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Habitat mapping project of the proposed Iraqi Marshlands National Park area

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Abstract

New ecological surveys in support of the creation of the proposed Iraqi Marshlands National Park were undertaken by Nature Iraq in June 2008 at the Central Marshes in southern Iraq. Surveys that occurred in two focal areas - Al Chibaish Marsh (10 sites) and Abu Zirig Marsh (two sites) - were supported by a preliminary land cover survey in November 2007. Satellite images from 2007 for the Central Marshes were acquired to support creation of maps. The "Iraqi Marshlands Habitat Classification System" based on vegetation types has been developed to inventory habitats in these marshlands and to develop a methodology for application elsewhere in Iraq. Six habitat classes (inland running water, river or canal; inland standing water; marsh vegetation; desert; woodlands; and herbaceous vegetation) are included in this classification system, each of which is divided into several subclasses. The dominant habitat subclasses in the Central Marshes study area are: (1) rooted submerged vegetation, (2) helophytic vegetation (reed bed or reed mace bed), (3) free-floating vegetation, (4) terrestrial vegetation-shrub, (5) unvegetated river or canal, (6) unvegetated desert, and (7) flooded communities. This paper constitutes a review of the progress in developing this habitat classification system that remains under development.

Keywords

Habitat mapping, Iraqi marshlands, marshland restoration

Introduction

The Government of Iraq is currently considering the establishment of a new National Park in a portion of the Central Marshes of southern Iraq. A "Draft Management Plan for the Central Marsh National Park, Iraq" has been developed (New Eden Group 2008). To assist in this planning process, a baseline habitat survey was deemed to be essential. Thus, in 2007 Nature Iraq with the financial support of the Italian Ministry of Environment, Land and Sea initiated a project to identify, survey and map habitats in the area of the proposed park in collaboration with the Iraq Ministry of Environment. This habitat project is also related to other projects that Nature Iraq is carrying out (such as the completion and implementation of a Management Plan for the Hawizeh Marsh, Iraq's first Wetland of International Importance designated under the global Ramsar Convention in 2007; Rubec 2008). This paper discusses the national park habitat mapping project.

The classification of vegetation types is usually achieved through the grouping of similar types of vegetation according to logical criteria (Sayre et al. 2000). One of the first attempts to classify marsh habitats was Warming (1909) in his book "Oecology of Plants" which identified two major types of wetland depending on plant communities: Saline swamp (with halophytic vegetation) and freshwater swamp. Mader (1991, cited in Tiner 1999: 258) emphasized that classification should be: (1) Flexible, general, and of wide geographic applicability in order to allow for the prediction of distribution patterns over a range of environmental situations; (2) professionally credible, preferably through experimental validation; (3) based on concepts that are understandable by non-technical people; (4) logical, consistent, and objectively quantifiable so as to function within in empirical computer-operated information system; and (5) designed and documented so that regular professional staff can, with nominal training, use the system to identify and map field sites.

Adaptation of the European Nature Information System (EUNIS) habitat classification (Davies et al. 2004) was chosen as the model for classification of habitats in this project. The EUNIS habitat types are classified hierarchically (Davies et al. 2004). Other habitat classification systems are also organized hierarchically and contain descriptions of the classified units (FGDC 1996, Grossman et al. 1998). Thus, the Nature Iraq team chose to establish Iraq's classification scheme based on vegetation in addition to other criteria and emulate the experience in the references noted here. The Italian partners helped in developing the Iraqi project by assisting with training in the use of the EUNIS system. After field testing, modifications were undertaken to make it more applicable in Iraq's marshlands.

Vegetation is the focal issue in this habitat study of a key area of Iraq's southern marshlands due to the importance of plants as food and shelter for people and wildlife. This is supported by the economic value of many aquatic plants as food or in manufacturing and their role in cleaning water, and because these plants often are indicators of hydrological and environmental conditions at the sites.

In the last few decades at various times (and again in 2008 due to drought), there has been a significant reduction in the water levels in this area of southern Iraq, which has led to a deterioration in water quality and changes in the distribution and status of the biodiversity of the region. Monitoring of the impact of these variations in water conditions has become critical to the marsh restoration efforts in Iraq.

