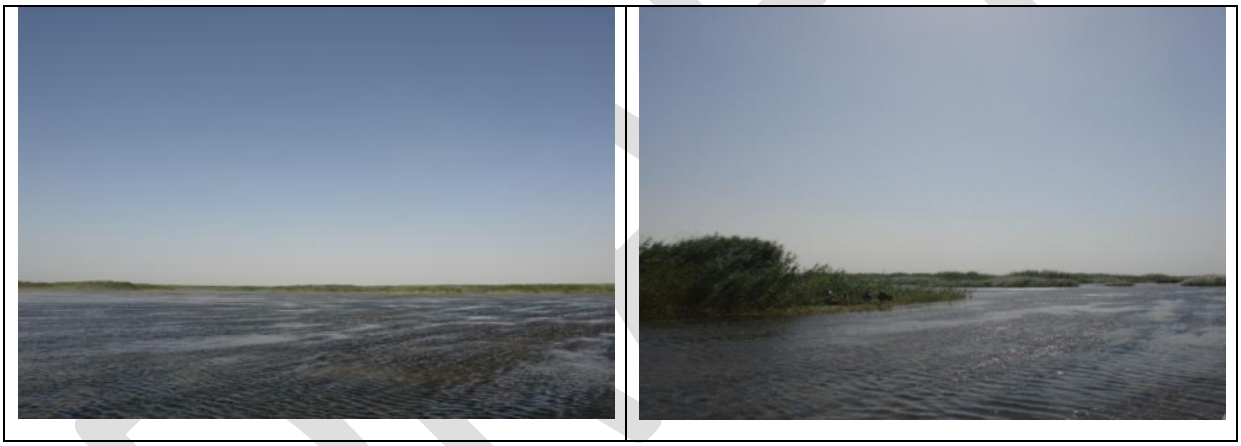


Plate 5: Survey Site HAB_CM_5

Site description:

This site is similar to CM2 with an open water area and randomly distributed reed groups. Also there is a street (the same street in the previous site) adjacent to the area on the east side and there are small Typha groups (also on the eastern side of the area). There is a small area beside the street which is without submerged vegetation and deeper than the rest of the area. The submerged plants appear to have a greater density than at CM2 and they also show decay at the surface as well. This area is closer than the previous site to its source of water, which comes from the Abu Zirig area.

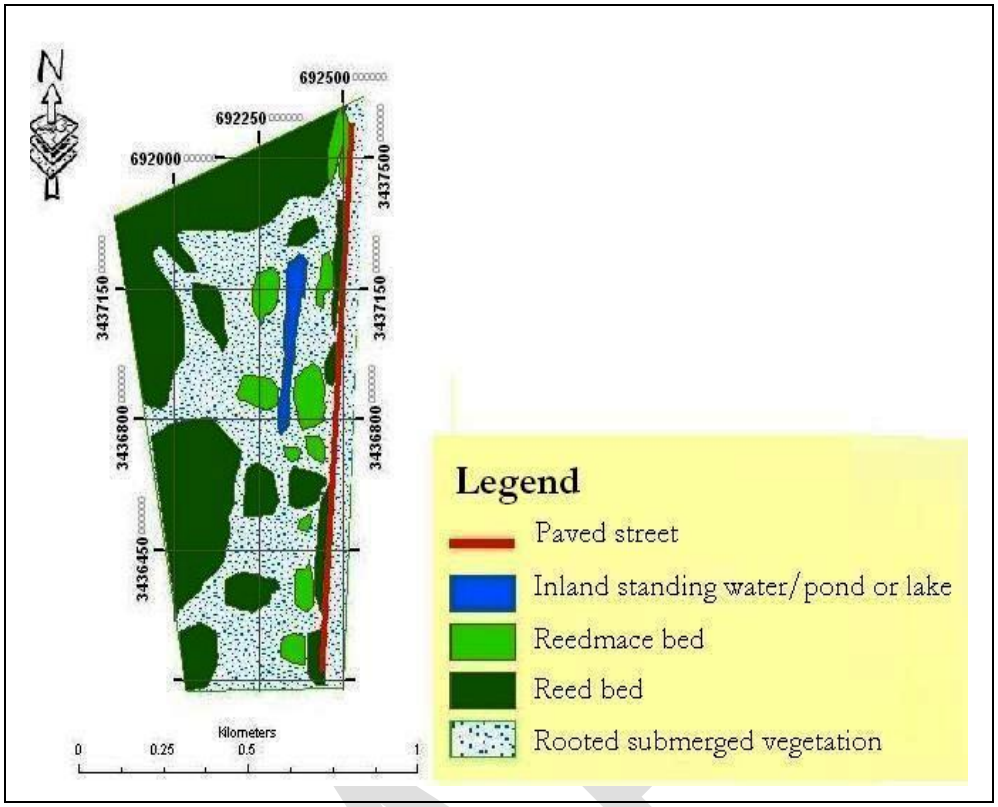


Figure 2: Sketch shows the features of the surveyed site HAB-CM5

Water Quality:

The measurement was taken at 8:30 am on 14/6/2008. The air and water temperatures were 31˚C and 24.9˚C respectively and the values were not high since they were measured in the morning were the water depth was 0.57m. The electrical conductivity was 3320 µs/cm and the salinity was 1.6 ppt. As for dissolved oxygen, it was 4 mg/l. The pH of this site was slightly alkaline (pH 8.23) because of the ability to buffer pH by the presense of carbonate and bicarbonate (Stirling, 1985; Al- Mousawi and Hussain.1992). This slight alkaline is a clear feature of Iraq's water (Al-Zubeidy, 1985, Al-Ghafly, 1992, Ghani, 1996). The turbidity was 0.22 NTU, TOC 1.93 % and chlorophyll-a 4.375 (mg/m^3).

Phytoplankton:

Total phytoplankton count: 2012.9 x 10^{3}cell/L. Species number: 100

The dominant phytoplankton group was Bacillariophyta 1617.4 x 10^{3}cell/L, followed by Chlorophyta 310.9 x 10^3 cell/L. Bacillariophyta was represented by 75 species (5 taxa central and 70 taxa pennate). The centric diatoms were dominated by *Cyclotella meneghiniana*, *Cyclotella striata*, and *Cyclotella atomus*. The pennate diatoms were dominated by *Achnanthes minutissima* with the presence of *Navicula radiosa*, *Navicula cuspidate*, and *Nitzschia palea*. Chlorophyta on the other hand, was represented by 16 species dominated by *Eudorina elegan* with the presence of *Coelastrum astroideum*, *Oedogonium* sp., and *Scenedesmus arcuatus* var. *platydiscus*. *Eudorina elegan* is among the most frequently encountered species of the green algae (Goldstein, 1964). This species is also known to be common in hard waters (Prescott, 1982).

Cyanophyta was represented by 6 species, dominated by *Chroococcus minor, Chroococcus turgidus* and *Oscillatoria limnetica*.

Chroococcus minor often forms small masses on *Potamogeton* spp., or other submerged plants; sometimes buried in the decaying tissues of higher plants. On the other hand, *Oscillatoria limnetica* is known to be common in shallow waters among submerged aquatics (Prescott, 1982).

Benthic Macroinvertebrates:

Total density of benthic macroinvertebrates in this site was 146 (individual/m²), dominated by the shrimp *Caridina babaulti basrensis* followed by the larvae of the narrow-winged damsels *Ischnura sp.2*. According to the Pollution Tolerance Index, water quality in this site was fair. This result could be confirmed by recording the dominance of the shrimp *Caridina babaulti basrensis* followed by the larvae of the narrow-winged damsels *Ischnura sp.2,* low density of the blood midges, the absence of the oligochaetes (Index V, Table 2) , and the relatively good diversity for the whole site (See Index V, Table 3 and Figure 13).

Plants:

This site has seven plant species; three of them were emergent plant including *Typha domingensis* (30%), *Phragmites australis* (20%) and *Schoenoplectus litoralis* with lowest vegetation cover. The other group were submerged plants with the most dominant species here being *Myriophyllum sp.* (30%) and other species with less percentage cover including: *Potamogeton pectinatus, Ceratophyllum demersum* and *Potamogeton lucens.* The total vegetation cover percentage was 95%.

Fish:

This shallow water (depth of 0.75-1.25m) site had high vegetation and slow current that was nearly stagnant. The site appeared to provide habitat for many fish especially carp (*Cyprinus carpio*) but other fish species represented in the site were *Acanthobrama marmid, Aspius vorax, Barbus luteus, Carassius carassius* (Cyprinidae), *Heteropneustus fossilis* (Heteropneustidae), *Silurus triostegus* (Siluridae), and *Liza abu* (Mugilidae).

Birds:

The most noticeable finding in this site is the occurrence of considerable diversity of Waders. In spite of this, the site did not appear to contain the ideal habitat for this group, but the existence of the paved road that crosses the wetlands with its muddy margins made it possible for five Wader species to reside at this site. The Black-winged Stilt *Himantopus ostralegu*, Spur-winged Lapwing *Vanellus (Hoplopterus) spinosus*, Red-wattled Lapwing *Vanellus (Hoplopterus) indicus*, White-tailed Lapwing *Vanellus leucurus (Chettusia leucura)*, and Kentish plover *Charadrius alexandrinus* existed on the muddy margin along the road, although in few numbers. The occurrence of these birds over this site might indicate the richness of this area in terms of food resource, or it might be related to the less disturbance comparing with the former site.

Also, it was noticed that the population of the Pygmy Cormorant *Phalacrocorax pygmaeus*, comparing with the former site (CM2) was higher. This illustrates either richness in fish resources or suitable habitat for foraging. In addition, the occurrence of the Red-crested Puchard *Netta rufina* suggests either the area is suitable habitat for living (or even breeding), or related to less disturbance over this site compared with the former one.

Greater numbers and species of Terns and Gulls were observed in this site when comparing with HAB_CM2, and this illustrates the richness of fish resources of this area. Also, and for the same reason, more Pied Kingfishers *Ceryle rudis* were observed (3 in CM2 and 17 in the current one), which could support the theory of more available food resource (fish).

Occurrence of the insectivorous birds was noticeable over this site. Some Blue-cheeked Bee-eaters *Merops [superciliosus] persicus*, Graceful Prinia *Prinia gracilis*, and Iraq Babbler *Turdoides altirostris* were present in their suitable niches, catching the flying insects and insects among the plant leaves. And this occurrence might contribute to the current site's additional dimension of having such a "new" state of bird-life comparing with the former site (CM2).

Relationships among the organisms and their environments:

Water quality was fair because of moderate dissolved oxygen concentration (likely influenced by wind action). Transparancy of the water was high (low turbidity) and the water was brackish (water is

considered brackish if the salinity is more than 0.5 ppt (Cowardin, *et al.* cited in Tiner, 1999, p 273)). The increased phytoplankton diversity may have resulted from the fair water quality, relatively high water transparency, low turbidity and decreased water depth. Also the Chlorophyll-*a* indicated that the water is mesotrophic and the plant cover was lesser in comparison with HAB_CM2 and that supports the increase in the total number and diversity of the phytoplankton. This site had the higher number of Chlorophyta species, although they were represented by low counts. The plant percentage differs from the previous site HAB_CM2 and the dominant plant species *Myriophyllum sp.*, which is a submerged plant, is an indication that the water quality was better than water quality of HAB_CM2 due to the presence of the water movement (as this area is closer to its water source coming from the Abu Zirig area). Also the plant cover was in good condition and not as decomposed, and this leads to increased oxygen through the process of photosynthesis in addition to the time of the survey, which was in the morning when the water temperature was not high. The dominant submerged plants had aciculated leaves and that might be due to the water movement. According to the Pollution Tolerance Index (PTI) the water quality was fair and this result can be supported by the dominance of shrimp and the relatively high diversity of benthic macroinvertebrates due to the presence of appropriate aquatic plants. The plant cover was low in comparison with site HAB_CM2, which benefitted certain benthic species that need a larger area for movement and swimming such as shrimp.

Although the phytoplankton, macrobenthos, and plants reflected the fair water quality and biological indicators, still the fish groups might indicate poor water quality, but this may be due to the deficiency of fish sampling and the high presence of birds that feed on fish. Regarding the bird data several parameters should be considered such as time, wind velocity, and the season. Increased numbers of Pygmy Cormorants *Phalacrocorax pygmaeus* as well as the presence of Red-crested Pochards *Netta rufina* indicate good water quality when compared to the CM2 (because the diving birds prefer clear water where they can fish easily). The former bird was not recorded at this site during previous Key Biodiversity Area survey years (Salim, 2006). Also low plant cover of the submerged plants in comparison with HAB_CM2 supports the activity of Pygmy Cormorants *Phalacrocorax pygmaeus* in the site. Presence of waders, which were not seen in the HAB_CM2, indicates the existing of food resources (benthic invertebrates) in suitable habitat. Also the higher number of birds that feed on fish (Terns, Gulls and Kingfishers), when compared to HAB_CM2 also indicated increased food resources and/or low movement and noise by people. The existence of insectivorous Blue-cheeked Bee-eaters *Merops [superciliosus] persicus*, Graceful Prinia *Prinia gracilis*, and Warblers indicate the higher presence of insects than at site HAB_CM2.

Conservation status:

The identified macroinvertebrates in this site are common in Iraqi water. All identified Phytoplankton species in this site are common and the dominant species may indicate relatively mesotrophic water conditions. The plant species are common in the lower Mesopotamian marshes. *Myriophyllum* sp. belongs to one of the missing families in the Flora of Iraq book and thus it is difficult to know anything about the conservation status of this plant in Iraq. All the identified fish in this site are common in Iraqi water especially the southern marshlands. As for birds: the Conservation-concern (CC) Pygmy Cormorant *Phalacrocorax pygmaeus* existed in increasing numbers over the area, and this might due to the development of suitable habitat (reedbeds and open water), the CC Red-crested Pochard *Netta rufina* might breed in the site. The CC Slender-billed Gull *Larus genei* also might breed in the nearby area. The site harbours the endemic bird Iraq Babbler *Turdoides altirostris* as a regular breeder.

Management requirements:

It is urgently recommended to insure a sufficient amount of water to create a stable level of water at key times in the year (during fish spawning and bird breeding periods for example). There is a general need to increase water levels and also to restore the fresh water sources in order to decrease water salinity and to

improve circulation by restoration of the old hydrological regime of the Central Marshes (where the water enter to the Central Marshes from the northeastern side and move out through the outlets to the south of the Central Marshes). So it is recommended to establish inlets from the Tigris River or its tributaries as well as to reduce the human disturbance and target the local community with educational and awareness programs.

Central Marsh (Al-Baghdadia) HAB_CM_10

N 31°02'21.0" E **47°2.0'13.0"**

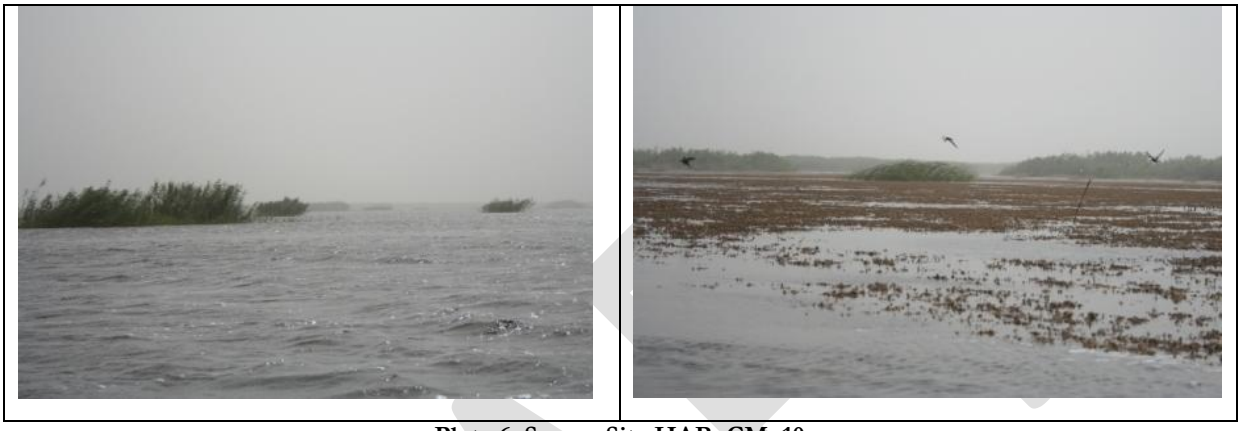


Plate 6: Survey Site HAB_CM_10

Site description:

This is site is known as Al Baghdadia Lake (or Bargah). It is a large open water area with submerged vegetation and surrounded from all directions by reed beds *(Phragmites australis)*. There are little groups of reed (tahala) in the middle of the Bargah. Fishermen are active in the site and use nets and home-made electrofishing devices but there are no people living in the area. There is a paved street close to this area from the west behind the reed beds.

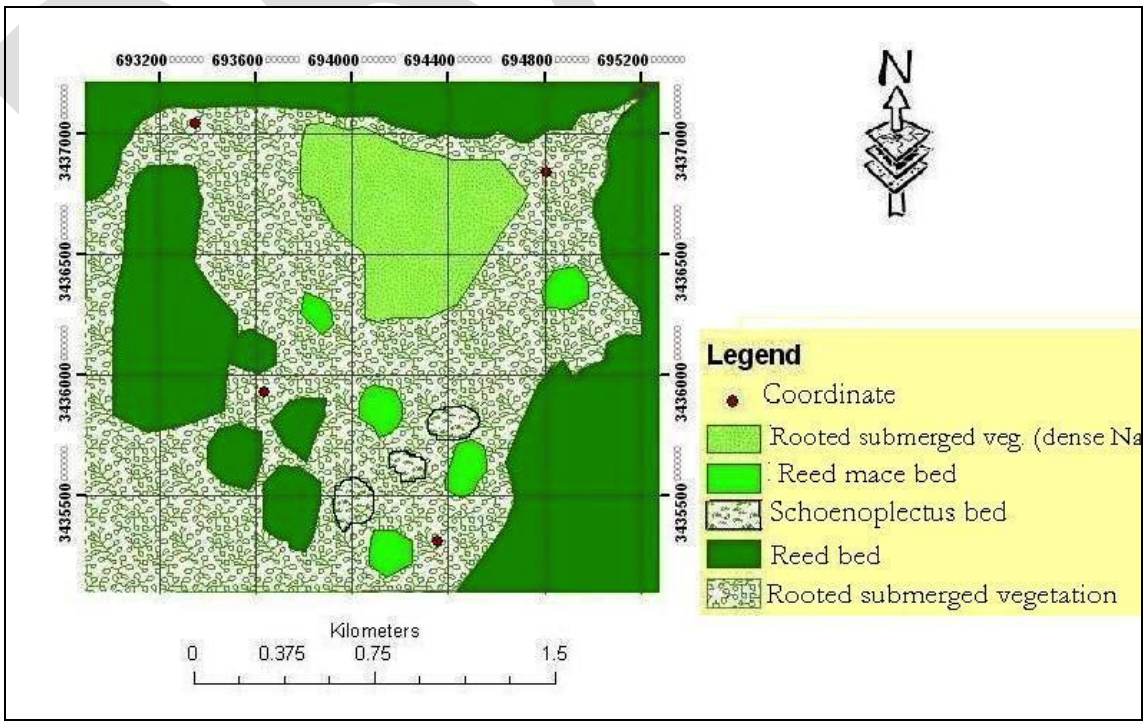


Figure 3: Sketch show the features of the surveyed site HAB-CM10

Water Quality:

The physical measurements were taken at 17th of June, 2008 at 6:45am. During the time of the survey, air temperature was 26˚C and water temperature was 22.5˚C (these are normal values according to the time and date of measurement). The water depth was 0.6 m. The electrical conductivity was 4310 µs/cm and the salinity was 2.2 ppt. Dissolved oxygen was 4.81 mg/l. The pH of this site was slightly alkaline (pH8.2) because of the buffering which results from the presence of carbonate and bicarbonate elements (Stirling 1985; Al-Mousawi and Hussain cited in Hussain, 1994, p 95- 126). The turbidity was 0.46 NTU, TOC was 2.68 % and chlorophyll-a content was 0.885(mg/m^3).

Phytoplankton:

Total phytoplankton count: 409.1 x 10^{3}cell/L. Species number: 56

The dominant phytoplankton group was Bacillariophyta with 329.4 x 10^{3}cell/L, followed by Chlorophyta with 56.5 x 10^{3}cell/L. Bacillariophyta was represented by 75 species (5 taxa central and 38 taxa pennate). The centric diatoms were dominated by *Cyclotella meneghiniana* and *Cyclotella atomus*. The pennate diatoms were dominated by *Achnanthes minutissima, Cymbella microcephala, Fragilaria vaucheriae, Navicula viridula var. rostellata* and *Nitzschia palea*. Chlorophyta was represented by six species dominated by *Kirchneriella irregularis*.

Benthic Macroinvertebrates:

Total density of benthic Macroinvertebrates in this site is 162 (individual/m^2), dominated by the midge larvae of the *Paratendipes albimanus* followed by the shrimp *Caridina babaulti basrensis* and the midge larvae of the *Chironomus riparius* respectively. Depending on the PTI, water quality in this site was fair. This result could be confirmed by the relatively moderate diversity for the whole site (See Index V, Table 3 and Figure 13). The absence of the Oligochaetes and the low density of the blood midges (See Index V, Table 2) are probably due to the hard bottom, which was confirmed in the lab by the blunt teeth for the blood midges' mentum, mandible, and premandible. In addition, the absence of the Hemipterans, the low density of the shrimps, as well as odonata larvae (See Index V, Table 2) are probably due to the few shelters provided by the dominant aquatic plants in this site, which was *Najas marina*.

Plants:

This site had a very dense growth of rooted submerged vegetation (70%) especially the species *Najas marina*, the other species (emergent and terrestrial) were present at a lower percent cover (did not exceed 20% of the vegetation cover percentage). This site had eight plant species which were *Najas marina*, *Chara* sp.*, Myriophyllum* sp., *Phragmites australis, Schoenoplectus litoralis, Tamarix* sp., *Typha domingensis* and *Potamogeton pectinatus*. The total vegetation cover was 90%.

Fish:

Carp (*Cyprinus carpio*) were the primary species present. Other fish species found in this site were *Acanthobrama marmid, Aspius vorax, Barbus luteus, Carassius carassius* (Cyprinidae), *Heteropneustus fossilis* (Heteropneustidae), *Silurus triostegus* (Siluridae), and *Liza abu* (Mugilidae).

Birds:

The most important observation over this site was the occurrence of considerable numbers of the diving duck Red-crested Pochard *Netta rufina*, as there were more than 70 individuals, including many young juveniles over the waters of this site. Also, there were large numbers of other diving birds like the Little Grebe *Tachybaptus ruficollis* and the Pygmy Cormorant *Phalacrocorax pygmaeus* compared with the former sites (CM2 & CM5). This illustrates the open nature of the water at this site surrounded by dense reed-

beds; also, it may indicate the abundancy of food resources at the site. Also, some noticeable numbers, comparing with the other sites, of Herons *Ardea* sp. were observed fishing in the site. The scattered dead *Tamarix* shrubs support ideal roosting and fishing location for the Herons and the Pygmy Cormorants/

The site provides good habitat for shelter, feeding and breeding areas for Purple Swamphen *Prophyrio prophyrio* and Moorhen *Gallinuylua chloropus* during summer. Some Pied Kingfishers *Ceryle rudis* were seen roosting on the edge of the reedbeds; such a location supports good posts to spot fish from above.

Relationships among the organisms and their environments:

Water quality was fair due to the moderate dissolved oxygen concentrations that may be caused by the strong wind that helps mix and dissolve oxygen into the water column. Photosynthesis may be higher in this site due to the low turbidity and relatively high water transparency, which in turn can increase the oxygen concentration in the water (Almousawi and Hussain cited in Hussain 1994 p 95- 126; Ghani, 1996). The main dominant phytoplankton species were diatoms that favor salinity. The total phytoplankton count indicates that the water conditions are oligotrophic according to Kassim (2005), which suggest low nutrient content. Actual decreases were observed in the Cyanophyta (blue green algae), which indicates high oxygen levels in comparison to the previous sites (CM2 & CM5). The dominant plant was the submerged plant *Najas marina* likely due to the low water level and high transparency that helps it to grow and its strong ability to compete with other plants as it has a high tolerance and contains spines (one common name is the Spiny Naiad). The existence of terrestrial plant debris like *Tamarix* sp. indicates that the area was dried before. Little Bittern prefers this kind of environment, which provides a natural roosting (perching) location (in addition to the reedbeds) that were noticed everywhere in the marshlands (Salim, 2004 A, B). The availability of suitable habitat allowed the diving birds, like the Pygmy Cormorant *Phalacrocorax pygmaeus* and the Red-crested Pochard *Netta rufina*, to live in this site rather than in other areas of dense submerged vegetation where there is no space or visibility for undersurface feeding. The presence of herons that feed on fish indicates that the area is rich in fish. The results indicate that water quality is fair depending on PTI and suggests that the area has moderate diversity conditions in comparison to other sites. The absence of Hemiptera in this site indicates as mentioned that there is high wind current; less shrimps, red worms, and Odonata in comparison to the previous sites. This is due to the solid soil likely as a result of plants burning in the past during the drainage of the marshes or this may have been the result of the dominancy of the plant *Najas marina* that does not provide good shelter for benthic invertebrates.

Conservation status:

All the identified Phytoplankton species in this site are common in Iraq's water and the total count of species indicates relatively oligotrophic water conditions. The identified macroinvertebrates are common in Iraq (there are no or few references which deal with the conservation status of benthics). All of the eight plant species are common in Iraq except *Myriophyllum* sp. which belongs to one of the missing families in the Flora of Iraq's series and thus it was difficult to know the conservation status of this plant in Iraq. There are 11 species of *Tamarix* in Iraq, most of them are common or occasional, two of which are very rare (Townsend and Guest, 1980, Vol. 4-I, p160). There are some references referring to *Tamarix* as a native plant in Iraq (Ani, Habib, Abdulaziz, & Ouda, 1971) and (Habib, Al-Ani, Al-Mufti, Al-Tawil, & Takessian, 1971). If the site remains flooded, the Tamarix will likely disappear. All the identified fish species are common in Iraq's southern marshlands. As for birds, this site is very important for the conservation concern Red-crested Pochard *Netta rufina*. The conservation concern Pygmy Cormorant *Phalacrocorax pygmaeus* showed higher numbers as they find a suitable habitat in this area and many Little Grebes *Tachybaptus ruficollis* (the Iraqi race) were observed, which is endemic and a conservation concern bird.

Management requirements:

This area needs to be refreshed by fresh water coming from Tigris River or its tributaries in Missan governorate (Amara). In fact, there is plan to create an inlet for the Central Marshes, from Al Btaira River (a branch of Tigris River) which in turn will supply this area with fresh water and support the environment by increasing the quantity and improving the quality of water, which will then support and increase the plants, phytoplanktons, zooplanktons, fish, mammals, and birds at the site to achieve their original status in this area before its drainage. It is recommended to reduce the human disturbance and target the local community with educational and awareness programs.

Central Marsh (Um Lilo - Beginning of Al-Baghdadia) HAB_CM_11

N 31˚01'28.7" E 47˚2.0'16.9"

Plate 7: Survey Site HAB_CM_11

Site description:

This site is considered to be an extension of the Abu Sobat canal serving as an inlet to Al Baghdadia Lake (Bargah). The canal divides the area into two sides (East & West) but the habitats are the same on both sides of river (canal). There are small open water areas with high density submerged plant communities and surrounded by reed (*Phragmites australis)* and Typha (*Typha domingensis*) from all directions. All submerged plants are decayed on the water surface. Buffalo grazing is present in the area and there are many fishing nets in the canal.

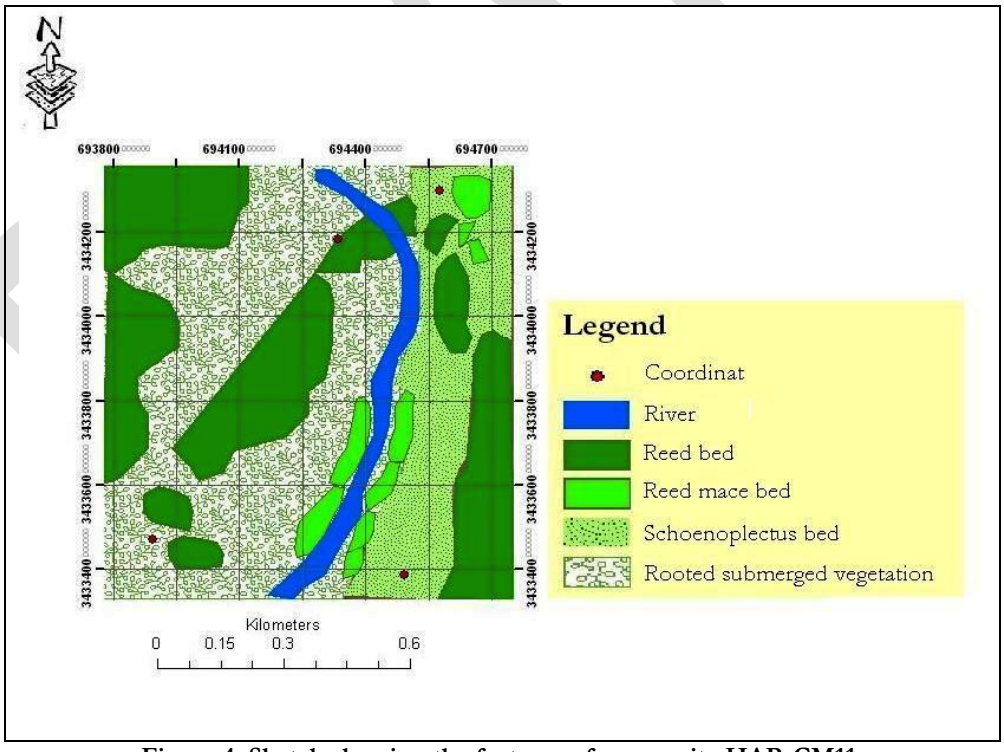


Figure 4: Sketch showing the features of survey site HAB-CM11.

Water Quality:

Water quality parameters were measured at 6:20 am on 17/6/2008. The air temperature was 27.1˚C and the water temperature was 23˚C. These values were normal according to the time and date of the measurement (Kinnesh, 1986). The water depth was 1.1 m. The electrical conductivity was 3870 µs/cm and the salinity was 2 ppt. As for dissolved oxygen, it was 3.43 mg/l. The pH of this site was slightly alkaline (pH 8.11) because of the buffering ability resulting from the presence of carbonate and bicarbonate elements (Stirling 1985; Al- Mousawi and Hussain, 1992). The turbidity was 0.56 NTU, TOC was 2.68 %, and chlorophyll-a 5.29 (mg/m^3).

Phytoplankton:

Total phytoplankton count: 380.2 x 10^{3}cell/L. Species number: 105

The dominant phytoplankton group was Bacillariophyta with 315.9x 10^{3}cell/L, followed by Cyanophyta with 35.2 x 10^{3}cell/L and Chlorophyta with 26.1 x 10^{3}cell/L. Bacillariophyta was represented by 86 species (8 taxa central and 75 taxa pennate). The centric diatoms were dominated by *Chaetoceros* sp., *Cyclotella meneghiniana*, *Cyclotella stelligera,* and *Cyclotella striata*. The pennate diatoms were dominated by *Achnanthes minutissima, Fragilaria pulchella, Fragilaria ulna,* and *Nitzschia palea.*

Cyanophyta was represented by 10 species dominated by *Microcystis aeruginosa* and *Merismopedia glauca. Microcystis aeruginosa* is a common species in hard waters becoming especially abundant during summer periods (Prescott 1982). Both dominant blue-green algae are known to favor mesotrophic waters (Wehr and Sheath 2003).

Chlorophyta was represented by nine species dominated by *Mougeotia* sp.; this species favors flowing waters (Wehr and Sheath 2003).

Benthic Macroinvertebrates:

This site differs from the other sites by harboring the highest density of benthic macroinvertebrates; total density of benthic macroinvertebrates in this site was 322 (individual/m^2), dominated by the shrimp *Caridina babaulti basrensis,* which affected the evenness by its high density compared with the other species (See Index V, Table 2 and 3). This could be due to the shelters provided by the thick submerged vegetation dominated by *Ceratophyllum demersum* and the water depth that allows such species to swim easily in the water column beneath these types of Macrophytes. According to the Pollution Tolerance Index, water quality in this site was fair. This result could be confirmed by recording the dominance of the shrimp *Caridina babaulti basrensis* and the relatively moderate diversity for the whole site (See Index V, Table 3 and Figure 13). The low density of the larvae of the blood midges and the absence of the oligochaetes is probably due to the hard bottom and the little organic matter available for its feeding. This was confirmed after mounting of the blood midges' specimens. To note, one of the important observations in this site is the blunt teeth of the blood midges' mentum, mandible, and premandible.

Plants:

This site has the highest number of plant species in comparison with other sites, the dominant submerged species were *Ceratophyllum demersum* (30%), *Potamogeton lucens* (20%*) Potamogeton pectinatus* (5%), *Myriophyllum sp* (5%), *Chara* sp (+), *Hydrilla verticillata* (+), *Vallisneria* sp (+), and *Potamogeton perfoliatus (+).* The other group was the emergent species, which included *Phragmites australis* (30%), the dominant plant in this group, *Typha domingensis* and *Schoenoplectus litoralis (*however with lower density). Total vegetation cover was 105% due to the high density of vegetation and the stratum distribution of plants.

Fish:

High and thick reed (*Phragmites australis*) provide shady habitat with shallow and stagnant water. This site is a spawning ground for Cyprinidea fish that need shallow and warm water. Small fish could be seen

around the site. The fish present in this site were: *Aspius vorax, Barbus luteus, Carassius carassius* (Cyprinidae), *Heteropneustus fossilis* (Heteropneustidae), *Silurus triostegus* (Siluridae, which is dominate at the site), and *Liza abu* (Mugilidae).

Birds:

This marsh provided very suitable habitat for the Little Grebe *Tachybaptus ruficollis* that existed in good numbers. It also might be a good habitat for the breeding of this bird. Some Herons *Ardea* were observed foraging in this site where there might be good fish resources. Also this site provided excellent habitat (as shelter and breeding site) for some Purple Swamphen *Prophyrio prophyrio* and Moorhen *Gallinuylua chloropus*.

Since the site was not a suitable habitat for them, no Waders were seen. Terns and Slender-billed Gulls *Larus genei* were present in fair numbers that might indicate the richness of this site with food resource (fish). Also there were some Pied Kingfishers *Ceryle rudis* perching on the reed stalks at the edge of reedbeds watching for their prey (fish).

Relationships among the organisms and their environments:

Fair water quality, the dissolved oxygen was moderate to low (3.4 mg/l) and this might be because of the time of sampling and the brackish water. The depth of water was moderate with low turbidity (relatively clear water). The results of phytoplankton indicate fair water quality and the chlorophyll-a results supported this (Kassim, 2005). Phytoplankton diversity was high compared with the other sites; the Cyanophyta can display tremendous environmental ranges and tolerate many changes. They prefer pH mainly between 8.0-8.3 and the availability of nutrients.

The Pennate Diatoms were dominant in this site and this agrees with previous studies that indicated the dominancy of Bacillariophyceae specially *Cyclotella*, *Nitzschia*, *Navicula*, and *Cymbella* among the algal flora (Hassan and Al-Saadi, 1995; Al-Lami *et al*., 1996; and Al-Saadi *et al*., 2000). Most of the pennate diatoms are known to be abundant in little assemblages, with fine substrata, reduced canopy, low gradients, low discharges, and relatively high salinity (Blinn and Herbst, 2003). The plant cover was high, the dominant submerged plants were *Ceratophyllum demersum* and, to a less degree *Potamogeton lucens*. There was *Vallisneria sp* in this site and this plant is eaten by fish and provides shelter for fish eggs. *Ceratophyllum sp.* was dominant because it is tolerant plant and can grow in different environments with varied current water (Al-Saadi and Al-Mayah, 1983). The results for the fish study in this site were close to the results of the previous sites, which indicate that the water quality is still poor according to the absence of sensitive fish species such as *Barbus sharpeyi* (locally called Bunni) and the dominance of predator species such as *Silurus triostegus* (Jurry*)*. The direct and indirect coupling between ichthyofaunal communities and human impacts on estuaries reinforces the choice of a taxonomic group as a biological indicator that can assist in the formulation of environmental and ecological quality objectives, and in the setting of environmental and ecological quality standards for these systems (Whitfield and Elliott, 2002)

The water quality (according to benthics view point) was fair depending on PTI which can be supported by the diversity of benthics (moderate diversity) and also the dominance of the shrimp according to their sensitivity to water quality. The dominance of the shrimp is due to the existence of many shelters created by the submerged plants, particularly *Ceratophyllum* sp., and the appropriateness of the site in relation to water depth where these types of benthics can be found swimming under the plants. The low density of red worms and the absence of Oligochaetes was likely due to the hard soil (ground) and the exiguity of organic matter are a required food source for these groups

Because of the presence of the river and the movement of boats and people, the presence of large birds was decreased. This however was accompanied by a noticeable increase in Cattle Egret *Bubulcus ibis* and this indicates the presence of many water buffalo at this site. Also there are few Diving birds at the site

although the site appears to have the food resources for these birds. The presence of other birds that feed on the fish such as Gulls, Terns, and Kingfishers indicates the abundant presence of fish.

Conservation status:

All identified Phytoplankton species in this site are common in Iraq's water and the total count of species indicates relatively oligotrophic-mesotrophic water conditions. The macroinvertebrates that exist at this site are also common in Iraq (but there is little information about the conservation status of benthic macroinvertebrates in Iraq). Plants in this site are common in the marshes. *Hydrilla verticillata* is an exotic species which appeared after the re-flooding of the marshes. *Hydrilla* sp. is not mentioned in the Flora of Iraq where only three plants of Hydrocharitaceae are mentioned as existing in Iraq (Townsend and Guest, 1985, Vol. 8, p.2). *Myriophyllum* sp. belongs to one of the missing families in the Flora of Iraq and that's why there is little information about the conservation status of this species. The plant *Potamogeton perfoliatus* is considered rather rare in Iraq as mentioned in the Flora of Iraq (Townsend & Guest, 1985, Vol. 8, p.23), but right now it is widespread in the southern marshes. All the identified fish species are common in Iraq's southern marshlands. This area represents spawning ground for many fish species especially the Cyprinidae family, which is the dominant family in our inland water. The conservation status of birds at this site is as follows:

The Little Grebe *Tachybaptus ruficollis* (Iraqi subspecies) existed in this area in good numbers. The conservation concern Slender-billed Gull *Larus genei* existed in the area. It is also a good habitat for breeding of Purple Swamphen *Prophyrio prophyrio*.

Management requirements:

More water is required for the site, this will help in improving the status of the nutrients, dissolved oxygen, salinity and water temperature so that the overall conditions will improve and the diversity of species will increase. To improve the water quality in this site and then restore the original biodiversity that existed before, the suggestion is to restore the old hydrological model of the Central Marshes by restoring water sources from the Tigris River (fresh water resources). It is recommended to reduce human disturbance and target the local community with educational and awareness programs.