Thus, one of the goals of this project is to improve the monitoring of the Iraqi marshlands. Remote sensing and satellite imaging technology, it was hoped, should improve the efficiency of monitoring field trips and reduce associated cost. Ground-truth field data was essential to developing the classification scheme and to map the habitats. Later, it was also felt that the level of effort to deliver the overall project could be reduced if the satellite images indicated that there was significant change in the study sites and the overall proposed national park area. To carry out this project, the work was divided into three steps: S(I) Discussions and planning; (II) land cover survey; and (III) description and definition of habitats.

Step I included discussions between Nature Iraq, Italian and other international experts about how to carry out the project and what was needed to achieve it. Step I also included the preparation of a work plan, definition of needs and the training of staff. Step II was supported by an initial field trip in November 2007 designed to identify land cover classes in the Central Marsh of the Al Chibaish Marsh area (CM) and the Abu Zirig Marsh area (AZ). For Step III in June 2008, sites were identified as habitats of specific species and described according to water quality, sediments, birds, fish, benthic macroinvertebrates, zooplankton and phytoplankton, plants and habitat characteristics and their status. The "Iraqi Marshlands Habitat Classification System" is gradually being refined, but currently remains provisional.

Additional surveys supporting Step III will cover the environmental parameters that can give Nature Iraq an indication of the environmental or economic values of each habitat subclass. This information will help decision-makers to prepare plans for ongoing marsh restoration and conservation of those sites that are important from an environmental point view, such as the National Park in the Central Marshes and Ramsar sites in Iraq.

Objectives

This project has three objectives:

– To survey and obtain specific data that can support Nature Iraq projects;
– To use standard criteria for describing the status of the marshes in terms of vegetation cover, water quality and biodiversity; and
– To facilitate conservation of these sites.

Materials and methods

Study area

The ground-truth field surveys focused on describing the ecological characteristics and habitat structure at representative sites. All selected sites were within the proposed Central Marshes National Park area and were distributed between the Al Chibaish Marsh area and Abu Zirig Marsh area. Table 1 includes the names, codes and GPS coordinates of each habitat survey site. The exploratory field trip conducted in November 2007 was the starting point of the project. By using satellite images from 2006, an initial land cover survey and water quality study was conducted for nine candidate survey sites in these marshes. There is also data from previous surveys in August 2007 for all of Iraq's southern marshlands and their adjacent areas (Abdulhassan 2007). The most recent survey was in June 2008 (by using another satellite image from 2007) and some of the results of this work are presented in this paper. Twelve sites were surveyed from the 14 to 18 June 2008, ten of which were in Al Chibaish Marsh area and two were in Abu Zirig Marsh area.

Satellite image processing

Remote sensing has long been identified as a technology capable of supporting the development of habitat maps over large areas. Satellite images contain a information regarding land and water characteristics and the application of digital image process-

Table 1. Site names and nodes, and GPS coordinates at Al Chibaish (CM) and Abu Zirig (AZ) for the 14 to 18 June 2008 habitat survey.

Area (Central Marsh)	Name of site	Site code No.	GPS soordinates					
			N latitude			E longitude		
			°	'	"	°	'	"
Al 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

ing allows for the extracting of data from a digital image very effectively. In the work, remote sensing activities allowed for survey of the extension and the distribution of the land cover classes of marshes and to ability to analyze the development of wetland vegetation.

A first map of the Central Marshes was created on the basis of SPOT satellite images acquired in July 2006. The pre-processing of SPOT satellite data has included radiometric calibration and atmospheric effect correction (dark object subtraction). Image interpretation and analysis of vegetation indices allowed for the spectral analyses of surfaces and the characterization of the different land cover classes. Then, supervised image classification allowed the creation of detailed land cover maps at the scale of 1:50,000.

In a second phase of the work, ASTER satellite images acquired in July 2007 were processed to obtain updated maps of the study area. The same techniques of image pre-processing and supervised classification used for the SPOT images were applied. The monitoring survey ground-truthing gave parameters necessary to refine and validate the land cover classification obtained from the remote sensing analysis. The final products, based on the "Iraqi Marshlands Habitat Classification System", are land-cover maps at the scales of 1:50,000 and 1:100,000 (see Fig. 1). It is expected that the project can eventually permit effective, low-cost monitoring of these Iraqi marshlands by applying remote sensing and satellite imaging technology.