Central Marsh (Core Area) HAB_CM_12

N 31˚04'32.2" E **47˚59'58.8"**

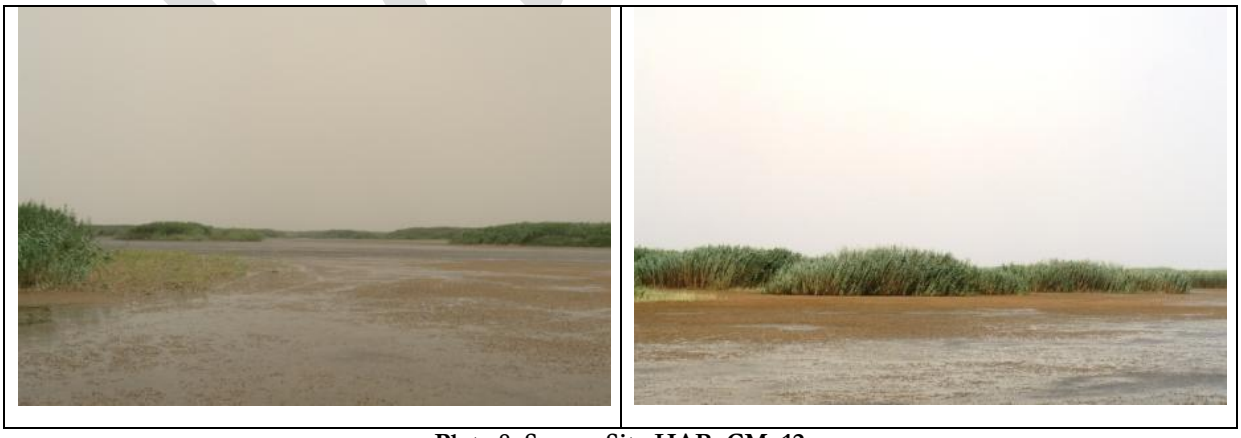


Plate 8: Survey Site HAB_CM_12

Site description:

This site is an open water area (Bargah) with submerged vegetation in different densities. It is surrounded from all directions by reed (reedbeds) and also there are groups of reed inside the area. Most of the

submerged plants are decayed on the water surface. This area was burnt before and the ground was brownish and includes spots with low densities of submerged plants.

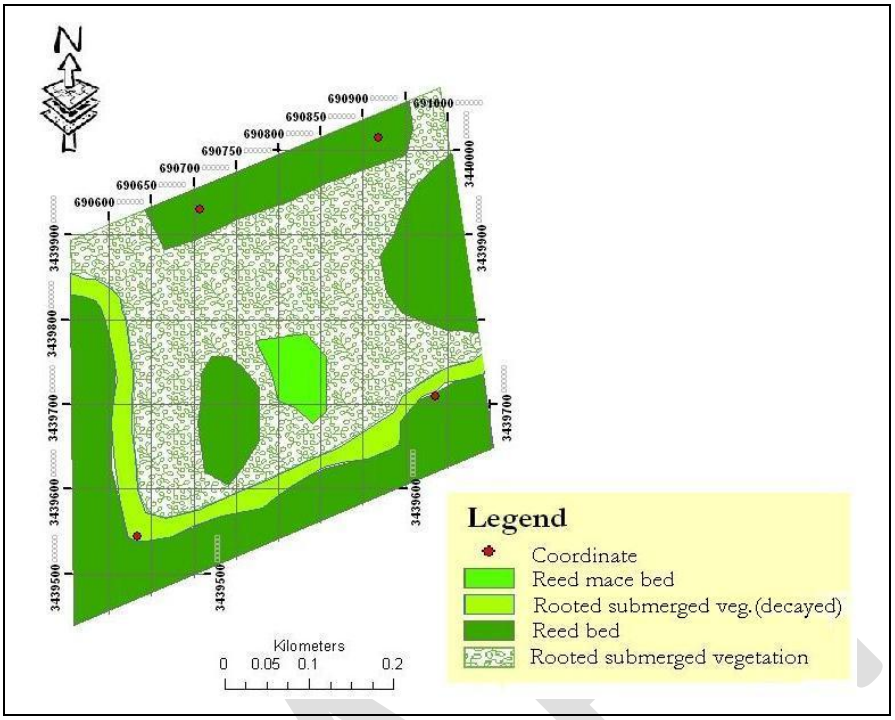


Figure 5: Sketch show the features of survey site HAB-CM12

Water Quality:

The measurements were taken at 11:40 am on 17/6/2008. The air temperature was 39.4˚C and the water temperature 27.3˚C (the high water temperature was due to the time and date of measurement). Water temperature is considered as an important factor in the aquatic environment. The water depth was low (0.37m) thereby increasing the water temperature (Almousawi *et al*., 1990; Ghani, 1996). The electrical conductivity was 4620 µs/cm and the salinity was 2.4 ppt. As for dissolved oxygen, it is an important factor in aquatic environment as well as being an indicator of organic pollution in aquatic environment (where there is an inverse relationship between oxygen level and the organic pollution). This site had the highest value for dissolved oxygen with 8.51 mg/l due likely to low turbidity (Maiyza and Said, 1989) in addition to high winds at the site. The pH of this site was slightly alkaline (pH 8.07) because of the buffering ability of carbonates and bicarbonates (Stirling, 1985; Al- Mousawi and Hussain cited in Hussain, 1994, p 95- 126). The turbidity was 0.78 NTU, TOC was 1.90 %, and chlorophyll-a was 12.21 (mg/m^3).

Phytoplankton:

Total phytoplankton count: 2079.6 x 10^{3}cell/L. Species number: 112

The dominant phytoplankton group was Bacillariophyta with 1266.3 x 10^{3}cell/L. Cyanophyta followed the diatoms having a total count of 437.7 x 10^{3}cell/L. Bacillariophyta was represented by 86 species (9 taxa central and 77 taxa pennate). The centric diatoms were dominated by *Cyclotella atomus*, *Cyclotella meneghiniana*, and *Cyclotella striata*. The pennate diatoms dominanted in this site were *Achnanthes minutissima*, *Bacillaria paxillifer*, *Epithemia sorex*, *Epithemia zebra*, and *Fragilaria pulchella* whereas Cyanophyta was represented by 11 species mainly dominated by *Oscillatoria limnetica.* As for the other groups: Chlorophyta, Pyrrophyta, and Euglenophyta were 140 x 10^{3}cell/L, 135.9 x 10^{3}cell/L, and 99.7 x 10^{3}cell/L, respectively (Index IV). The following recorded the highest total counts for all of the surveyed sites: Cyanophyta,

Pyrrophyta, and Euglenophyta. Generally, blue-greens are ubiquitous in waters of a great range of salinity and temperature (Waterbury and Stanier cited in Bold and Wynne, 1985, p 221- 223). In addition blue-green algae seem to be more abundant in neutral or slightly alkaline habitats, although some like Chroococcus prefer low pH levels (Brock, 1973). Pyrrophytes on the other hand, are minor members of the summer phytoplankton as most species are long day or warm temperature organisms with maximum growth during summer. While, Euglenophyta species tend to grow in waters that are enriched with organic compounds, such as after pollution (Wehr and Sheath, 2003).

Benthic Macroinvertebrates:

Total density of benthic macroinvertebrates in this site was 169 (individual/m²), dominated by the shrimp *Caridina babaulti basrensis,* which affected the evenness by its high density compared with the other species (See Index V, Table 2 and 3). This could be related to the shelters provided by the thick submerged vegetation dominated by *Myriophyllum* sp. The low water depth probably resulted in the low density of shrimps when compared with the density found in HAB-CM11. According to the Pollution Tolerance Index, water quality in this site was fair. This result could be confirmed by recording the dominance of the shrimp *Caridina babaulti basrensis* and the relatively moderate diversity for the whole site (See Index V, Table 3). The low density of the larvae of the blood midges and the absence of the oligochaetes is probably due to the hard bottom.

Plants:

Myriophyllum sp. (40%) was the most dominant species at the site. This area was burned in the past so the ground had a brownish color and included spots with low density of submerged plants, and other submerged plants had a low vegetation cover percentage (VCP): *Ceratophyllum demersum, Chara* sp.*, Najas marina.* The emergent plants included: *Phragmites australis* (30%), *Typha domingensis* and *Schoenoplectus litoralis* also with very low VCP.

Fish:

This site had shallow and stagnant water and due to the shallowness and high winds, it was not possible to conducting sampling in this area. But the site may be a productive area for small fish.

Birds:

This site was not a good site for most birds either for its natural conditions or for the weather conditions during the time of the survey. The existence of some diving birds at this site may be because of the clear water, taking into consideration that these species are fish-eaters (Little Grebe *Tachybaptus ruficollis* and Pygmy Cormorant *Phalacrocorax pygmaeus*). Also, this site did appear to provide good shelter and breeding habitat for some Moorhens *Gallinuylua chloropus* and Purple Swamphen *Prophyrio prophyrio*. It seems that this site may also form good habitat for the breeding of Whiskered Tern *Chlidonias hybrida* although no nests or chicks were found, but the majority of the birds that were seen in this site were juveniles. Also there were some Slender-billed Gulls *Larus genei* and other species of Terns *Chlidonias hybrida* that might find food resource in this area sufficient.

Occurrence of Sand Martin *Riparia riparia* in large numbers in this site might illustrate the richness of this site with the flying insects. They were flying all the time in spite of the windy weather. Some Basra Reed Warblers *Acrocephalus griseldis* were found foraging at the edges of the reedbeds among the reed stalks where it was very suitable habitat/niche for breeding.

Relationships among the organisms and their environments:

The site had fair water quality probably due to the low depth (shallow water) and the high winds that resulted in relatively high dissolved oxygen concentrations (Al- Mousawi and Whitton, 1983). The availability of the photosynthesis requirements is reflected by high chlorophyll-*a* concentration when

compared with the other sites. There was high productivity due to the availability of nutrients that come from the decomposition of plants that in turn lead to good light penetration, thus increasing the photosynthesis of phytoplanktons. Phytoplankton diversity and biomass were highest here compared to all sites. This site may be considered polluted or enriched due to the existence of Cyanophyta, Pyrrophyta and Euglenophyta species that favor such conditions. In addition, the shallow water, the availability of organic compounds, the relatively high salinity (compared to other sites and likely resulting from the high evaporation) and the low turbidity, provided conditions for the dominance of the diatoms especially the pennates. The existence of Chlorophyta is proportional with the results of plant cover percentage of the submerged plants, probably because the abundance of green-algae results from the high ratio of cell surface area to volume, as compared to large organisms, this increases the efficiency of light absorption per unit of cell volume and of the uptake of CO_2 and nutrients from the environment (Szelag-Wasielewska, 2003).

The dominant submerged plant was *Myriophyllum* sp. and *Ceratophyllum demersum* to a lesser degree. The low depth of water facilitates the drying of submerged plants or at least those parts that are close to the water surface, and leads to the decomposition of these parts and then increasing the nutrients which encourage the growth of other organisms such as phytoplankton… etc. Also, one of the factors which facilitate the blooming of *Myriophyllum* is clear water (high transparency and low turbidity) (Al-Saadi and Al-Mayah, 1983). There was no sampling of fish in this site because of the shallow water and the high wind, which made the sampling difficult. The water quality was fair from a benthic view point. The dominant macroinvertebrate was shrimp but less than in the previous sites because of the shallow water that likely made the movement of shrimp difficult. Also the diversity of benthics was moderate which confirmed that the water quality was fair. Red worms were almost completely missing and also oligochaetes because these species dig into the ground and the ground appeared hard.

According to the strength of wind at this site, which affected the existence and distribution of birds, it was too hard to record birds, but there were important observations such as the existence of Whiskered Tern *Chlidonias hybrida* on the floating parts of the submerged plants including some young birds. This suggests that the site is a suitable habitat for the nesting of this bird (Salim, 2006). Also, it was noticed that some of Sand Martins *Riparia riparia* were perching beyond the reed-wall to avoid the strong wind.

Conservation status:

The identified phytoplankton species were common but the presence of certain species in relatively larger numbers may be an indicator of enriched waters. All the identified macroinvertebrates were common in Iraq. All plants species were common in the lower Mesopotamian marshes of southern Iraq. As for birds: the endemic Little Grebe *Tachybaptus ruficollis* occurs regularly in this area and might breed, the conservation concern Slender-biller Gull *Larus genei* existed in this area, the conservation concern Whiskered Tern *Chlidonias hybrida* might breed in this area. This site is also important for the Threatened and endemic Basra Reed Warbler *Acrocephalus griseldis* either for general occurrence or as a breeding site.

Management requirements:

It is urgently recommended to increase the water level and improve the water quality by restoring the inlets (water sources) from the Tigris River also to reduce the human disturbance and target the local community with educational and awareness programs. Due to the presence of Cyanophyta, Pyrrophyta, and Euglenophyta, these phytoplankton groups are known to be available in relatively polluted waters. Thus, it is recommended that this site needs more water to aid in the water purification of the site. This site and other sites need to have a slightly decreased vegetation cover to create free space for other organisms like fish. Increasing the water level would improve this situation also cutting some plants by mechanical methods.

Central Marsh (Eishan Al-Gubba) HAB_CM_13

N 31˚04'10.8" E 47˚01'3.6"

Plate 9: Survey Site HAB_CM_13

Site description:

A paved street divides this area into two sides: The western side is an aquatic habitat with reedbeds and a water passage close to the street, also there is an area of high ground to the southwest of the site with terrestrial plants (*Tamarix* sp.) and dry aquatic plants (dry *Phragmites australis*), furthermore the soil is wet as in a seasonal marsh. The eastern side includes three types of habitat, 1st (in the northeast) is reed & reed mace bed; 2nd (in the middle and east) is dry land without plants and it is use by people, and 3rd (in the southeast) is terrestrial vegetation. This area contained high buffalo breeding activities.

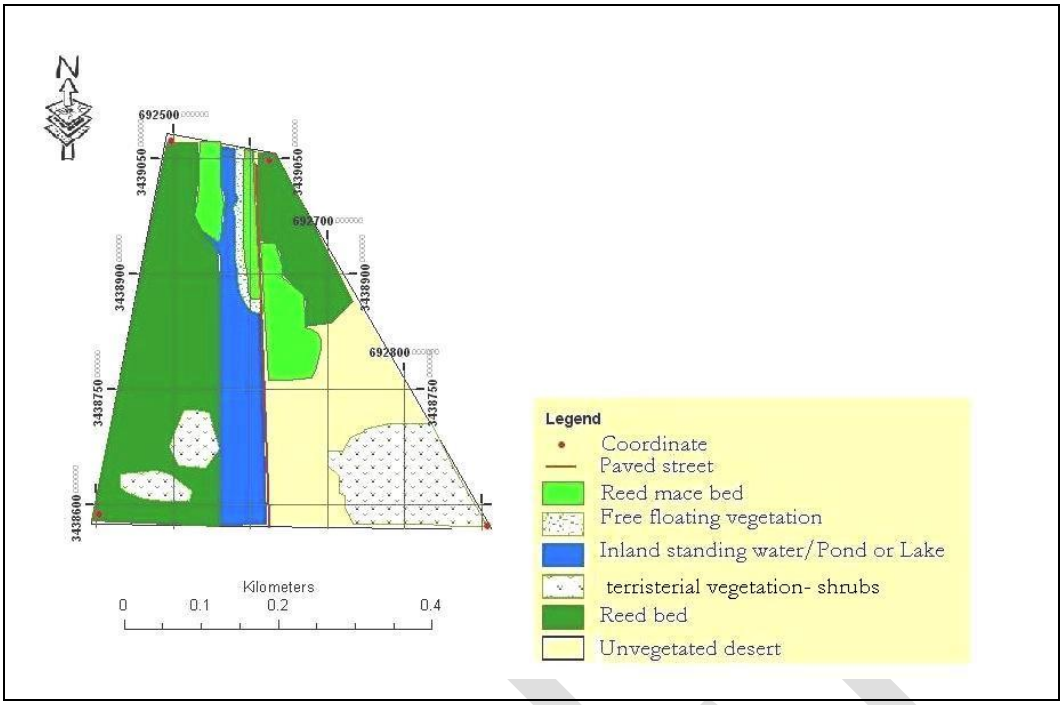


Figure 6: Sketch shows the features of survey site HAB-CM13

Water Quality:

The physical measurements and sampling were done at 11:00 am on 14/6/2008. The air temperature was 35.5˚C and the water temperature 26˚C; the water temperature was high due to the time and date of measurement. The water depth was 1.1m. The electrical conductivity was 3400 µs/cm and the salinity was 1.7ppt. The dissolved oxygen was 3.18mg/l. The pH of this site was slightly alkaline (pH 8.01) because of the buffering ability of carbonates and bicarbonates (Stirling, 1985; Al- Mousawi and Hussain, 1992). The highest value of TOC was in this site with 8.63 %, likely causing the highest turbidity of all the sites, which was 2.63 NTU and chlorophyll-a was 7.72 (mg/m^3).

Phytoplankton:

Total phytoplankton count: 2163.5 x 10^{3}cell/L. Species number: 99

The dominant phytoplankton group was Bacillariophyta 2070.9x 10^{3}cell/L compared with the other phytoplankton groups, which had very little appearance in this site. Bacillariophyta was represented by 86 species (8 taxa central and 74 taxa pennate). The centric diatoms were dominated by *Cyclotella atomus*, *Cyclotella meneghiniana*, and *Cyclotella striata.* The pennate diatoms were dominated by *Nitzschia palea, Nitzschia longissima, Nitzschia microcephala, Bacillaria paxillifer*, *Achnanthes minutissima, Fragilaria brevistriata, Fragilaria vaucheriae,* and *Navicula cincta.*

Benthic Macroinvertebrates:

This site differs from the other sites by harboring the lowest density of benthic macroinvertebrates, total density of benthic macroinvertebrates in this site was 121 (individual/m^2), dominated by the shrimp *Caridina babaulti basrensis,* which affected the evenness by its high density compared with the other species (See Index V, Table 2 and 3). According to the Pollution Tolerance Index (PTI), water quality in this site is poor. This result could be confirmed by the high turbidity, relatively poor diversity and evenness of the whole site (See Index V, Table 3 and Figure 13), harboring the lowest density of benthic macroinvertebrates when compared with the other sites (See Index V, Table 2), and the benthic habitat perturbation observed due to the dense buffalo activity there.

Plants:

There are a paved street divide this area into two sides; one primarily aquatic with aquatic plants and the other one dry with terrestrial plants though the soil was wet and it most likely is a seasonal marsh. This area contained high buffalo breeding activities and the breeding area had no vegetation. The total number of species was only 6, *Phragmites australis* (30%) was the dominant species and *Suaeda* sp., and *Tamarix* sp. were present to a lesser degree. Other species have low a vegetation cover percentage (VCP) were *Typha domingensis*, *Aeluropus lagopoides* and *Salvinia natans*. Total VCP was 85% for the low density of plant cover in comparison with the other survey sites.

Fish:

This site has shallow, stagnant water but may be a productive site for small fish. The fish present in the site were *Aspius vorax, Barbus luteus, Carassius carassius* (Cyprinidae), *Heteropneustus fossilis* (Heteropneustidae), *Silurus triostegus* (Siluridae), and *Liza abu* (Mugilidae).

Birds:

Like the previous site, it seems that this area was not rich in bird life. The wind was not calm, which caused resulted in fewer bird observations over this site. There were Waders in this site (Black-winged Stilt *Himantopus ostralegu*), as the site is suitable for these birds (though there were not many present possibly because of the weather). Some Collared Pratincoles *Glareola pratincola* were flying over the site suggesting that this area or areas near it are suitable for breeding of this species. The occurrence of arid land habitats indicates the presence of the Egyptian Nightjar *Caprimulgus aegyptius*. This bird might breed in or nearby the area where there is suitable habitat. Also there were some Crested Larks *Galerida cristata* that belong to the same semi-desert habitat.