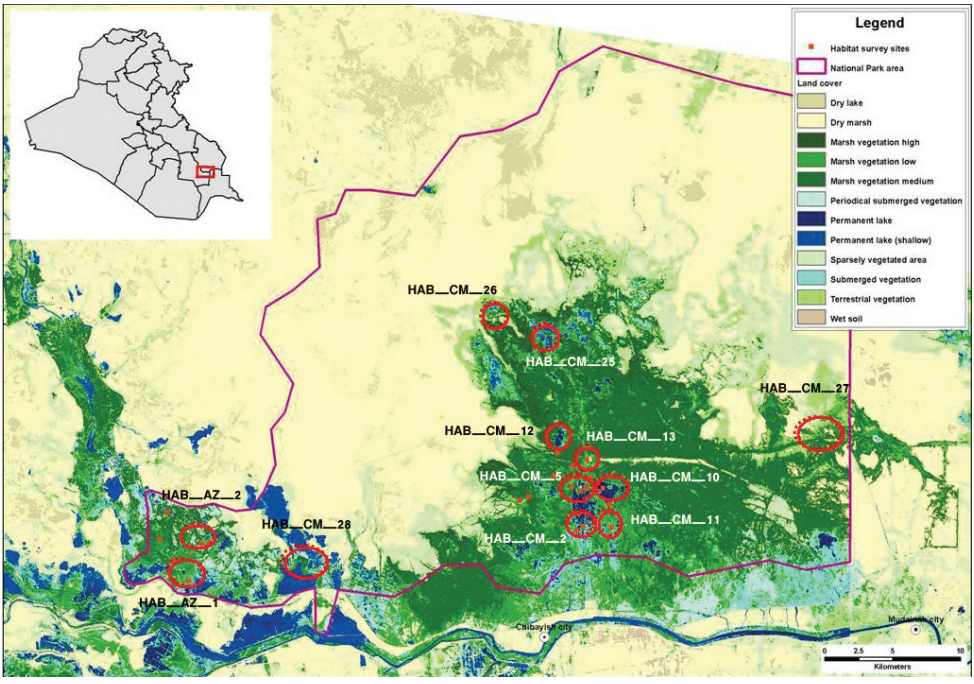

Figure 1. Satellite-based land-cover classification of the Central Marsh (Al Chibaish and Abu Zirig) showing the selected survey sites (circled areas).

The Habitat Hectare Approach (HHA) for assessing habitat

In order to characterize vegetation classes and subclasses of high conservation priority and to gather quantitative data on species richness, plot studies were used (as suggested by Sayre et al. 2000). The number of plots at the site was determined by the range of distinct habitats defined in preliminary classifications of the sites (usually between one and four habitat types). The HHA involves assigning a habitat score to a habitat zone that indicates the quality of the vegetation relative to established 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 (thus calculating "habitat hectares"). The components are divided into two groups reflecting an assessment of both "site condition" and "landscape context". This is useful for habitat assessment and ground-truthing (DSE 2004). The HHA method was applied in the ground-truthing exercises as a methodology to check the classification of the land-cover classes resulting from remote sensing application. Due to the broader complexity of the HHA method, only the determination of vegetation cover from this method was applied within each hectare and without the scoring (Fig. 2).

Vegetation

Plant genera and species were identified using botanical keys (Townsend and Guest 1966, 1968, 1974, 1980a, 1980b, 1985). The descriptions of aquatic plants were checked using other Iraq-specific references (e.g. Al-Sa'ady and Al-Mayah 1983). Internet botanical resources were also used to confirm the identification of some plant species (Google Image Search 2008). Species were identified in the field where possible or collected in nylon bags, pressed and transferred to the lab for identification with appropriate botanical keys. These specimens are now preserved in Nature Iraq's herbarium in Sulaimani, Iraq.

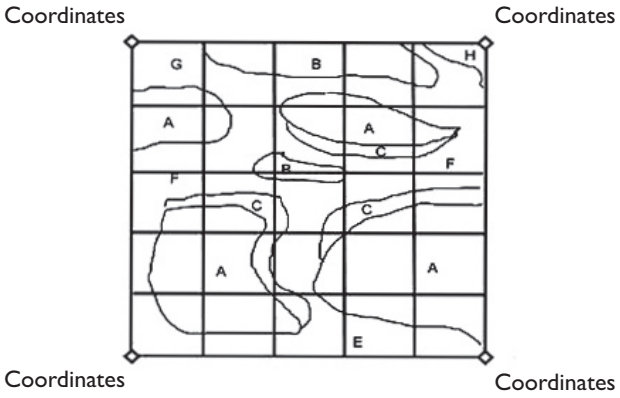

Figure 2. Application of the Habitat Hectare Approach (HHA) method; field data sheet for describing habitats (codes A-F indicate habitat classes).

Photographic records of fresh specimens were also used to aid identification. Percent vegetation cover for each plant species found at each site was estimated (using the HAA method) and used to calculate the total percentage vegetation cover for the whole site.

Results and discussion

Vegetation

The dominant vegetation type at each site was used as the basis for identifying the habitat types. Some plant species were common and found at most of the sites while others were restricted to one or two sites, but most of the identified plants are common in these Iraqi marshes. Some species are native to Iraq such as *Aeluropus lagopoides* that exists near the margins of the marshlands (Townsend and Guest 1968). *Hydrilla verticillata* is known to be an invasive species in some parts of the world and may be a new exotic species in Iraq as it was not mentioned in (Townsend and Guest 1985). Those authors listed only three plant species belonging to Hydrocharitacea of which *Hydrilla verticillata* was not included. It is possible that it was introduced during the period of great ecological change that occurred with the drainage and later reflooding of the marshlands of southern Iraq in the 1990s and after 2003. A noteworthy point about these plant communities is that the reed growth probably expanded in the last few years because of the decrease in water level (those species need a water depth of more than 2 m in the open water areas to avoid reed expansion). This has led to the decrease of total open water area and the closing off of many water passages due to the expansion of reeds. Table 2 provides a listing of the percentage vegetation cover at each of the 12 survey sites examined in June 2008.

Habitat classification system for the southern Marshlands of Iraq

Classification systems have been developed in order to divide habitats into groups with similar features or functions. This is important in Iraq for identifying and describing habitats in order to assess their biodiversity status and habitat functions and then establish conservation plans for Iraq's ecologically important habitats. As in many classification systems, including the EUNIS (Davies et al. 2004), the classification developed for Iraq's habitats is organized hierarchically. It includes a description of the classes and subclasses of habitats. This provisional Iraqi system is modeled only partially on the EUNIS system as some of the classes are chosen while others are not because they are not applicable for Iraq's marshlands. However, even the applicable parts were subjected to some modifications to make them fit more readily with the uniqueness of Iraq's marshlands. For example, the class "permanent lake ice" that is used in the EUNIS system, is excluded from Iraqi marshlands classification system because there is no such habitat in the marshes of Iraq. Also, the class "permanent inland saline and brackish lakes, ponds, and pools" was retained but under the subclass "salt water".

Table 2. Vegetation cover (%) of each of 12 survey sites.

Plant species	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
Aeluropus lagopoides						*				*		
Alhagi graecorum									*		*	
Ceratophyllum demersum	15	5		30	10		5			10	10	20
Chara sp.			5	*	5					5		
Cressa cretica									*	*	*	
Cynanchum acutum									*			
Hydrilla verticillata	5			*						25	5	20
Myriophyllum sp.	10	30	5	5	40							
Najas marina			70		5						10	
Phragmites australis	10	20	5	30	30	30	50	20	40		50	50
Phoenix dactylifera											*	
Potamogeton crispus												
Potamogeton lucens	40	*		20								10
Potamogeton pectinatus	10	10	5	5			5			40		
Potamogeton perfoliatus				*						*		
Salvinia natans						5				*	*	
Schoenoplectus litoralis	*	*	*	5	*						*	
Suaeda sp.						20		5	*			
Tamarix sp.			*			20		20	20			
Typha domingensis	20	30	*	10	5	10	10	5		20	5	*
Vallisneria sp.				*								

*Trace occurrence-detectable.