Relationships among the organisms and their environments:

According to the measured parameters, water quality may be considered to be relatively poor. Dissolved oxygen concentration ranged between 3-2 mg/l, and this is a high value compared to the high concentrations of the organic materials (TOC) (Rian, Astafan and Abdulrasheed, 2003; Gupta, 1999). This may be due to boat movements in the area and the increased occurrence of phytoplankton as referred to by the high values of chlorophyll-*a* (7.7 mg/L). Also the time for measuring DO was at 11.00 am, i.e., during the peak hour of the photosynthesis. The dominant species are those that are more tolerant of relatively high salinity and turbidity. Water quality according to the final total count and chlorophyll-*a* concentration is mesotrophic to eurotrophic (Kassim, 2005). The *Salvinia natans* provides useful fodder for wild duck and other fowl with which the marshes abound (Townsend and Guest, 1966, Vol.2, p63). The frequent movement of buffalo and boats in the area and the slightly turbid water obstructs submerged plants' growth (Al-Saadi and Al-Mayah, 1983) and this may provide more room for phytoplankton to grow (due to low competition over nutrients) as confirmed by the high results for population and diversity of phytoplankton in the area. The dry part of the area is characterized by the presence of plants like *Tamarix* sp. and *Suaeda* sp., as well as reed (*Phragmites australis*) which is capable of growing in such environment due to the wet soils. Also there are floating plants like *Salvinia* in the flooded parts behind the paved road. The presence of buffalo in the area helps to mix the organic materials that reside in the soil and the water, which provides more opportunities for phytoplankton to grow and thus increasing water turbidity (suspended matter-turbidity + phytoplankton-turbidity).

According to PTI, the water quality was poor, which is supported by (1) high turbidity in the area, (2) low benthic diversity, (3) very low benthic density compared to other sites, and (4) the disturbance caused by buffalo movement. In spite of the high presence of organic materials in the area, which would encourage the presence of Oligochaetes, blood midges, they did not show up due to the environmental instability caused by the presence of buffaloes. We noticed small numbers of swimming water beetles. Fish

community results indicated a deterioration in water quality due to the absence of the sensitive species and the dominance of more tolerant species (Whitfield and Elliott, 2002). The area had a poor bird count (influenced by high winds), although there was a presence of some dryland birds like the Black Francolin *Francolinus francolinus* due to the presence of the dry part of the site as well as the wild plants that give shelter to these birds. Due to the human and buffalo presence, this area is an ideal environment for Cattle Egret *Bubulcus ibis* as there is a relation between buffalo and these birds, which feeds on the worms on the buffalo's back and cleans it of parasites. According to the historical observations, this site was one day very important for wintering waterfowl as large numbers were observed at 70s over these areas and the adjacent areas (George and Vielliard, 1990; Carp and Scott, 1979).

Conservation status:

The mentioned phytoplankton species above were common in Iraq's southern marshlands. The recorded species and chlorophyll-*a* may indicate meso-eutrophic waters. All the identified benthics species were common in Iraq's southern marshlands. All plants at this site were common in Iraq. There are some references referring to *Tamarix* and *Suaeda* species as native species in Iraq (Al-Ani, Habib, Abdulaziz, & Ouda, 1971; Habib, Al-Ani, Al-Mufti, Al-Tawil, & Takessian, 1971). *Aeleoropus lagopoides* is native in Iraq (Townsend and Guest, 1968). All the identified fish species are common in Iraq. This area represents a spawning ground for many fish species specially the family Cyprinidae, which are the dominant family in our inland water.

As for birds, the conservation concern Collared Pratincole *Glareola pratincola* might breed in the nearby area. This site might harbor more bird species of conservation concern, but the wind did not allow for clear observations.

Management requirements:

Higher water levels would help in increasing of the circulation of nutrients and increasing dissolved oxygen concentrations that would then supports the diversity and richness of planktons, plants, fish,…etc. These requirements (increase a water quantity and improve water quality) can be addressed through the restoration of the water sources from the Tigris River. The increased vegetation cover prevents light from penetrating deep into the water, so some harvesting or other control vegetation growth might benefit the site. Also human disturbances are affecting this site and it would be important to target the local community with educational and awareness programs.

Central Marsh (Al-Hummara Al-Kabera) HAB_CM_25

N 30˚59'21.0" E 46˚49'37.3"

Plate 10: Survey Site HAB_CM_25

Site Description:

It is a dry area with mixed terrestrial plants (southwestern) and aquatic plants (northwestern & northeastern). There is small area that still contains a little water (of only 5-20 cm depth), so this site is considered a seasonal marsh. There is also a paved road adjacent to the area on the west-southwest side. There are many people living on the edge of the road and breeding buffalo.

Note: This area was determined by two points in the west and the description is about 1 Km toward the east. The site was dry (it was flooded in summer, 2007), so no data was gathered for water quality, Phytoplankton, Benthic Macroinvertebrates and Fish. Due to high winds no bird observations could be made.

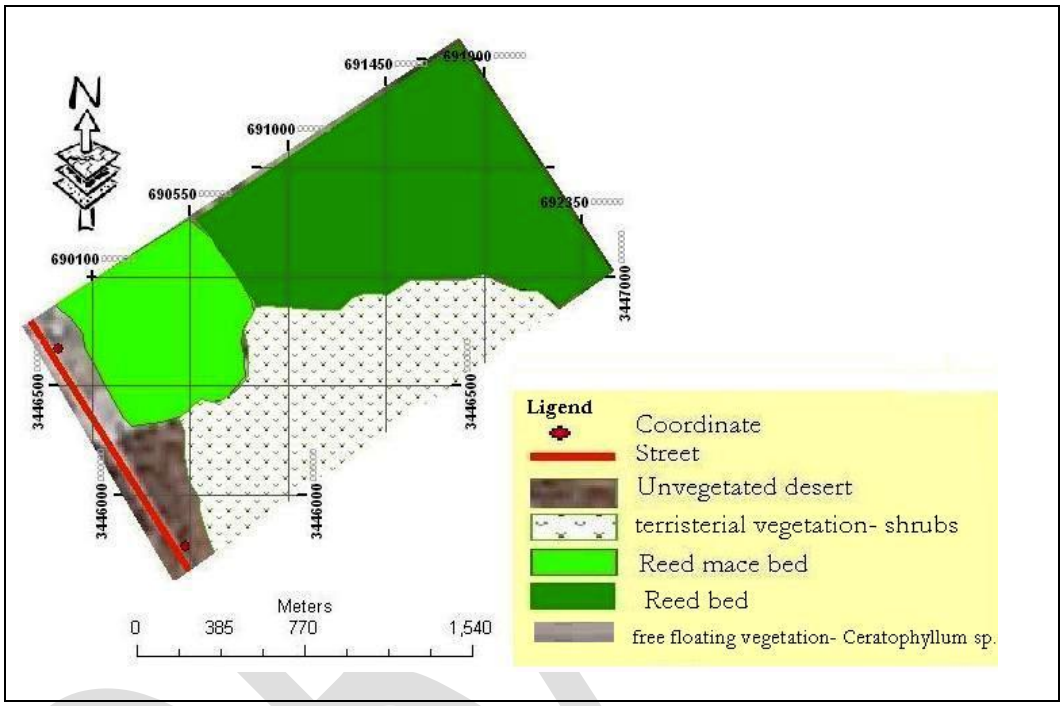


Figure 7: Sketch shows the features of survey site HAB-CM25.

Plants:

The site is dry with a small area having very little stagnant water with a low density of submerged plants that are *Ceratophyllum demersum* and *Potamogeton pectinatus*. Another semi-dry site had remnent emergent plants with *Phragmites australis* being the dominant species and *Typha domingensis* with low density of VCP also *Tamarix sp.* was present near the site. In general this site had 70% of total VCP.

Birds:

Bird observations over this site were not conducted as strong winds decreased bird activity. Obviously, the current site does not provide good habitat for birds. The water body is restricted to limited patches among the reed stalks that neither form open water to provide suitable habitat for any water bird species nor thick reedbeds that might attract other birds, including Passerines. Formerly (few years ago), this site was filled with water (Salim, 2006) and was rich with bird species, but obviously, it has been affected by severe fluctuations in water level and the lack of water that reflected directly on the bird life over this site.

Conservation status:

All the identified plants are common in Iraq. No bird species of conservation status were observed. This might be due to the weather conditions that did not allow for good bird watching during the time of the survey.

Management requirements:

The site is dry (except some patches with very shallow water). It is urgently recommended to supply sufficient amount of water in order to restore the original status of this area in addition to the restoration of the original flora and fauna. This is possible by adopting a plan to create inlets from the Tigris River into the Central Marshes. Also it is recommended to reduce human disturbance and target the local community with educational and awareness programs.

Central Marsh (Al-Saigal) HAB_CM_26

N 30˚59'21.0" E 46˚49'37.3"

Plate 11: Survey Site HAB_CM_26

Site Description:

This was another dry area (it is a seasonal marsh) with *Phragmites australis* and terrestrial plants (*Tamarix* sp. and *Suaeda* sp.). There is a paved street from north to south and adjacent to the site from east the plants decrease and the area turns into open desert. As the site was dry, there was no data about water quality, Phytoplankton, Benthic Macroinvertebrates, or Fish.

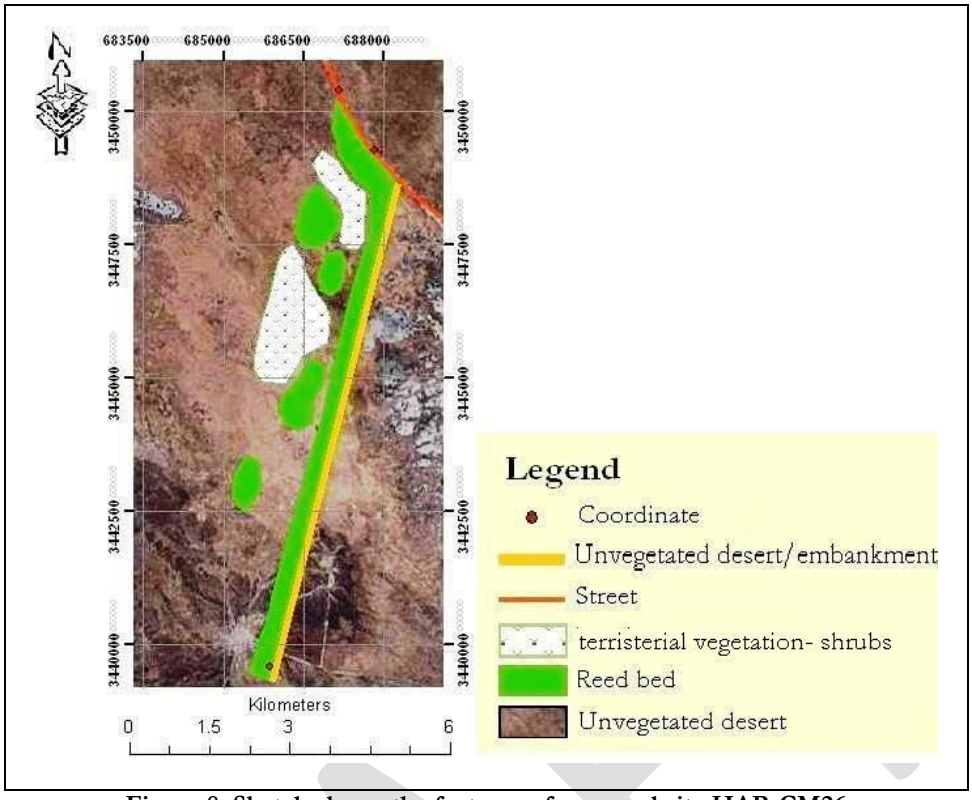


Figure 8: Sketch shows the features of surveyed site HAB-CM26

Plants:

It is a dry area, a seasonal marsh with terrestrial plants. In addition to the reeds (*Phragmites australis*) this site has few other species and an overall vegetation cover of 50%. It tends towards being a desert area with highly saline soils. The most dominant species were *Phragmites australis* (20%) and *Tamarix sp.* (20%), the other two species were *Typha domingensis* (5%) and *Suaeda sp.* (5%) which had lowest VCP.

Birds:

Obviously, this dry area was formerly a marshland. This is suggested by the existence of dry reed beds. The few bird species that were found in this area during the survey were either arid-land birds or semi-desert area birds. A few adult Black Francolin *Francolinus francolinus* were observed. In another area, there were two Egyptian Nightjar *Caprimulgus aegyptius.* These represent key birds for the Iraqi arid-land habitat. The Egyptian Nightjar is a nocturnal bird that might breed in this area as it supports good habitat for breeding under the scattered *Tamarix* shrubs. Also there was some semi-desert and desert areas species: the Crested Larks *Galerida cristata* that were searching for shelter away from the strong winds during the survey time.

Conservation status:

The plant species that exist in this site are common in Iraq. There are some references referring to *Tamarix* and *Suaeda* species as native species in Iraq (Al-Ani, Habib, Abdulaziz, & Ouda, 1971; Habib, Al-Ani, Al-Mufti, Al-Tawil, & Takessian, 1971). As for birds, the conservation concern Black Francolin might breed in this area, as it is typical for harboring good numbers of this bird. Also, it might have some mammals such as rodents, jackels, wolves and wild boar.

Management requirements:

The recommendation for this site is to increase the water level in all the Central Marsh, which in turn will contribute to the re-flooding of this area. This can be done by establishing inlets from the Tigris River or its tributaries.

Central Marsh (Zichri) HAB_CM_27

N 30˚59'21.0" E 46˚49'37.3"

Plate 12: Survey Site HAB_CM_27

Site Description:

It is a dry site (seasonally wet) located to the west of a soil embankment extending beside the area from north to south. All areas are covered by a low density of dry reed with terrestrial vegetation (*Tamarix* sp. and *Suaeda* sp.). Since the site was dry, no data about water quality, Phytoplankton, Benthic Macroinvertebrates or Fish were gathered.

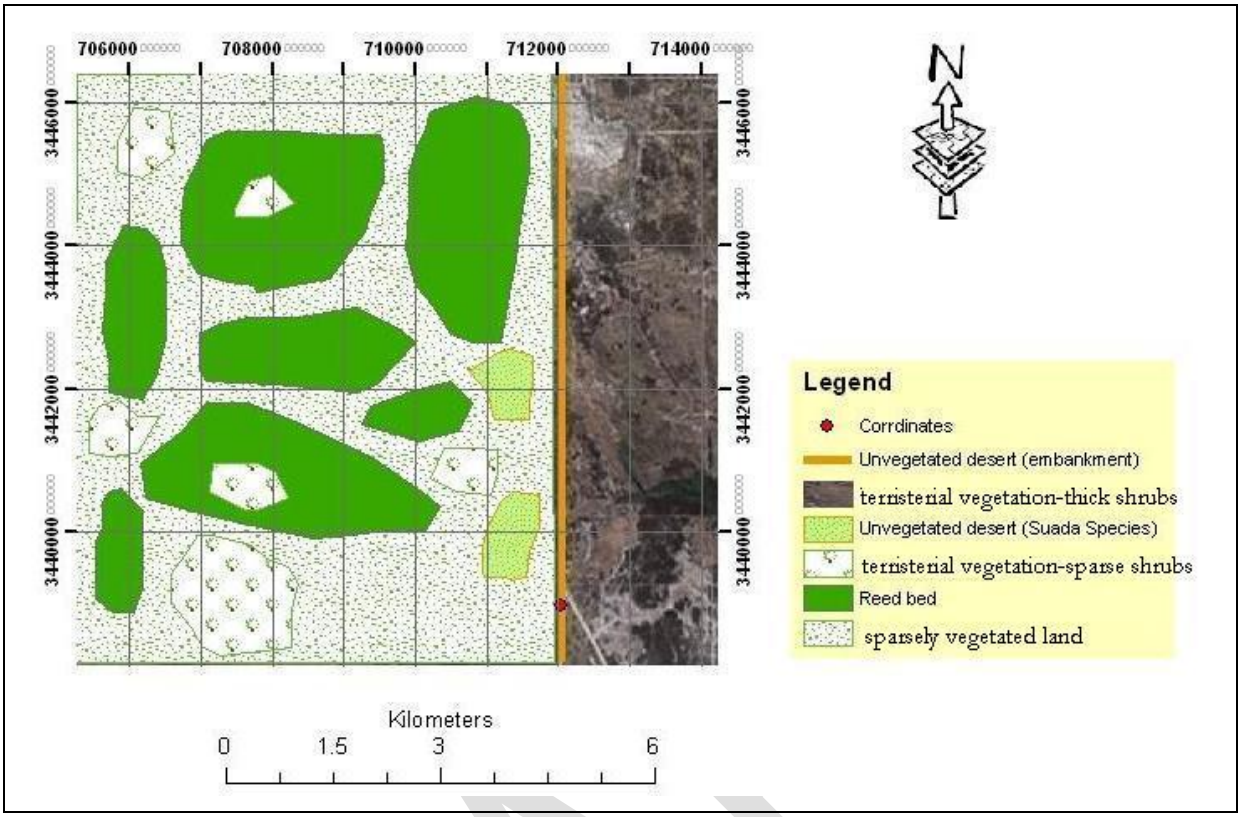


Figure 9: Sketch shows the features of surveyed site HAB-CM27

Plants:

This is a dry site; the soil has a high level of salinity; all areas were covered by a low density of dry reed with terrestrial vegetation. This site in certain seasons, particularly winter, becomes marsh when the water level increases. Six plants species were recorded: *Phragmites australis* had the highest VCP and was the most dominate compared with other species, the species with secondary dominance was *Tamarix* sp., all the other species were terrestrial and had very low VCP; these included *Alhagi graecorum, Suaeda* sp., *Cressa cretica* and *Cynanchum acutum.*

Birds:

Zichri was a flooded marsh area a few years ago. It was known to provide good bird habitat and typical bird species of the marshlands, but now it seems to have turned into a dry area with dry reed and *Tamarix*. Only the passing of a couple of Black-winged Stilt *Himantopus ostralegu* were observed and some crossing Slender-billed Gulls *Larus genei*. Likely these birds were crossing from other areas and did not use the site directly.

There were some crossing desert-species like the Pin-tailed Sandgrouse *Pterocles alchata* in addition to some other species known to occur in dry habitats, such as the Blue-cheeked Bee-eater *Merops [superciliosus] persicus*, and more than 300 individuals of the Sand Martin *Riparia riparia*. Also, there were considerable numbers of the Crested Lark *Galerida cristata,* which is a typical bird for the arid and semi-desert habitat; though it can also be found in more wet habitats.

The most important avifaunal finding in this site was the presence of good numbers of nests for the Dead Sea Sparrow *Passer moabiticus* in addition to some adult individuals of this restricted-ranged bird.

Conservation status:

For plants, *Cynanchum acutum* is occasional in the desert region of Iraq though rare in the steppe region (Townsend and Guest, 1980, Vol. 4-I, p554), *Cressa cretica* belongs to one of the missing families in the unpublished volumes of the Flora of Iraq (Some references refer to *Cressa critica* as a native plant in Iraq such as Ani et al. (1971) and Habib et al (1971) other plants are common in lower Mesopotamian marshlands. As for birds, it is a very important area for the breeding of the conservation-concern Dead Sea Sparrow *Passer moabiticus*. This area represents typical habitat for the breeding of this bird regularly in quite good numbers.

Management requirements:

The recommendation for this site is to increase the water level in all the Central Marsh, which will contribute to the reflooding of this area. This can be done by establish inlets from the Tigris River or its tributaries.

Central Marsh (Al-Hammar) HAB_CM_28

N 30˚59'21.0" E 46˚49'37.3"

Plate 13: Survey Site HAB_CM_28

Site Description:

The major part of this area is open water with rooted submerged vegetation surrounded by reed mace beds (*Typha domingensis*) from the east and west. From the north there were reed beds of *Phragmites australis*. From the south there was a small canal and a paved street. There is another paved street extend from south to the north with openings for water movement (this street extends inside the marsh and was built as a strategy for drying the marsh by the old regim). There are small soil embankments to the southeast of the area. It is also a buffalo grazing area.