It is important to underscore that this is a provisional classification system that will be modified in the future as more knowledge of Iraqi habitats is acquired. At this point, it is divided into three major habitat categories: (1) Water, (2) marsh and (3) terrestrial habitat. These three categories include six classes and each one of them is divided into subclasses and, in some cases, secondary subclasses. Table 3 outlines the provisional "Iraqi Marshlands Habitat Classification System" for the marshes of southern Iraq and their associated surrounding terrestrial habitats.

Habitat Types

The proposed "Iraqi Marshlands Habitats Classification System" presented in Table 3 is based on vegetation due to the ecological importance of vegetation communities and because vegetation is a result of the ecological conditions. Table 4 describes the specific habitats seen within the study areas along with a basic site description of example study sites.

Table 3. Provisional "Iraqi Marshlands Habitat Classification System".

WATER

1. Inland running water, river or canal

1.1 Unvegetated rivers and canals

1.2 Submerged river and canal vegetation

1.3 Riparian vegetation

2. Inland standing water

2.1 Pond or lake – Unvegetated standing water

2.2 Unvegetated mudflat – Unvegetated mud, temporarily submerged and subject to water level fluctuations

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

2.4 Aquatic communities – With aquatic vegetation communities formed by free floating vegetation, rooted submerged vegetation or rooted floating vegetation

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

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

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

2.5 Salt water – – Saline ponds and lakes with phanerogamic communities

MARSH

3. Marsh Vegetation

3.1 Permanent Marsh

3.1.1 Helophytic vegetation

3.1.1.1 Reed bed (*Phragmites australis* beds)

3.1.1.2 Reed mace bed (*Typha domingensis* beds)

3.1.1.3 *Schoenoplectus litoralis* bed

3.1.1.4 *Cladium mariscus* vegetation –*Cladium mariscus* bed

3.1.2 Woody vegetation – Tree size formations with willow (*Salix* sp.) and poplars (*Populus* sp.) within the marsh, excluding riparian treed formations having a linear structure

3.1.2.1 Riparian willow – Dominated by willow formations (*Salix* sp.)

3.1.2.2 Riparian poplar – Dominated by poplar formations (*Populus* sp.)

3.2 Brackish or saltwater marsh vegetation – Brackish or saline marshes with halophytic vegetation

3.2.1 Salt pioneer swards – Pioneer communities growing on salt or brackish mudflat (*Salicornia* sp. pl. community)

TERRESTRIAL HABITATS

4. Desert

4.1 Desert shrub

4.2 Unvegetated desert

4.3 Unvegetated saline lands

5. Woodlands

5.1 Woodland, forest and other wooded area

5.2 Shrub

6. Herbaceous vegetation

6.1 Grassland

6.2 Steppe

6.3 Sparsely vegetated land

Table 4. The habitat classes identified at each site with site description.

Central March 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 bed) 3.1.1.2 Helophytic vegetation (reed mace bed) 2.4.1 Free-floating vegetation	This is an open water area that is adjacent to the road on the east and surrounded by reed beds in the other directions; there also are groups of reeds that are distributed randomly inside the area. There are small groups of *Typha* sp. (reed mace beds) and *Schoenoplectus litoralis* close to the road (in the east side of area). The water is shallow. The open area is covered by submerged plants and most of them are decayed at the surface.
	HAB-CM-5	1.1 Unvegetated 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 Site CM-2 (thus an open water area with randomly distributed reed groups). There is a road adjacent to the site from the east and there are small *Typha* groups (on the east side of the area). There are small areas beside the road where submerged vegetation is absent and the water is deeper than the rest of area. The submerged plants are more dense than Site CM-2 but similarly decayed.
	HAB-CM-10	2.4.2 Rooted submerged vegetation 3.1.1.1 Helophytic vegetation (reed beds)	This is Lake is 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 occurs in the area by nets and 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 an inlet to Al Baghdadia Lake (Bargah). This canal divides the area into two sides (east and west) but the habitats are the same on both sides of the canal. They have small open water areas with a high density of submerged plants and are surrounded by reeds and *Typha* from all directions. All submerged plants are decayed on the surface of water. The canal is bordered by a line of *Typha* followed by a line of reeds on both sides. This is a water buffalo grazing area. There is extensive fishing with 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	This open water area (known locally as "Bargah") has submerged vegetation in different densities. It is surrounded on all sides by reeds beds and there are groups of reeds inside the area of the Bargah. Most of the submerged plants are decayed on the water surface. This area had been burned before and the ground was brownish and included 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 Unvegetated desert 6.3 Sparse vegetation	A paved road divides this area into two sides: The west side is an aquatic habitat with reed beds and a water passage close to the road. There is also an area of high ground to the southwest with terrestrial plants (*Tamarix* sp.) and aquatic plants (dry *Phragmites australis*). The soil is wet indicating that this is a seasonal marsh. The east side includes three types of habitat, (a)[t] in the northern portion are reed beds and reed mace beds; (b)in the middle area is dry land without plants that is use by the local people; and (c) in the southern portion is terrestrial vegetation. This area includes high usage by water buffalo, including breeding activity.

Central March CM	Site code	Types of habitat	General description of the site
	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 northeast). There is a small area that still contains some shallow water (5–20 cm depth). The area is considered a seasonal marsh. There is a paved road adjacent to the area on the west. There are many people who live along the road and breed water buffalo. Note: The siting of this area was determined by two coordinates to the west and the description places it about 1 km toward the east.
	HAB-CM-26	5.1 Unvegetated desert 3.1.1 Helophytic vegetation (reed beds) 4.1 desert shrubs	This is a dry area (a seasonal marsh) with *Phragmites* that was dry. It also has terrestrial plants (*Tamarix* sp. *and Suaeda* sp.). There is a paved road to the east of area and as one moves northward, the plant cover decreases 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 dry reeds with low density intermixed with terrestrial vegetation (*Tamarix* sp. *and 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 road. There are small soil embankments to the southeast of the area. The area is used for water buffalo grazing.
Abu Zirig (AZ)	HAB-AZ-1	1.1 Unvegetated 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 road on the south and to a soil embankment of the river that is adjacent to the area and has openings that feed the marsh with water from the river on the west side of the marsh. There are date palm trees on the soil embankment. This area is considered a water buffalo grazing area; local people cut and collect the reeds for water buffalo feeding and manufacturing of goods. The area is close to Al Fuhood City.
	HAB-AZ-2	1.1 Unvegetated 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 an open, moving water area devoid of 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 have emerged above the water surface due to the decreasing water level).

Conclusions and recommendations

The study area and its 12 survey sites in the Central Marsh of Iraq, were set up to assess the application in a real life situation of the Habitat Hectare Assessment (HHA) methodology and to develop a practical classification system for Iraqi habitats based on anticipated habitat classes that had been previously observed. A provisional hierarchical classification system, the "Iraqi Marshlands Habitat Classification System", was created to facilitate mapping these habitats into distinct units. Six habitat classes have been identified, each of which is divided into several subclasses. However, the people of the local communities in these marshes use specific terms to describe habitat types. Two examples are "bargah" which means a pond or lake with unvegetated standing water habitats, and "sibil" which means inland running water/river or canal. Efforts are being made to associate these local names with the scientific categories that have been identified so the classification system and maps becomes practical for local use. This habitat classification system is still undergoing development and will be subjected to further rigorous review.

The author urges consideration of the following recommendations that directly consider plant diversity and the health of the habitats of the southern marshes of Iraq:

It is recommended that additional habitat survey work in other areas in Iraq be initiated in order to verify the applicability of the provisional classification system and its methodology.

In 2008, the Nature Iraq team observed that, in this area, water levels are still decreasing in addition to having on-going poor water quality conditions. To return to a better state comparable to pre-1990 conditions (e.g. before drying of these marshes) for both nature and the local people of the southern marshes of Iraq, it is recommended that Iraq should maximize the restoration of as much of the ecological character of this area as possible.

Application of a standardized habitat classification is essential to monitoring of the progress of this restoration effort. It is recommended that the provisional habitat classification system discussed in this paper be completed and put into operational use as soon as feasible.

The habitat types of greatest importance in restoration efforts will be those that bring stability and economic value to the local communities. The area strongly needs a permanent increase in the quantity of useable water to help restore habitats that are critical to water buffalo for example, a mainstay of the local marsh people. Thus, it is recommended that Iraq make all efforts to foster the restoration of its freshwater sources that once flowed from the Euphrates River and the Tigris River.