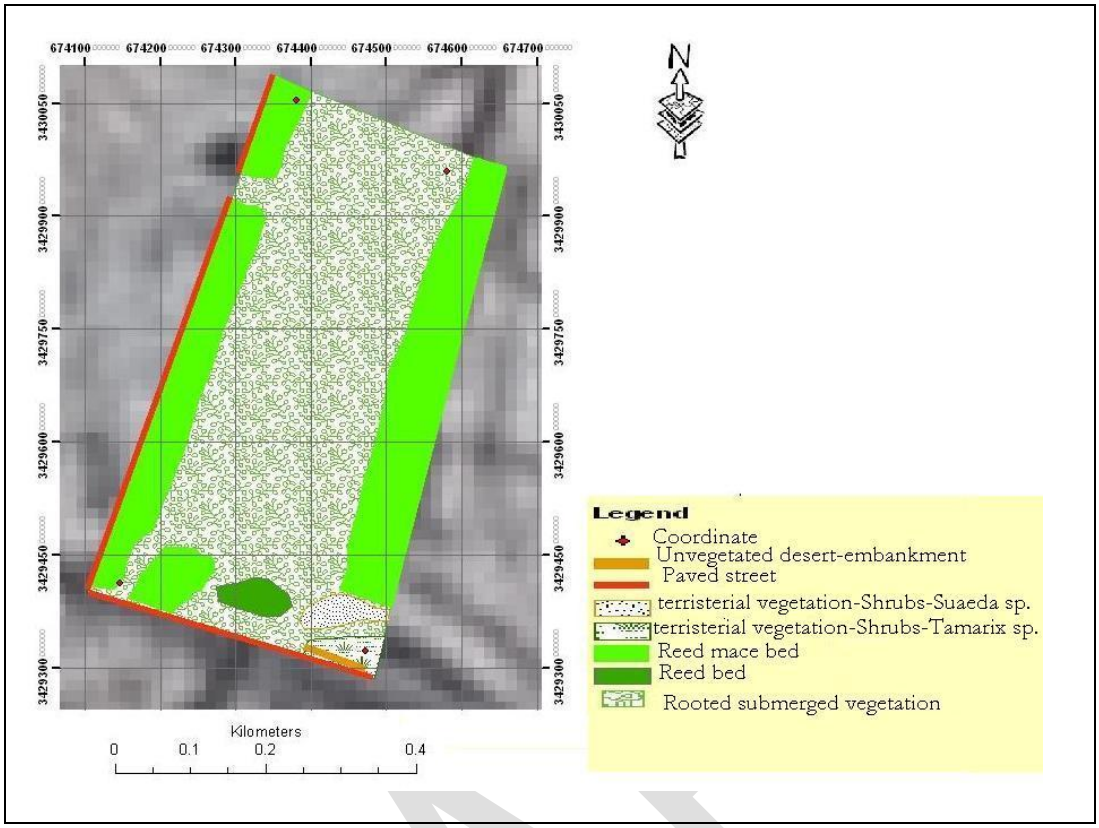


Figure 10: Sketch showing the features of surveyed site HAB-CM28

Water quality:

The water quality measurements were taken at 12:30 am on 15/6/2008. The air temperature was 35.5˚C and the water temperature was 27˚C. The water temperature was high due to the time and date of measurements (Al Mousawi et al., 1990; Ghani, 1996). The water depth was 1.1m, the electrical conductivity was 1235 µs/cm, and the salinity was 0.4 ppt. The lowest salinity values of all survey sites were recorded in this site and also in HAB-AZ-1, HAB-AZ-2 (the latter two are in the Abu Zirig area, which receive their waters from the Gharraf River, a branch of the Tigris). This site (HAB-CM28) is near to the waters coming from Abu Zirig toward the Central Marshes). The highest value for dissolved oxygen was in this site (9.11 mg/l) probably due to the low turbidity and the low level of salinity (Maiyza and Said, 1989). Results indicate a simple difference in pH among the sites because of the buffering ability resulting from carbonates and bicarbonates (Stirling, 1980). Result was slightly in alkaline side which is clear feature in the Iraqi water (Al-Zubeidy, 1985; Al-Ghafly, 1992, Ghani, 1996). The highest pH value was in this site (8.53) likely because of the increasing dissolved oxygen due to photosynthesis and consumption of CO_2 (Goldman and Horn, 1983). The turbidity was 0.38 NTU, TOC was 2.58 % and chlorophyll-a was 1.84 mg/m^3.

Phytoplankton:

Total phytoplankton count: 644.6 x 10^{3}cell/L. Species number: 69

The dominant phytoplankton group was Bacillariophyta with 564.2 x 10^{3}cell/L, compared with the other phytoplankton groups, which had very low occurance in this site. Bacillariophyta was represented by 48 species (3 taxa central and 45 taxa pennate). The centric diatoms were represented by only three species: *Cyclotella meneghiniana*, *Cyclotella striata* and *Cyclotella atomus*. The pennate diatoms were mainly dominated by

Cocconeis placentula var. euglypta, with the presence of *Achnanthes minutissima*, *Cymbella microcephala, Fragilaria vaucheriae, Mastogloia braunii, Nitzschia palea* and *Rhopalodia musculus*.

Benthic Macroinvertebrates:

Total density of benthic Macroinvertebrates in this site was 196 individual/m^2; dominated by the shrimp *Caridina babaulti basrensis,* which affected the evenness with its high density compared to the other species (Index V, Table 2 and 3). According to the Pollution Tolerance Index (PTI), water quality in this site was good. This result could be confirmed by the dominance of the shrimp *Caridina babaulti basrensis*, the absence of the blood midge larvae, the relatively moderate diversity and good richness for the whole site (See Index V, Table 3 and Figure 13), and the water quality measurements recorded for this site. The presence of the worm *Limnodrilus hoffmeisteri* is probably due to the presence of the optimum benthic habitat for this species, characterized by the soft, muddy bottom.

Plants:

This area could be characterized as open water with rooted submerged vegetation surrounded by reed mace *(Typha domingensis)*. The site had little dry area with terrestrial plants. Grazing is present in this site (water buffalo). *Potamogeton pectinatus* is the dominant species, the second is *Hydrilla verticillata* in less density and then *Typha domingensis,* other species present in lower VCP were *Ceratophyllum demersum*, *Chara* sp., *Potamogeton perfoliatus*, *Salvinia natans*, *Aeluropus lagopoides*, and *Cressa cretica*.

Fish:

Shallow, stagnant water supported small fish; the fish presented in this site were: *Aspius vorax, Barbus luteus, Carassius carassius*, *Cyprinus carpio* (from family Cyprinidae), *Heteropneustus fossilis* (from family Heteropneustidae), *Silurus triostegus* (from family Siluridae), and *Liza abu* (from family Mugilidae).

Birds:

Although the area can be characterized as having good habitat diversity there is high disturbance caused either by the human activities or the area being open and close to the street that may have caused the absence of many birds during the survey. The existence of some Sand Martins *Riparia riparia* might indicate the presence of flying insects over the area. Most of the birds that were observed were crossing over the site.

Relationships among the organisms and their environments:

Good water quality due to fresh water and oxygen concentration was high with clear water. High oxygen led to a higher pH value (but still within Iraqi limits). Submerged plants were dominating in most of the site. The dominating plants had acicular leaves, like *Ceratophyllum demersum* and *Potamogeton pectinatus*, which are adapted to water movement (waves). Water being fresh, also helps those species to grow. Furthermore, the leaves give more area for photosynthesis, therefore possibly increasing the dissolved oxygen concentration. Also submerged plants provide shelter and food for some fish and other species (Al-Saadi and Al-Mayah, 1983). There are terrestrial plants on the edge of the site near the paved road, which can provide appropriate environment for some birds. According to PTI, water quality was good and there are some benthic macroinvertebrate observations that support the water quality being good: dominance of the shrimp, good richness and moderate diversity and the absence of Blood Midges.

There was a presence of Oligochaetes in the area that had mud substrate (the suitable substrate for them). Fish results indicated an improvement in water quality due to the absence of two predators (*Siliurus triostegus* and *Heteropneustes fossilis)*. The availability of submerged plants and high oxygen allowed for the dominance of plant-eating species (Herbivorous fish) like *Barbus luteus* (locally called Hemri) and *Carassius auratus* (locally called Karssen). Although the area is perfect for several bird species like Waders, yet they were rather few most likely due to human disturbance as the site is close to the road. The recorded

species were crossing over the site. Some Sand martins *Riparia riparia* that feed on flying insects were found. Their population also indicated that they are relatively few compared to other sites. Total phytoplanktons number indicated that the environment is oligotrophic. Also, the chlorophyll content tended to be oligotrophic and this maybe due to the shortage in organic materials as well as most of the identified species were edible, which increases grazing by zooplankton. *Cocconeis placentula* var. *euglypta* was the dominant pennate diatom, which is known to prefer relatively high pH as confirmed by pH results of this site compared to other sites.

Conservation status:

The main diatoms and phytoplankton species recorded here were common in Iraq's southern marshlands. The water quality according to the total count was oligotrophic to slightly mesotrophic. Most of the recorded benthic macroinvertebrates species are common in Iraq. The dragonfly *Hagenius* sp. is found exclusively in this site. This genus is known from the eastern United States and southeastern Canada and only one species known as the Dragonhunter was recorded there. Further identification work is recommended to see if the species found in HAB-CM28 is a new species or not. All the dominant plants are common, *Hydrilla verticillata* is an exotic plant, *Potamogeton perfoliatus* is mentioned in the Flora of Iraq (Townsend and Guest, 1980, Vol. 8, p23) as rather rare in Iraq, only found once in the steppe region and in a few places in the desert region but recently this plant has spread in the wetlands of Iraq. *Aeluropus lagopoides* is a native plant in Iraq (Townsend and Guest, 1968). All the identified fish species are common in Iraq's water particularly the southern marshlands. No birds of conservation status were found over this area possibly because of the high human disturbance.

Management requirements:

It is recommended to reduce the human disturbance and target the local community with educational and awareness programs. For benthic macroinvertebrates, it is recommended to conserve this site due to the presence of the dragonfly *Hagenius* sp. which was found exclusively in this site and due to its limited density. The site would also benefit from more water. To note, fresh water from the Tigris River (more clean water) in a good amount would be very useful to make this site healthier, e.g. to support the existence of specific organisms that provide food for fish and birds or to support the diversity and richness of phytoplankton species, plant …etc.

Central Marshes, Abu Zirig area (Close to Al-Fuhood Town) HAB_AZ_1

N 30˚59'4.8" E 46˚46'30.1"

Plate 14: Survey Site HAB_AZ_1

Site description:

The major habitat is reed bed (*Phragmites australis)* and there are small open water areas between the reed beds. This area is adjacent to the street on the south, in addition to the soil embankment of the river (which is adjacent to the area and includes openings that feed the marsh with water) from the west. There are date palm (*Phoenix dactylifera)* trees on the river soil embankment. This area is considered as a buffalo grazing area. Also the people collect reed (cut reed) for buffalo feeding and manufactured materials. The area is close to Al Fuhood city.

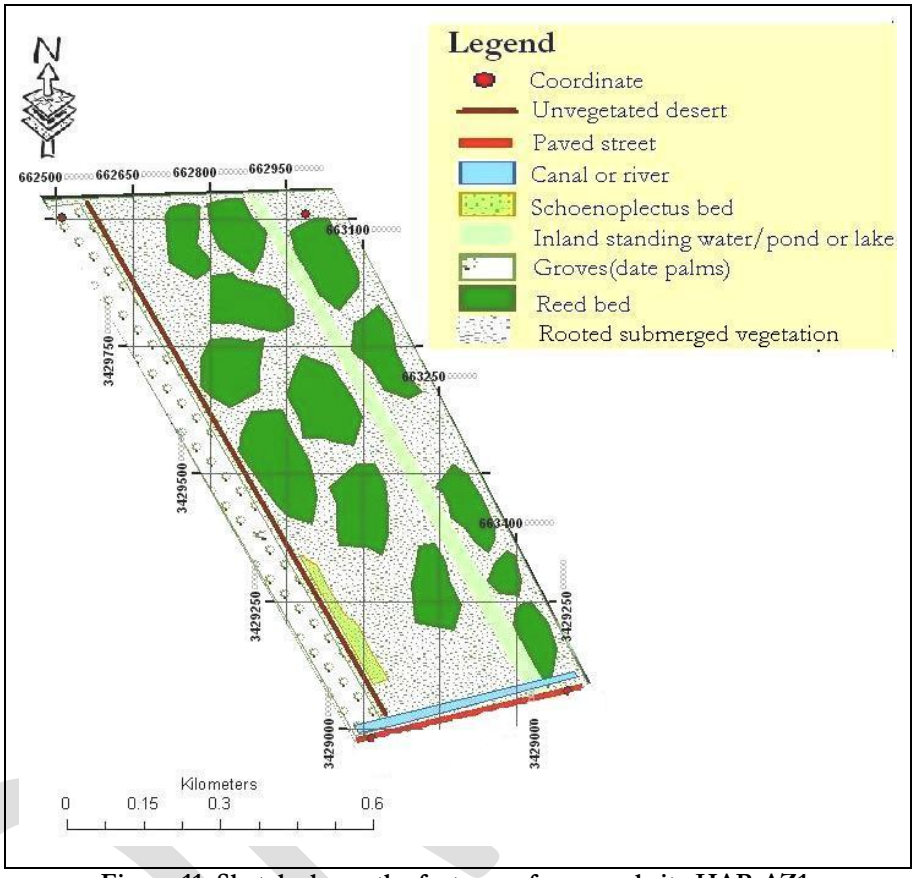


Figure 11: Sketch shows the features of surveyed site HAB-AZ1.

Water Quality:

The physical measurements and sampling were done at 12:30 pm on 15/6/2008. The air temperature was 34.5˚C and the water temperature was 26.6˚C. The water depth was 1.2m. The electrical conductivity was 1389 µs/cm. The salinity was low (0.5 ppt) and the water source of this site is from the Gharraf River, a branch of the Tigris branch. A moderate value was recorded for dissolved oxygen (6.3 mg/l) in this site due to low turbidity and low salinity (which is an obstacle to dissolved oxygen) (Maiyza and Said, 1989) and likely also due to wind action. The pH of this site was slightly alkaline (pH 8.2) because of the buffering ability resulting from carbonates and bicarbonates (Stirling, 1985; Al- Mousawi and Hussain, 1992). The turbidity was 0.22 NTU, TOC was 3.89 % and chlorophyll-a was 2.89 mg/m^3.

Phytoplankton:

Total phytoplankton count: 507.2 x 10^{3}cell/L. Species number: 61

The dominant phytoplankton group was Bacillariophyta with 439.8 x 10^{3}cell/L. Bacillariophyta was represented by 44 species (5 taxa central and 39 taxa pennate). The centric diatoms were dominated by *Cyclotella meneghiniana*, *Cyclotella atomus*, and *Cyclotella stelligera*. The pennate diatoms were dominated by *Achnanthes minutissima* and *Amphora veneta.*

Benthic Macroinvertebrates:

Total density of benthic macroinvertebrates in this site was 156 individuals/m², dominated by the larvae of the narrow-winged damsels, *Ischnura* sp. *2* followed by the shrimp, *Caridina babaulti basrensis* and the pouch snail, *Physa acuta,* respectively. According to the Pollution Tolerance Index, water quality in this site was good. This could be confirmed by the presence good water quality indicators such as the mayfly larva *Procloeon* sp. 1 with a relatively good densitiy (See Index V, Table 2) as well as the relatively good diversity, richness, and evenness for the whole site (See Index V, Table 3 and Figure 13), and water quality measurements recorded for this site. The presence of the worm *Tubifex tubifex* and the blood midges is probably due to the presence of optimum benthic habitat for this species, characterized by the soft, muddy bottom and the organic matter available. In addition, the presence of a relatively good density for gastropods such as *Lymnaea auricularia*, *Bellamya bengalensis*, and *Physa acuta* is probably due to the position of one of the four replicates during sampling, which was near the main canal that feeds the site which was closest to the water source from the Gharraf River where the gastropods are abundant.

Plants:

The reed (*Phragmites australis)* was the most dominant plant (50%) in this site, which are harvested by the locals. The area where buffalo are grazing occurs is close to Al Fuhood city. This area shows the effects of the grazing by being filled with the thick lower part of the reed stems. Also, there are cultivated palm trees (*Phoenix dactylifera)* near the site. The density of the submerged plants was low, the total number of species was ten, two of them mentioned above and the others as follows: *Alhagi graecorum*, *Ceratophyllum demersum*, *Cressa cretica*, *Hydrilla verticillata*, *Najas marina*, *Salvinia natans, Schoenoplectus litoralis* and *Typha domingensis*.

Fish:

This shallow area with low water current and freshwater is a good habitat for Cyprinidea to spawn. The fish present in this site were *Aspius vorax, Barbus luteus, Carassius carassius* (from family Cyprinidae), *Silurus triostegus* (from family Siluridae), and *Liza abu* (from family Mugilidae).

Birds:

In previous visits to this site, higher bird diversity and larger individual species populations have been seen than occurred for this survey, but the decrease might be attributed to human disturbance at the time of the survey or to some other accidental factor. The occurrence of Little Grebe *Tachybaptus ruficollis* may be related to the availability of shelter and food resources, also to the clear clear that is good for fishing by this species. This was also the same case with the high number of Herons.

The absence of Waders was because of the lack of their typical habitat (mudflats and unvegetated water margins). But the site does form the typical habitat for Moorhen *Gallinuylua chloropus* with dense reed beds that face open water. Some Slender-billed Gulls *Larus genei* were observed foraging over the surface of the water, searching for the small fish.

Relationships among the organisms and their environments:

Water quality was good. The water was clear with dissolved oxygen concentrations relatively high and moderate water depth according to marshes (Yuaqub and Salman, 1992, cited in Hussain, 1994, 299 pp). Phytoplankton diversity was less compared to other sites. Total phytoplankton count indicated that water was oligotrophic. Chlorophyll-a concentrations tend to be mesotrophic (Kassim, 2005). Dominant species are *Cyclotella* and *Achnanthes* which indicated organic pollution as confirmed by the TOC results. The majority were emerged plants such as reed *(Phragmites australis)* in the form of scattered communities covering about 50 % of the site. Reed was cut by people to use it as fodder or for manufacture. Cutting stimulated reed to grow to compensate the missing green parts, therefore it needs more nutrients and

thus competing with phytoplankton for nutrients and this may support the result of the low phytoplankton count in the area. Submerged plants are less dense which may be due to boat, buffalo and water movement in the area. According to the PTI, water quality was good, supported by the appearance of Mayfly larva as well as the good benthic diversity. Oligochaetes and Blood midges were present (few) due to the fact that the ground was muddy and suitable for these species. Results showed that water characteristics were good as there was dominance of Herbivore fish and this showed the good WQ compared to Chibaish area (CM). The area was suitable for birds, but the low bird diversity might be due to human (hunting) and buffalo disturbance as the site was close to Al-Fhood town. The presence of sand martin *Riparia riparia* indicated by the flying insects and benthic results suggests the presence of Anopheles mosquitoes in the area. The presence of gulls suggests that small fish are present in the area.

Conservation status:

The phytoplankton species at this site were common, total count and chlorophyll-a concentrations indicated oligo-mesotrophic water quality. All the identified benthics species were common in Iraq's water. While *Cressa cretica* is native in Iraq, all other identified plants were common in Iraq but *Hydrilla verticillata* is an exotic species. In fact, this species is not mentioned in the Flora of Iraq (Townsend and Guest, 1985, Vol.8, p2). All the fish species that were observed are common in the Iraq's southern marshlands. This area is good spawning ground for many Cyprinidae fish.

This site harbors some threatened and Conservation Concern bird species: the conservation concern Little Grebe *Tachybaptus ruficollis* (the Iraqi subspecies) and the conservation concern Slender-billed Gulls *Larus genei*

Management requirements:

This site needs an increase in water levels to a lesser degree rather than other sites in the survey. Water regulators are needed to better controlling the water level in this site. To reduce human disturbance, it is recommended to target the local community with educational and awareness programs.

Central Marshes, Abu Zirig area (Close to Al-Fuhood Town) HAB_AZ_2

N 31°0.0'53.5" E 46°41'18.4"

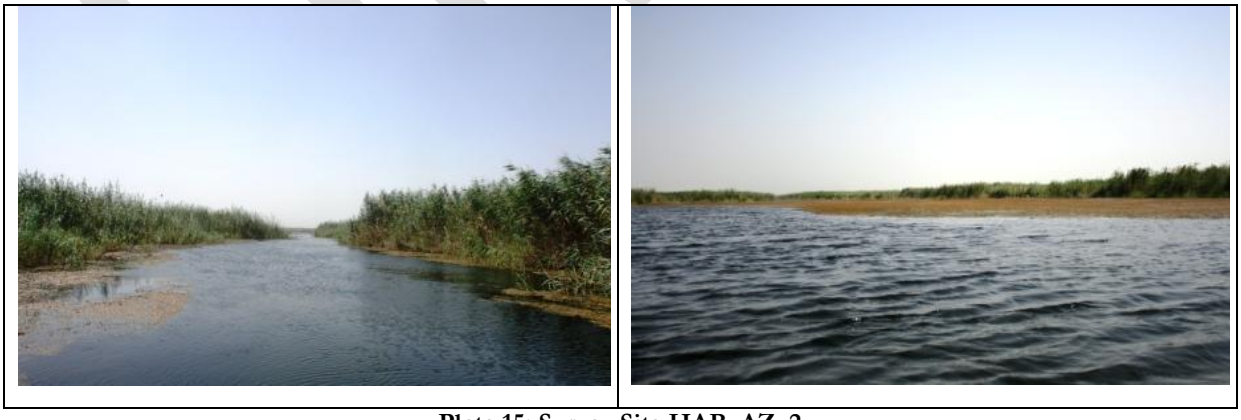


Plate 15: Survey Site HAB_AZ_2

Site description:

This is a water passage (canal) with a depth of about 2m, surrounded on two sides by reeds (*Phragmites australis*) that form the borders of the canal. The height of the reed found in this site was about 2-3 m above the water surface. This canal extends from roughtly north to south. There are areas close to the reed with dense and decayed (at the surface) submerged plants. Also there is a narrow area in the middle

(where the central current of canal runs) without plants and deeper than the rest of the area. This area is used for breeding by some birds on the submerged plants.

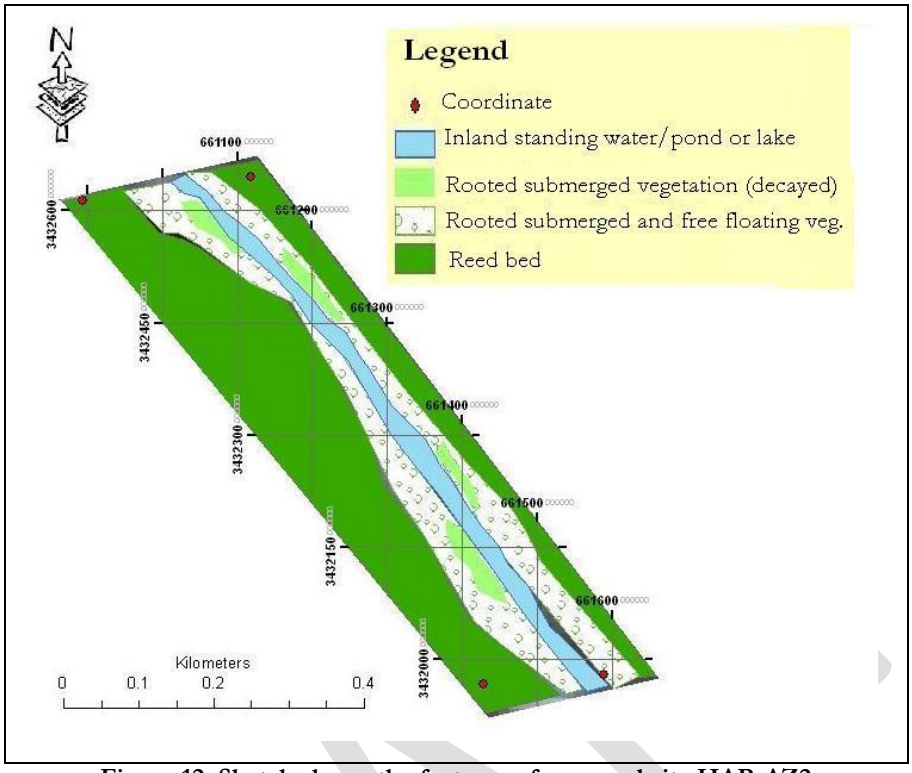


Figure 12: Sketch shows the features of surveyed site HAB-AZ2

Water quality:

The measurements were taken at 8:00 am, on 15/6/2008. While the air temperature was 30 ˚C, the water temperature was 25˚C with a depth of 2 m. The electrical conductivity was 1388 µs/cm and the salinity was 0.5 ppt. The water supply of this site comes from the Gharraf River, a branch of the Tigris. The result for pH was slightly alkaline (pH 7.9). This is a clear feature in Iraqi waters (Al-Zubeidy, 1985; Al-Ghafly, 1992, Ghani, 1996). The low value of pH (compared with the previous site) could be due to lower dissolved oxygen (but the inability to measure dissolved oxygen concentrations was caused by a malfunctional multimeter) and an increase in organic materials (Brown, 1980). The turbidity was 0.24 NTU, TOC was 2.17%, and chlorophyll-a was 1.075 mg/m^3.

Phytoplankton:

Total phytoplankton count: 786.6 x 10^{3}cell/L. Species number: 60

The dominant phytoplankton group was Bacillariophyta with 757.5 x 10^{3}cell/L. Bacillariophyta was represented by 48 species (4 taxa central and 44 taxa pennate). The centric diatoms were dominated by *Cyclotella meneghiniana*, *Cyclotella kuetzingiana*, *Cyclotella atomus*, and *Cyclotella stelligera*. The pennate diatoms were dominated by *Navicula radiosa, Gomphonema olivaceum, Fragilaria ulna, Cymbella turgid, Nitzschia palea, Nitzschia gracilis,* and *Nitzschia obtuse.*

Benthic Macroinvertebrates:

Total density of benthic macroinvertebrates in this site were 142 individuals/m^2, dominated by the Planorbid gastropod, *Gyraulus* followed by the shrimp, *Caridina babaulti basrensis* the narrow-winged damsels, *Ischnura* sp 2, and the pygmy backswimmer, *Neoplea* sp., respectively. Pollution Tolerance Index in this site indicated fair water quality and the dominance of the Planorbid gastropod *Gyraulus* suggested

organic enrichment in the sediments. The results obtained from the Pollution Tolerance Index can be confirmed by the relatively good diversity for the whole site (See Index V, Table 3 and Figure 13).

Plants:

This site has a small water passage surrounded by marsh with a high density of tall reeds (*Phragmites australis).* The canal had only submerged plants (with only a narrow area in the middle without submerged plants). This area is used for breeding by some birds on the submerged plants. To note, five plant species were recorded in this site, all of them were aquatic and can be divided into two groups: 1) emergent (*Phragmites australis* and *Typha domingensis)* and 2) submerged *(Ceratophyllum demersum, Hydrilla verticillata* and *Potamogeton lucens).*

Fish:

This was a very good area with fresh and moving water, with different shallow and deep water habitats. It was the only area in the southern marshlands that appears to support *Barbus xanthopterus* (called locally Kattan) but its numbers are decreasing based on past observations. This area can be considered as important to Kattan. Other fish present in this site included: *Aspius vorax, Barbus luteus, Carassius carassius*, *Cyprinus carpio* (Cyprinidae), *Silurus triostegus* (Siluridae), and *Liza abu* (Mugilidae).

Birds:

It is good area with a rich diversity of birds. Also multiple plant cover provides a variety of different different habitats.

This area is known to be a stable breeding area for the threatened Marbled Duck *Marmaronetta angustirostris.* During this survey four individual birds were observed. Marbled Duck occurs regularly in this site during winter and summer where it breeds in summer (Salim, 2004a). The availability of food resource (fish), suitable shelter and clear water for fishing provide good habitat for the many (33) Little Grebe *Tachybaptus ruficollis* that were observed in various areas over this site. Furthermore, there were considerable numbers of various species of Herons either foraging or hiding on the edges of the dense reedbeds.

Waders were observed at this survey due to the suitable environment and habitat for breeding such as: White-tailed Lapwing *Vanellus leucurus (Chettusia leucura)*, Red-wattled Lapwing *Vanellus (Hoplopterus) indicus* and Spur-winged Lapwings *Vanellus (Hoplopterus) spinosus.*

This area harbored considerable numbers of Coot *fulicat atra* (including juveniles), Moorhen *Gallinuylua chloropus* (including juvs.), and Purple Swamphen *Prophyrio prophyrio*, wherever there was typical habitat cover and rich food resource. Some Wader species were also observed.

The presence of Collared Pratincoles *Glareola pratincola* might indicate that there was an area of dry land nearby suitable for breeding, as this bird flies over the area to catch flying insects. Also, there were considerable numbers of Slender-billed Gulls *Larus genei* and Terns over the water.

With regards to the Passerines, some good diversity in species (comparing with the other sites) was also observed, such as: more than 250 Sand Martin *Riparia riparia*, some Hooded Crows *Corvus[corone] cornix*, some Crested Lark *Galerida cristata* (these were foraging on dry land beyond the edges of the area), White-checked Bulbul *Pycnonotus leucogenys*, Graceful Prenia *Prinia gracilis*, Basrah Reed Warbler *Acrocephalus griseldis*, Iraq Babbler *Turdoides altirostris*, Common Babbler *Turdoides caudata*, and House Sparrow *Passer domesticus*.

Relationships among the organisms and their environments:

Water quality was considered good in this site. The water was clear and two meters in depth. Total number of phytoplankton and chlorophyll concentration indicated that the water was oligo-mesotrophic. The pennate diatoms were the dominant group indicating the presence of organic materials. The canal

centre (2m depth) had few or no plants. Submerged plants grew densely on the sides (edges) of this deep canal. The surface parts of these plants that were exposed to dryness were partially decomposed. Dominant submerged species were *Ceratophyllum demersum* and *Hydrill*a sp. and, to a lesser occurrence, *Potamogeton lucens*. Reed (*Phragmites australis)* was higher than in the Chibaish area sites (CM) as this area had never been dried. The PTI indicator showed fair water quality. The presence of *Gyraulus* sp. indicated organic pollution in the sediment. PTI results were supported by the good benthic diversity in the area. The fish community indicated that water quality was good as well since the *Barbus xanthopterus* seen at the site are a native fish and very sensitive to poor water quality. Also, the dominance of the plant-eating (Herbivorous) species was an indication of a healthy fish community, which in turn indicates good water quality (Hussain, *et al.*, 2008).

During the summer survey for the Key Biodiversity Areas (KBA) program that preceded this Habitat Survey, the area was characterized by high bird diversity and population. Some of the recorded bird species were not observed in the previous sites and that were observed in this area during the KBA survey had returned to other dry areas or environments with tree and shrub habitats in nearby areas such as Doves, Wood Pigeons *Columba palumbus*, White-cheeked Bulbul *Pycnonotus leucogenys*, and other Passerines. The presence of the Grebes species is due to the suitability of the environment and the water purity for feeding and the availability of good shelters for breeding. The area was important and suitable for breeding of Marbled Teal *Marmaronetta angustirostris*, which is threatened and was also found consonantly during the previous surveys in this area (Salim, 2004 A and B). There were considerable populations of Herons in the area who depend on the presence of fish. High populations of Coot, Moorhan and Purple Swamphen, which breed in the same place due to suitable shelters (reed beds), were seen. Also considerable populations of Waders were observed in this survey due to the suitable environment and habitat for breeding such as: White-tailed Lapwing *Vanellus leucurus (Chettusia leucura)*, Red-wattled Lapwing *Vanellus (Hoplopterus) indicus* and Spur-winged Lapwings *Vanellus (Hoplopterus) spinosus*. These birds breed in this area regularly (Salim, 2004a & b). The noticeable presence of fish-eating birds with population counts suggests the good fish resources in the area. There was also a high population of Sand Martins *Riparia riparia* (feeding on flying insects), and Barn Swallow *Hirundo rustica* that was not observed in most of the previous sites.

Conservation status:

Common phytoplankton species were present, although they were few. The total phytoplankton count and chlorophyll-a concentrations indicated oligo-mesotrophic water quality. The identified macroinvertebrates were common in Iraq (there are few references on the conservation status of benthic macroinvertebrates in Iraq). All plants species are common in Iraq, but *Hydrilla verticillata* is an exotic species. All the sampled fish are common in Iraq but the native fish *Barbus xanthopterus* (Kattan) has become less common and can be considered a symbol of this marsh. It is important to keep a proper water flow to support this kind of fish. This site harbored good bird diversity, which included some threatened or conservation concern species such as: Marbled Duck *Marmaronetta angustirostris,* Little Grebe *Tachybaptus ruficollis* (the Iraqi race), Purple Swamphen *Prophyrio prophyrio,* Hooded Crow *Corvus[corone] cornix* (the Iraqi race), Iraq Babbler *Turdoides altirostris* & Common Babbler *Turdoides caudate, and* Basra Reed Warbler *Acrocephalus griseldis.*

Management requirements:

There is a significant water pollution problem here that requires some form of water treatment to improve conditions and help increase the diversity and richness of species at the site. Also to reduce the negative effects of human disturbances, it is suggested to target the local community with educational and awareness programs and establish some water regulators to enable better water control. Lastly, it would

be useful to study the Kattan stock in this area more to determine what their overall status is. It may be necessary to add fingerlings through artificial breeding to improve fish stocks at the site.

Conclusions

The field survey was conducted to investigate the ecological characteristics and habitat structures at representative sites. All the selected sites were within the Central Marshes - some of them were in the Chibaish area (CM sites) and the others were in the Abu Zirig area (AZ sites).

The sites visited in November 2007 proved to have different characteristics from their status on the 2006 satellite image that was available at that time and did not match the habitat classification scheme that was initially developed, thus a new satellite image was acquired and a modified habitat classification scheme was used in a survey that took place in June of 2008. This classification system proved to a better tool for identifying the individual habitats found within the survey sites but it should be noted that this recent classification system is still in its preliminary stages and will need to be updated or modified in the future. This survey focused on the characterization of the various types of habitats that can be gained through a limited series of monitoring sites in the Central Marshes of southern Iraq and by describing biodiversity as well as water quality. The classification system includes six major habitat classes and each one of them includes one or more sub-classes (see page 13). A complete list of the types of habitats actually seen in the survey are listed by site in Index I.

Some of habitat types are dominant in the marshlands such as "Rooted submerged vegetation" (2.4.2); sub-categories of "Helophytic vegetation" (3.1.1) ("Reed beds" (3.1.1.1) and "Reed mace beds" (3.1.1.2)); "Free floating vegetation" (2.4.1) or "Unvegetated river and canal" (1.1). While others are dominant at the margins of marshes (or in the dried marshes) such as: "Desert shrubs" (4.1), "Unvegetated desert" (4.2) or "Sparsely vegetated land" (6.3).

The water quality was poor at the sites HAB_CM2 and HAB_CM13, fair at the sites HAB_CM5, HAB_CM10, HAB_CM11 and HAB_CM12, and good at the sites HAB_CM28, HAB_AZ1 and HAB_AZ2. The improvement in the latter three sites appears to be related primarily to the access to better water quality via a direct connection to the Tigris River through the Gharraf River. This was supported by result of physical and chemical measurements of water in addition to the result of Phytoplanktons, Benthic Macroinvertebrates, Plants, Fish and Birds which also supported the result of water quality. Some of the sites (HAB_CM25, HAB_CM26 and HAB_CM27) were totally dry due to the decrease in water levels at the source (Euphrates River).

The water was brackish (Oligosaline) at all Chibaish area flooded sites (except HAB_CM28) where there is no circulation for the water and low water discharge from the source (the Euphrates River) as well as the low water depth and high water evaporation, while the water at Abu Zirig sites and HAB_CM28 was fresh due to fresh water source of the Gharraf River. Overall, the water level and water quality are not good the Central marshes and need much better management.

Most of the identified Plants, Fish, Phytoplanktons and Benthics Macroinvertebrates are common in Iraq's marshlands. There were many important birds, some of them are globally threatened and either of conservation concern or Iraqi endemics.

According to the result of Phytoplanktons and Chlorophyll-a, the water is between Oligotrophic and Mesotrophic.

According to the result of Benthic Macroinvertebrates, there is a dragonfly species (*Hagenius sp.*) which was found only in HAB_CM2. We suggest more study on this species.

HAB_AZ1 and HAB_AZ2 are very important habitat for native fish in Iraq such as Kattan (*Barbus xanthopterus*) as these sites were considered as good spawning ground for many Cyprinidae fish. These sites are also suitable for birds. Also, the results of fish showed that the predators are dominant in the Chibaish area, which need real and practical solutions.

Recommendations

The recommended solutions for each site are listed at each site details under management requirements subject, but the recommended solutions for the whole area (National park area and the whole Central marshes) are as following: To restore the sites to its original and normal situation before the drying of these marshes. This means that it needs to restore all the ecological conditions that were present before the drainage of the area. Water quality and quantity highly affect biodiversity. The area probably needs an increase in water. Furthermore it needs to restore its fresh water sources coming from branches of the Tigris River in order to get better water circulation which would bring cleaner water to the area and decrease water salinity. One of the suggested ways to increase the water level and improve the water quality, is to adopt the plan (through petitioning the government to adopt such plan) to create an inlet from the northeastern area of the Central Marshes via the Btaira River (a branch of Tigris River in Missan governorate). In this way, the water quality will improve and the ecosystem will be healthier.

Since the source of pollution is the accumulation of sewage and agricultural runoff coming from the waters of the Euphrates (which leads to the concentration of pollutants), it is suggested to establish water treatment plants at the points of sewage discharging in the cities or towns located on or near the water sources of these marshes and restore the old hydrological system with these openings functioning as inlets and others as outlets (recycling the water). Increasing of the water level or depth and establishing some water regulators to control water, can limit the growth of reed (*Phragmites australis*) and retain the normal status and biodiveristy of this area. In addition, it can enhance the original flora and fauna to return to this area. It is also recommended to study the status of Kattan stock and, if necessary augment their population by adding fingerlings through artificial breeding. Also it is recommended to reduce human disturbance and target the local community with educational and awareness programs.

This study attempted to create and test out a classification system for the habitats of the southern marshlands of Iraq. However, the recent habitat classification system is ongoing and still remains a proposal that could be updated or modified in the future. It is recommended to continue the study of marshland habitats in other study areas and update the classification system. Also, this work attempts to explain the relationships between the habitats and their flora and fauna, so it's recommended to study each type of habitats in detail and explore the specific environments that support the diverse flora and fauna of the marshlands. Remote sensing technology has proven to be an important tool in assessing the changing marshland habitats in the Iraqi marshlands and more investments should be made to use this technology in monitoring the restoration process of these areas.

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Index I: Habitat classes identified in each site with general description of each site.