Restoration of healthy habitats also requires improvement in water quality. It is further recommended that the Government of Iraq should establish wastewater treatment plants at the points of discharge in the cities that are located on the inlets of these marshes and help to restore the hydrological regime. Increases of water quality and water levels can likely assist in limiting the growth of reeds (such as Phragmites australis) and help restore the ecological character of these marshes.

Finally, it is also recommended that stakeholders initiate training programs to reduce human disturbance and engage the local community in these restoration efforts through education and awareness building about ecosystem health and the importance of particular habitats.

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References

Abdulhassan NA (2007) Preliminary study for the habitats in southern Iraq. Unpublished report. Sulaimani, Kudistan, Iraq: Nature Iraq.

Al-Sa'ady HA, Al-Mayah AA (1983) Aquatic Plants of Iraq. Center for the Arab Gulf. Basrah, Iraq: University of Basrah. (In Arabic).

Davies CE, Moss D, Hill MO (2004) EUNIS Habitat Classification. Copenhagen: European Environmental Agency and European Topic Centre on Nature Protection and Biodiversity. Accessed: http://eunis.eea.europa.eu/habitats/jsp.

DSE (Department of Sustainability and Environment) (2004) Vegetation Quality Assessment Manual-Guidelines for Applying the Habitat Hectares Scoring Method. Version 1.3. Melbourne, Australia: Department of Sustainability and Environment, Government of the State of Victoria. Accessed: http://www.dse.vic.gov.au.

FGDC (Federal Geographic Data Committee) (1996) Vegetation Classification and Information Standard. Reston, Virginia, USA: FGDC Secretariat. Cited in Sayre et al. (2000).

Google Image Search (2008) Fall 2008, Accessed: http://www.image.google.com.

Grossman DH, Faber-Langendon D, Weakley AS, Anderson M, Bourgeron P, Craword R, Goodin K, Landaal S, Matzler K, Patterson K, Pyne M, Reid M, Sneddon L (1998) International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Vol. 1. The National Vegetation Classification System: Development, Status, and Application. Arlington, Virginia, USA: The Nature Conservancy. Cited in Sayre et al. (2000).

New Eden Group (2008) Draft Management Plan for the Central Marsh National Park, Iraq. Sulaimani, Kurdistan Iraq. Unpublished.

Rubec CDA (2008) Draft Management Plan for the Hawizeh Marsh Ramsar Site, Iraq. Sulaimani, Kudistan, Iraq: Nature Iraq. Report developed for the Iraq National Marshes and Wetlands Committee. Accessed: www.natureiraq.org.

Sayre R, Roca E, Sedaghatkish G, Young B, Keel S, Roca R, Sheppard S (2000) Nature in Focus. Rapid Ecological Assessment. Washington, D.C., USA: Island Press.

Tiner RT (1999) Wetland Indicators. A Guide to Identification, Delineation, Classification, and Mapping. Boca Raton, Florida, USA: CRC Press.

Townsend CC, Guest E (1966) Flora of Iraq. Vol. 2. University Press, Glasgow, United Kingdom: Robert MacLehose and Company Limited.

Townsend CC, Guest E (1968) Flora of Iraq. Vol. 9. University Press, Glasgow, United Kingdom: Robert MacLehose and Company Limited.

Townsend CC, Guest E (1974) Flora of Iraq (Vol. 3). University Press, Glasgow, United Kingdom: Robert MacLehose and Company Limited.

Townsend CC, Guest E (1980a) Flora of Iraq (Vols. 4-I). University Press, Glasgow United Kingdom: Robert MacLehose and Company Limited.

Townsend CC, Guest E (1980b) Flora of Iraq (Vols. 4-II). University Press, Glasgow, United Kingdom: Robert MacLehose and Company Limited.

Townsend CC, Guest E (1985) Flora of Iraq (Vol. 8). Tonbridge, United Kingdom: The Whitefriars Press Ltd.

Warming E (1909) Oecology of Plants. An Introduction to the Study of Plant Communities. Oxford, United Kingdom: Clarendon Press. (Updated English version of 1896 text). Cited in Tiner (1999).