Central marshes (CM)	Site code	Types of habitat	General description of the site
	HAB-CM-2	2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 3.1.1.2 Helophytic vegetation (reed mace beds) 2.4.1 Free-floating vegetation	This is an open water area that is adjacent to the street on the east and surrounded by reed beds in the other directions, also there are groups of reeds which are distributed randomly inside the area. There are small groups of Typha (reed mace beds) and *Schoenoplectus litoralis* close to the street (in the east side of area). The depth of water is low. The ground of open area is covered by submerged plants and most of them are decayed on the surface.
	HAB-CM-5	1.1 Un-vegetated River and Canal 2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 3.1.1.2 Helophytic vegetation (reed mace beds) 2.4.1 Free-floating vegetation	Similar to CM2 (open water area with randomly distributed reed groups). Also there is a street adjacent to the area from the east and there are small Typha groups (on the eastside of the area). There is small areas beside the street which are without submerged vegetation and deeper than the rest of area. The submerged plants are more density than Cm2 and they are decayed too.
	HAB-CM-10	2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds)	This is Al Baghdadia lake (also known as a "Bargah"). It is a large open water area with submerged vegetation and surrounded from all directions by reeds (reed beds). There are small groups of reed (known as "Tahala") in the middle of the Bargah. Fishing is done in the area by nets & electroshock.
	HAB-CM-11	2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 2.4.1 Free-floating vegetation	This is considered as an extension to Abu Sobatt canal, which is considered an inlet to Al Baghdadia lake (Bargah). This canal divides the area into two sides (east & west) but the habitats are the same in the two sides of the canal (river), which are small open water areas with high density submerged plants and surrounded by reed and Typha from all directions. All submerged plants are decayed on the surface of water. The canal (river) is bordered by a line of Typha followed by a line of reeds on both sides. This is a buffalo grazing area. There are many of fishing nets in the moving water of the canal.
	HAB-CM-12	2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 2.4.1 Free-floating vegetation	Open water area (known locally as "Bargah") with submerged vegetation in different densities. It's surrounded on all sides by reeds (reed beds) and also there are groups of reeds inside the area the Bargah. Most of the submerged plants are decayed on the water surface. This area was burned before and the ground was brownish and includes spots with a low density of submerged plants.
	HAB-CM-13	2.3 Amphibious communities 2.4.1 Free-floating vegetation 3.1.1.1 Helophytic vegetation (reed beds) 4-2 Un vegetated desert 6-3 Sparse vegetation	The paved street divide this area into two sides: The west side is an aquatic habitat with reed beds and a water passage close to the street, also there is an area of high ground to the southwest with terrestrial plants (*Tamarix* sp.) and aquatic plants (dry *Phragmites australis*) and the soil is wet indicating that this is a seasonal marsh. The east side includes three types of habitat, 1st (in the north) are reed beds & reed mace beds, 2nd (in the middle) is dry land without plants and use by the local population, and 3rd (in the south) is terrestrial vegetation. This area includes high buffalo breeding activity.

	HAB-CM-25	3.1.1 Helophytic vegetation (reed beds) 4-1 desert shrubs 2.4.1 Free-floating vegetation	This is a dry area with a mix of terrestrial plants (to the southwest) and aquatic plants (to the northwest and north east). There is a small area that still contains a little water (5-20 cm depth), so the area is considered a seasonal marsh. There is a paved street adjacent to the area on the west. There are many people who live along the street and breed buffalo. Note: This area was determined by two coordinates to the west and the description is about 1 Km toward the east.
	HAB-CM-26	5.1 Un-vegetated desert 3.1.1 Helophytic vegetation (reed beds) 4-1 desert shrubs	This is a dry area (seasonal marsh) with *Phragmites* that was dry and also terrestrial plants (*Tamarix* sp. & *Suaeda* sp.). There is a paved street to the east of area and as you move northward, the plants decrease and the area becomes more desert-like.
	HAB-CM-27	3.1.1 Helophytic vegetation (reed beds) 4-1 desert shrubs	This is a dry site (seasonally wet) that is located to the west of a soil embankment that extends beside the area from north to south. The entire area is covered by low density dry reeds intermixed with terrestrial vegetation (*Tamarix* sp. & *Suaeda* sp.).
	HAB-CM-28	2.4.2 Rooted submerged vegetation 3.1.1.2 Helophytic vegetation (reed mace beds) 4-1 desert shrubs 2.4.1 Free-floating vegetation	The main part of this area is open water with rooted submerged vegetation and surrounded by reed mace beds (*Typha domingensis*) from the east and west. From the north there are reed beds. From the south there is a small canal and the street. There are small soil embankments to the southeast of the area. The area is used for buffalo grazing.
Abu Zirig (AZ)	HAB-AZ-1	1.1 Un vegetated River and canal 2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 2.4.1 Free-floating vegetation	The major habitat here is reed beds and there are small open water areas inside the reed beds. This area is adjacent to the street on the south, to the soil embankment of the river, which is adjacent to the area and has openings that feed the marsh with water: from river to marsh, are on the west side of the marsh. There are date palm trees on the soil embankment. This area is consider a buffalo grazing area and also the people collect the reed (cut reed) for buffalo feeding and manufacturing of goods. The area is close to Al Fuhood city.
	HAB-AZ-2	1.1 Un-vegetated River and canal 2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds) 2.4.1 Free-floating vegetation	This is a water passage (canal) with a depth of about 2 meters and width of about 25-30 meters, bordered on both sides by reeds that achieve heights of about 2-3 meters above the water surface. The canal extends from north to south. There are areas close to the reeds with dense and decayed submerged plants, and there is a narrow area in the middle of open, moving water without plants and deeper than the rest of canal. This area is used for breeding by some birds on the submerged plants (the tops of these plants are emerged above the water surface due to the decreasing of water level).

Index II: Water Quality Results for the Nov 2007 survey

The following are water quality data of the seven sites selected in National Park area for the first habitat survey in November 2007.

Habitat Project (Summer- 2007)								
Parameters		CM-2	CM-5	CM-10	CM-11	AZ-4	AZ-2	AZ-1
Air Temperature (°C)		28	28	23	19	27	31	31
Water Temperature (°C)		21.8	21	21	20.1	20.6	21.6	21.9
Water Depth (m)		1.15	1.1	0.9	0.9	2.0	1.2	1.5
Electric Conductivity (µS/cm)		2930	4200	4850	4420	1094	1233	1051
Salinity (ppt)		1.4	2.1	2.5	2.3	0.3	0.4	0.3
Dissolved Oxygen (mg/l)		3.39	1.03	2.1	1.5	2.4	2.2	2.9
pH		7.61	7.73	7.70	7.70	7.83	7.73	7.8
Secchi Disk (cm)		1.15	1.10	0.9	0.9	2.0	1.2	1.5
Turbidity (NTU)		2.21	3.60	3.78	2.40	3.84	2.40	4.93
Chlorophyll-a (mg/l)		1.87	9.48	5.61	3.47	0.66	0.66	0.66
TSS - (mg/l)		3.2	8.85	5.8	2.6	3.25	1.8	3.9
P-PO4-3- µg /L		1.14	1.14	1.70	1.70	0.85	0.57	0.57
Sulphate - SO4 -mg/l		885.87	1163.20	1205.87	1141.87	427.20	485.87	507.2
Alkalinity- CaCO3 - Mg/l		172	168	182	196	108	131	106
Major Ions	CaCO3- Mg/l	862.28	1167.05	1342.21	1215.09	410.37	462.42	409.87
	Ca - mg/l	163.73	177.35	197.79	209.82	103.81	116.63	105.21
	Mg- Mg/l	110.17	175.96	206.11	167.93	36.72	41.59	35.75
	CL - Mg/l	461.10	718.21	870.09	770.32	96.29	115.65	98.28

Index III: Water quality data of the second habitat survey in June 2008.

#	Parameter	HAB_CM_2	HAB_CM_5	HAB_CM_10	HAB_CM_11	HAB_CM_12	HAB_CM_13	HAB_CM_28	HAB_AZ_1	HAB_AZ_2
1	Air Temperature (°C)	24.5	31	26	27.1	39.4	35.5	35.5	34.5	30
2	Water Temperature (°C)	24.1	24.9	22.5	23	27.3	26	27	26.6	25
3	Water Depth (m)	0.96	0.57	0.6	1.1	0.37	1.1	1.1	1.2	2
4	Electric Conductivity (µS/cm)	2980	3320	4310	3870	4620	3400	1235	1389	1388
5	Salinity (ppt)	1.4	1.6	2.2	2	2.4	1.7	0,4	0.5	0.5
6	Dissolved Oxygen (mg/l)	2.37	4	4.81	3.43	8.51	3.18	9.11	6.3	-
7	pH	8.06	8.23	8.2	8.11	8.07	8.01	8.53	8.2	7.9
8	Turbidity (NTU)	0.78	0.22	0.46	0.56	0.78	2.63	0.38	0.25	0.24
9	Chlorophyll-a (mg/m^3)	3.55	4.375	0.885	5.295	12.21	7.72	1.845	2.89	1.075
10	TOC % (in particle)	1.88	1.93	2.16	2.68	1.90	8.63	2.58	3.89	2.17

Index IV: Phytoplankton Results from the June 2008 Survey

The following table provides phytoplankton population in selected sites:

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
CYANOPHYTA	*Anabaena* sp.			1				36.2			37.2
	Aphanocapsa sp.			1							1
	Arthrospira sp.							1	1		2
	Chamaesiphon sp.									1	1
	Chroococcus minor (Kützing) Nägeli 1849				18.1						18.1
	Chroococcus minutus						1	1			2
	Chroococcus turgidus (Kützing) Nägeli				9.1						9.1
	Gomphosphaeria aponina (Kützing 1836)				1	1			9.1		11.1
	Lyngbya aestuarii	18.1	1		1		1	18.1			39.2
	Lyngbya limnetica (Lemmermann 1898)							9.1			9.1
	Lyngbya sp.		1								1
	Leptolyngbya perelegans (Lemmermann) Anagnostidis & Komárek		1					18.1			19.1
	Merismopedia convolute (Brébisson)					1	1				2
	Merismopedia elegans						1	9.1			10.1
	Merismopedia glauca (Ehrenberg) Kützing, 1845	1		1			9.1				11.1
	Merismopedia tenuissima			1	1	9.1	1			1	13.1
	Microcystis aeruginosa (Kützning) Kützing 1846						18.1			1	19.1
	Oscillatoria acuminata (Gomont)							1			1
	Oscillatoria anguina									1	1
	Oscillatoria formosa							18.1	9.1		27.2
	Oscillatoria limosa		18.1	18.1			1	63.4			100.6
	Oscillatoria limnetica (Lemmermann 1900)	1	1	9.1	18.1	1	1	262.6	1	1	295.8
	Oscillatoria minima (Gicklhorn)			1						1	2
	Oscillatoria princeps (W. West & G.S. West)		1								1
	Oscillatoria tenuis (C. Agardh)		1								1
	Oscillatoria terebriformis (C. Agardh)		1	1			1				3
	Oscillatoria sp.									1	1
EUGLENOPHYTA	*Euglena gracilis*	1						9.1	1	18.1	29.2
	Euglena sp.							27.2	1		28.2
	Phacus gigas (Da Cunha)						1		18.1		19.1
	Phacus longicauda (Ehrenberg) Dujardin	9.1			9.1						18.2
	Phacus sp.		1	9.1		1	1	63.4			75.5
	Trachelomonas sp.	1							1		2
PYRRO PHYTA	*Glenodinium* sp.			9.1				9.1			18.2
	Peridinium cinctum (Müller)	1	1	9.1	18.1	9.1	1	126.8	18.1	1	185.2

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	Peridinium sp.	1			9.1	1					11.1
CHLOROPHYTA	*Ankistrodesmus bibraianus*									18.1	18.1
	Ankistrodesmus falcatus (Corda) Ralfs					1			1	1	3
	Botryococcus brunii									1	1
	Botryococcus protuberans (W. West & G.S. West)	1								1	2
	Bulbochaete sp.				1						1
	Closterium sp.	1	1		1			27.2	1		31.2
	Coelastrum astroideum (De Notaris)				27.2			18.1			45.3
	Cosmarium botrytis			1							1
	Cosmarium granutum	1									1
	Cosmarium leave	1									1
	Cosmarium subtumidum			1	1		1	1		1	5
	Desmidium sp.				1		1		1	1	4
	Euastrum insulare (wittr.) Roy			1	1		1				3
	Eudorina elegan (Ehren.)	1			244.5				9.1		254.6
	Kirchneriella irregularis (G.M. Smith) Korshikov		1	81.5		27.2		9.1			118.8
	Kirchneriella obesa (G.S. West) Schmidle	18.1		1			1		18.1	1	39.2
	Monoraphidium convolutum (Corda) Komárková-Legnerová			1			1			1	3
	Monoraphidium sp.								1		1
	Mougeotia elegantula (Wittrock)							63.4		1	64.4
	Mougeotia sp.	1		18.1		9.1	18.1	1		9.1	56.4
	Oedogonium sp.	9.1		1	9.1		1	9.1			29.3
	Oocystis sp.				1		1	1		1	4
	Ophiocytium bicuspidatum (Borge)						1				1
	Pandorina morum	1		1	1						3
	Pediastrum boryanum (Turpin) Meneghini								1		1
	Scenedesmus acuminatus (Lagerheim) Chodat				1						1
	Scenedesmus acuminatus var. tetradesmoides (G.M. Smith, 1916)				1						1
	Scenedesmus arcuatus var. platydiscus (G.M. Smith)				18.1						18.1
	Scenedesmus bijuga (Turpin) Lagerheim				1						1
	Scenedesmus quadricauda (Chodat)					9.1		1	1		11.1
	Staurastrum pilosum									18.1	18.1
	Staurastrum paradoxum							9.1			9.1
	Tetraedron minimum (A. Braun) Hansgirg			1							1
	Tetraedron regulare (Kützing)				1	9.1					10.1
	Tetraspora sp.				1						1
	Vaucheria sessilis					1					1
YTIA	*Aulacoseira granulata (Ehrenberg) Simonsen*	1									1

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	1979										
	Aulacoseira italica							1			1
	Aulacoseira jurgensii						1				1
	Aulacoseira varians							11.1			11.1
	Chaetoceros sp.						22.3	1			23.3
	Coscinodiscus divisus(Grunow)			1				1			2
	Coscinodiscus lacustris (Grunow)			11.1	22.3	1		1	22.3		57.7
	Coscinodiscus sp.						1				1
	Cyclotella atomus (Hustedt 1938)	55.6	111.3	44.5	111.3	55.6	1	55.6	222.6	55.6	713.1
	Cyclotella kuetzingiana (Thwaites 1848)	1	77.9			1		1	1		81.9
	Cyclotella meneghiniana (Kützing 1844)	22.3	22.3	33.4	501	33.4	33.4	89.1	89.1	33.4	857.4
	Cyclotella stelligera (Cleve & Grun. in Cleve) Van Heurck 1882			11.2			22.3		1		34.5
	Cyclotella striata (Kützing) Grunow	22.3	66.8	66.8	478.7	1	11.1	66.8	66.8	11.1	791.4
	Stephanodiscus astrea (Ehrenberg) Grunow				1				11.1		12.1
	Stephanodiscus sp.						1		11.1		12.1
BACILLARIOPHYTA / PENNALES	*Achnanthes biasolettiana (Grunow)*					1					1
	Achnanthes exigua		1		1		1	22.3	1		26.3
	Achnanthes hungarica (Grunow) Grunow		1								1
	Achnanthes lanceolata (Brébisson) Grunow in Cleve & Grunow						1	1			2
	Achnanthes minutissima (Kützing 1833)	77.9	22.3	44.5	144.7	22.3	22.3	66.8	77.9	55.6	534.3
	Amphipleura alata (Ehrenberg) Kützing			1	22.3	1	1	1	1		27.3
	Amphipleura pellucida				1			11.1			12.1
	Amphora coffeaeformis (C. A. Agardh) Kützing 1844	1			1		1	11.1			14.1
	Amphora ovalis (Kützing) Kützing 1844				1			22.3			23.3
	Amphora ovalis var. lybica									1	1
	Amphora pediculus	1		1			1				3
	Amphora perpusilla	1	1					1			3
	Amphora veneta (Kützing)	55.6	1		1	1			11.1		69.7
	Amphora sp.							1			1
	Anomoeoneis exilis				1					22.3	23.3
	Anomoeoneis sphaerophora							1			1
	Bacillaria paxillifer (Müller) Hendy 1951 (also known as Bacillaria paradoxa)	1	1	1	1		1	100.2	89.1	1	195.3
	Caloneis permagna (Bailey, 1850) Cleve, 1894				1			11.1	1		13.1
	Caloneis silicula (Ehrenberg) Cleve					11.1		1	1		13.1
	Campylodiscus clypeus (Ehrenberg) Ehrenberg ex Kützing							1	1		2

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	Cocconeis pediculus (Ehrenberg)	1	1				1		1	1	5
	Cocconeis placentula (Ehrenberg 1838)	1	1	1	1	1	1		11.1	1	18.1
	Cocconeis placentula var. euglypta (Ehrenberg) Grunow(1884)	1	1		1	1		44.5	22.3	100.2	171
	Cocconeis placentula var. lineata (Ehrenb.) Van Heurck (1880-1885)		1				1				2
	Cymatopleura solea (Brébisson) W. Smith 1851				1		1		1		3
	Cymbella affinis (Kützing)	1	1	22.3	11.1	1		1	11.1	1	49.5
	Cymbella affinis var. excisa				1			1			2
	Cymbella amphicephala var. intermedia					11.1	1				12.1
	Cymbella aspera (Ehrenberg) Cleve							1			1
	Cymbella cistula (Ehrenberg) Kirchner	1	1	1	1	1				1	6
	Cymbella cymbiformis				1						1
	Cymbella delcatula				1						1
	Cymbella microcephala Grunow in Van Heurck (1880)	11.1	1	1	11.1	33.4	11.1		1	22.3	92
	Cymbella pusilla (Grunow)	1			1		11.1	11.1	11.1		35.3
	Cymbella sumatrasis						1				1
	Cymbella tumida (Bréb.) Van Heurck		1								1
	Cymbella turgida (W. Gregory)		55.6			1					56.6
	Cymbella ventricosa (C. Agardh)	1			1		1				3
	Denticula sp.		1		11.1		1				13.1
	Diatoma tenue var. elongatum (Lyngbye)						1				1
	Diatoma vulgare (Bory 1824)							1			1
	Diploneis pseudoovalis						1	11.1	11.1		23.2
	Epithemia sorex (Kütz. 1844)	1	1	1				133.6	1	1	138.6
	Epithemia zebra (Ehrenberg) Kützing	1	1	22.3		1		100.2	44.5	1	171
	Epithemia zebra var. porcellus (Kützing) Grunow						1				1
	Epithemia zebra var. saxonica (Kützing) Grunov				1			22.3	1	1	25.3
	Eunotia arcus							1			1
	Eunotia alpina					1					1
	Eunotia formica							1			1
	Eunotia lunaris				1						1
	Eunotia pectinalis		1		1			1	1		4
	Eunotia pectinalis var. undulate							1			1
	Fragilaria acus var. radians	22.3	1	1	66.8	11.1	1	33.4	89.1	11.1	236.8
	Fragilaria brevistriata (Grunow)					1	1		66.8		68.8
	Fragilaria capitata (Ehrenb.) Lange-Bert. 1980	11.1					1	11.1	1	1	25.2
	Fragilaria construens (Ehrenberg)				1		1		22.3	1	25.3

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	Fragilaria fasciculata	1	1		1		1		11.1	22.3	37.4
	Fragilaria intermedia (Grunow)						1				1
	Fragilaria pulchella (Ralfs)		1	1	1		22.3	89.1	11.1		125.5
	Fragilaria ulna (Nitzsch) Lange-Bertalot	22.3	44.5		1	1	33.4	22.3	1	22.3	147.8
	Fragilaria ulna var. biceps (Kütz.)		1				1				2
	Fragilaria virescens				1						1
	Fragilaria vaucheriae (Kützing) Petersen	11.1			1	22.3	1	1	66.8		103.2
	Gomphoneis olivacea (Hornemann) P. A. Dawson ex R. Ross & P. A. Sims	1								11.1	12.1
	Gomphonema acuminatum (Ehrenberg 1832)				1					1	2
	Gomphonema turris (Ehrenberg)								1	1	2
	Gomphonema angustatum (Kützing) Rabenhorst (1864)				1						1
	Gomphonema constrictum var. capitata (Ehrenberg) Van Heurck		1		1	1	1	1	11.1	1	17.1
	Gomphonema gracile (Ehrenberg 1838) emend V.H.				1	1	1	1		1	5
	Gomphonema intricatum (Kützing)								1		1
	Gomphonema lanceolatum				1			1	1		3
	Gomphonema montanum						1	1			2
	Gomphonema olivaceum (Lyngb.) Kützing	1	77.9					1			79.9
	Gomphonema parvulum (Kützing) Kützing		1		1			1		1	4
	Gomphonema tergestinum (Grunow) Fricke				1			1	11.1		13.1
	Gyrosigma acuminatum (Kützing) Rabenhorst	1			1		1	1		1	5
	Gyrosigma balticum				1						1
	Gyrosigma peisonis (Grunow) Hustedt		1				1	1			3
	Gyrosigma spencerii (W. Smith) Cleve						1		1		2
	Hantzschia amphioxys (Ehrenberg) Grunow in Cleve & Grunow 1880	1					1	1	1	1	5
	Mastogloia braunii (Grunow)	1					1	55.6	11.1	22.3	91
	Mastogloia elliptica var. dansei (Thwaites) Cleve				1			11.1			12.1
	Mastogloia smithii (Thwaites ex W. Smith 1856)	1						1			2
	Mastogloia smithii var. amphicephala (Grunow 1880)			1	1					1	3
	Mastogloia smithii var. lacustris (Grunow 1878)	11.1	1	1	1	1	11.1	22.3	1	11.1	60.6
	Navicula atomus				11.1					1	12.1
	Navicula cincta (her.)				1		1	1	66.8		69.8
	Navicula crucicula (W. Smith) Donkin				1	1	1			1	4
	Navicula cryptocephala (Kützing)						1				1
	Navicula cryptocephala var. intermedia				1				1		2

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	(Grunow)										
	Navicula cryptocephala var. minuta			1	1		1	1	1		5
	Navicula cryptocephala var. veneta (Kützing) Rabenhorst			1	1		1		1		4
	Navicula cuspidata (Kützing) Kützing 1844		1	44.5	44.5	1	1	1	1		94
	Navicula grimmei						1				1
	Navicula halophila (Grunov) Cleve						1				1
	Navicula inflata					11.1	1	11.1			23.2
	Navicula mutica									1	1
	Navicula placentula								1		1
	Navicula placentula fo rostrata							1			1
	Navicula parva (Ralfs)			1		1					2
	Navicula pseudotuscula (Hustedt)	1						1		1	3
	Navicula pupula (Kützing) Mereschkovsky						1				1
	Navicula pygmaea (Kützing 1849)							1			1
	Navicula radiosa (Kützing)	22.3	77.9	1	33.4			1			135.6
	Navicula radiosa var. tenella (Bréb. ex Kütz.) Grun.	1	1								2
	Navicula rhynchocephala (Kützing 1844)	11.1			11.1		1	1	11.1	33.4	68.7
	Navicula spicula (Dickie) Cleve					1	1	1	1		4
	Navicula trivalis						1				1
	Navicula turgida					1	1	1			3
	Navicula viridula var. rostellata				44.5	33.4	1	44.5	44.5		167.9
	Navicula sp.						1				1
	Neidium productum (W. Smith) Cleve							1			1
	Nitzschia amphibia (Grunow)			1					1		2
	Nitzschia angustata (W. Smith) Grunow		1								1
	Nitzschia apiculata (Gregory) Grunow								1		1
	Nitzschia dissipata (Kützing) Grunow								11.1		11.1
	Nitzschia fasciculata (Grunow)								1		1
	Nitzschia filiformis (W. Smith) Van Heurck (1896)	1	1			1		1	1		5
	Nitzschia fonticola (Grunow in Cleve & Grunow) Grunow in Van Heurck(1881)			1	1		1		55.6		58.6
	Nitzschia frustulum (Kützing) Grunow in Cleve & Grunow(1880)		1						1		2
	Nitzschia gracilis (Hantzsch 1860)	22.3	33.4	1	1	11.1		22.3	22.5		113.6
	Nitzschia granulata (Grunow, 1880)					1					1
	Nitzschia hungarica (Grunow 1862)								1		1
	Nitzschia lgnorata				1	11.1					12.1
	Nitzschia linearis (Agardh) W. Smith				1			1	1		3
	Nitzschia longissima (Brébisson) Ralfs 1861		1				1	22.3	155.8	1	181.1

Location		Abu-Zirig Marsh		Central Marsh							Total count (cell x10³/L.)
Site Code		AZ -1	AZ -3	CM -2	CM -5	CM -10	CM -11	CM -12	CM -13	CM -28	
Species											
	Nitzschia microcephala (Grunow 1880)		1		1	11.1		1	100.2		114.3
	Nitzschia obtusa (W. Smith, 1853.)	1	33.4		1		1	22.3	1	1	60.7
	Nitzschia palea (Kützing) W. Smith	22.3	55.6	1	33.4	22.3	33.4	11.1	434.2	33.4	646.7
	Nitzschia punctata var. coarctata (Grunow) Hustedt						1		11.1		12.1
	Nitzschia scalaris (Ehrenberg) W. Smith				1		1		22.3		24.3
	Nitzschia sigma (Kützing) W. Smith		1		1		1	1	66.8		70.8
	Nitzschia tryblionella (Hantzsch)							1	1		2
	Nitzschia tryblionella var. levidensis (W. Smith) Grunow						1				1
	Pinnularia brebissoni									11.1	11.1
	Pinnularia virdis						1				1
	Plagiotropis lepidoptera					1	1	1			3
	Pleurosigma delicatulum (Grun.)	1	22.3	1	1	1	1	1	1	1	30.3
	Pleurosigma elongatum (W. Smith)				1					1	2
	Rhoicosphenia curvata (Kützing) Grunow 1860	1	1	1	1	1	1	22.3	11.1	11.1	50.5
	Rhopalodia gibba (Ehrenberg) O. Müller	11.1	22.3	11.1	1	1	11.1	11.1	1	1	70.7
	Rhopalodia gibba var. ventricosa (Kützing) H. Peragallo & Peragallo			1	1		1	1	1	1	6
	Rhopalodia musculus (Kützing) O.F. Müller				1		1	11.1	1	44.5	58.6
	Rhopalodia parallela (Grunow) O. Müller						1	1	1		3
	Surirella capronii (Brébisson)								1		1
	Surirella ovata (Kützing 1844)				1		1		1		3
	Surirella robusta (Ehrenberg)						1				1
	Surirella robusta var. splendila						1			1	2
	Surirella striatula								1		1
	Surirella sp.						1	1	1		3

Index V: Benthic Macroinvertebrate Results for the June 2008 Surve

Table 2: Benthic Macroinvertebrates distribution and abundance (individual / m²) for Habitat project, summer survey 2008.

Site Name		Al Bagh-dadia	Al Bagh-dadia	Al Bagh-dadia	Um Lilo (Start Of Al Baghd-adia)	Core Area	Eishan Al-Gubba	Al Ham-mar	Close To Al Fuhood Town	Close To Al Fuhoo d Town
Site Code		HAB-CM2	HAB-CM5	HAB-CM10	HAB-CM11	HAB-CM12	HAB-CM13	HAB-CM28	HAB-AZ1	HAB-AZ2
Date		14-6-2008	14-6-2008	17-6-2007	17-6-2008	16-6-2088	14-6-2008	15-6-2008	15-6-2008	15-6-2008
Time		6:10AM	8:54AM	8:30AM	6:10AM	11:36AM	2:45PM	12:05PM	10:30AM	8:05AM
Annelida	*Limnodrilus hoffmeisteri (Claparede, 1862)*							17		
	Tubifex tubifex (Mueller, 1774)								6	
Crustacea	*Caridina babaulti basrensis (Al-Adhub & Hamzah, 1987)*	16	39	32	221	103	100	108	25	25
	Elamenopsis kempi (Chopra & Das, 1930)							1		
Insecta	*Anax (Leach, 1815)*				1				2	
	Anopheles (Meigen, 1818)								2	
	Buenoa sp.1					1				
	Buenoa sp.2					1				
	Caenis sp.1		1	5		1				
	Chaoborus (Lichtenstein, 1800)				1					
	Chironomini sp.3			1						
	Chironomini sp.5								1	
	Chironomini sp.7		4						1	
	Chironomus riparius (Meigen, 1804)	15	8	28	22					
	Corisella (Lundblad, 1928)		1			16	2		1	
	Cybister (Curtis, 1827)				1	1		1	1	
	Donacia (Fabricius,	1								

Site Name		Al Bagh-dadia	Al Bagh-dadia	Al Bagh-dadia	Um Lilo (Start Of Al Baghd-adia)	Core Area	Eishan Al-Gubba	Al Ham-mar	Close To Al Fuhood Town	Close To Al Fuhoo d Town
Site Code		HAB-CM2	HAB-CM5	HAB-CM10	HAB-CM11	HAB-CM12	HAB-CM13	HAB-CM28	HAB-AZ1	HAB-AZ2
Date		14-6-2008	14-6-2008	17-6-2007	17-6-2008	16-6-2088	14-6-2008	15-6-2008	15-6-2008	15-6-2008
Time		6:10AM	8:54AM	8:30AM	6:10AM	11:36AM	2:45PM	12:05PM	10:30AM	8:05AM
	1775)									
	Enochrus (Thomson, 1859)		5		11	2	1		1	5
	Ephydra (Fallén, 1810)									1
	Erythrodiplax (Brauer, 1868)	3	8	6	6	6			4	4
	Georyssus (Latreille, 1809)				1					
	Glyptotendipes (Kieffer, 1913)		2	2						
	Hagenius sp. (Selys, 1854)							1		
	Histeridae sp.		1							
	Hydraenidae sp.1		2						1	1
	Hydrocanthus sp.1				2			1		
	Hygrobiidae sp.									2
	Hygrotus (Stephens, 1828)							1		5
	Ischnura sp.1		6	3		2		3	6	2
	Ischnura sp.2	12	20	15	13	22	5	32	32	25
	Ischnura sp.3								3	
	Laccophilus (Leach, 1815)		1							
	Leucotrichia sp.			1				1		
	Libellula needhami (Westfall, 1943)							2		
	Libellulinae sp.1	1	7				2			
	Libellulinae sp.2	3	11	1			3	5	4	
	Mesovelia (Mulsant and Rey, 1852)									1
	Micronecta (Kirkaldy,1897)		3							
	Neoplea (Esaki and China, 1928)		1		5		1	8	3	18

Site Name		Al Bagh-dadia	Al Bagh-dadia	Al Bagh-dadia	Um Lilo (Start Of Al Baghd-adia)	Core Area	Eishan Al-Gubba	Al Ham-mar	Close To Al Fuhood Town	Close To Al Fuhood Town
Site Code		HAB-CM2	HAB-CM5	HAB-CM10	HAB-CM11	HAB-CM12	HAB-CM13	HAB-CM28	HAB-AZ1	HAB-AZ2
Date		14-6-2008	14-6-2008	17-6-2007	17-6-2008	16-6-2088	14-6-2008	15-6-2008	15-6-2008	15-6-2008
Time		6:10AM	8:54AM	8:30AM	6:10AM	11:36AM	2:45PM	12:05PM	10:30AM	8:05AM
	Ochthebius sp.2							1		
	Paracymus (Thomson, 1867)						1			
	Paratendipes albimanus (Meigen, 1919)	110	10	58	30	2			2	3
	Pentaneura (Philippi, 1865)		2							
	Petrophila (Guilding, 1830)	1		1		1		2	4	2
	Procloeon sp.1	1			1			1	15	
	Ptiliidae sp.				1					
	Somatochlora (Selys, 1871)		1		1		1	2		1
	Suphisellus (Crotch, 1873)		3			1	4	1		9
	Sympetrum (Newman, 1833)	11	1	3	2	10		2	4	
Mollusca	*Bellamya bengalensis (Lamarck, 1822)*							2	7	
	Corbicula fluminalis (Müller, 1774)							1		
	Gyraulus (Agassiz, 1837)									29
	Lymnaea auricularia (Linnaeus, 1758)	2	8	6	3		1	2	12	6
	Melanoides tuberculata (Müller, 1774)	2	1							
	Melanopsis praemorsum (Linnaeus, 1758)								1	
	Physa acuta (Draparnaud, 1805)							1	18	3

Table 3: Benthic Macroinvertebrates' diversity, richness, and evenness for Habitat project, summer survey 2008.

Site Code	Number of species in samples	Shannon' diversity (H) of samples	Log(Number of species) in samples	H/log(N) evenness of samples
HAB-CM2	13	1.43125	2.564949	0.558003
HAB-CM5	24	2.580746	3.178054	0.812052
HAB-CM10	14	1.890942	2.639057	0.716522
HAB-CM11	17	1.278837	2.833213	0.451373
HAB-CM12	14	1.415835	2.639057	0.536493
HAB-CM13	11	0.827379	2.397895	0.345044
HAB-CM28	23	1.701407	3.135494	0.542628
HAB-AZ1	24	2.601808	3.178054	0.81868
HAB-AZ2	18	2.325279	2.890372	0.804491

Shannon' diversity (H) ≥ 2 is considered good

Shannon' diversity (H) ≥ 1 < 2 is considered moderate

Shannon' diversity (H) < 1 is considered poor

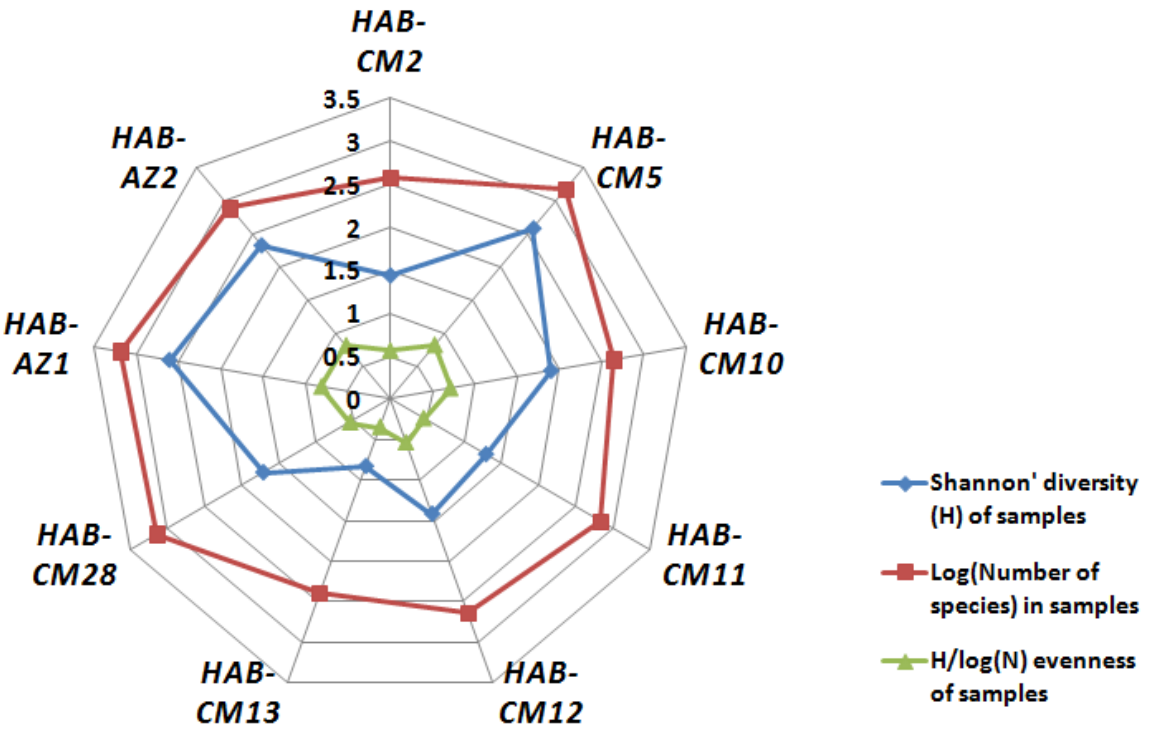

Figure 13: Benthic Macroinvertebrates' diversity, richness, and evenness for Habitat project, summer survey 2008.

Index VI: Fish species for each site

	Family	Scientific name	Local name	CM2, 5, 10		CM12	CM 11,13		CM28		AZ2		AZ1	
				mw*	ml*	NO sample	mw*	ml*	mw*	ml*	mw*	ml*	mw*	ml*
1	Cyprinidae	*Acanthobrama marmid* (Heckel, 1843)	Samnan Arez	15	11									
2	Cyprinidae	*Aspius vorax*	Shelak	74	23		50	20	43	17	60	20	28	15
3	Cyprinidae	*Barbus luteus*	Hemri	15	12		45	15	54	16	54	16	55	16
4	Cyprinidae	*Barbus xanthopterus*	Kattan								340	30		
5	Cyprinidae	*Carassius carassius* (Linnaeus, 1758)	Buchbuch	82	17		32	15	31	15	50	16	32	15
6	Cyprinidae	*Cyprinus carpio*	Samty	230	26				150	17	156	20		
7	Heteropneu-stidae	*Heteropneustus fossilis*	Abo al-hakam	112	23		40	17						
8	Siluridae	*Silurus triostegus*	Jurye	700	42		480	30					120	20
9	Mugilidae	*Liza abu*	keshny	28	15		18	12	26	14	27	14	32	16

***mw=mean weight (gm); ml= mean length (cm)**

Index VII: Plant species and their percentage in each site for June 2009.

		Vegetation cover % for each species which present in each site (non significant percentage is represented by +).											
	Sites code	HAB-CM-2	HAB-CM-5	HAB-CM-10	HAB-CM-11	HAB-CM-12	HAB-CM-13	HAB-CM-25	HAB-CM-26	HAB-CM-27	HAB-CM-28	HAB-AZ-1	HAB-AZ-2
1	*Aeluropus lagopoides*						*				+		
2	*Alhagi graecorum Boiss.*									*		*	
3	*Ceratophyllum demersum (hornwort)*	15	5		30	10		5			10	10	20
4	*Chara sp.*			5	+	5					5		
5	*Cressa cretica*									+	+	+	
6	*Cynanchum acutum*									+			
7	*Hydrilla verticillata*	5			+						25	5	20
8	*Myriophyllum sp.*	10	30	5	5	40							
9	*Najas marina Linnaeus*			70		5						10	
10	*Phragmites australis (Cav.) Trin. ex Steud.*	10	20	5	30	30	30	50	20	40		50	50
11	*Phoenix dactylifera*											+	
12	*Potamogeton crispus Linnaeus*												
13	*Potamogeton lucens Linnaeus*	40	+		20								10
14	*Potamogeton pectinatus Linnaeus*	10	10	5	5			5			40		
15	*Potamogeton perfoliatus (Linnaeus, 1753)*				+						+		
16	*Salvinia natans (Linnaeus)*						5				+	+	
17	*Schoenoplectus litoralis (Schrad.) Palla*	+	+	+	5	+						+	
18	*Suaeda sp.*						20		5	+			
19	*Tamarix sp.*			+			20		20	20			
20	*Typha domingensis Pers.*	20	30	+	10	5	10	10	5		20	5	+
21	*Vallisneria sp.*				+								