

Key Biodiversity Areas: Rapid assessment of fish fauna in southern Iraq

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Abstract

Surveys of fish in the southern marshes of Iraq are an integral component of the Key Biodiversity Areas (KBA) Project that was initiated in 2005 by Nature Iraq. This included sampling in the January to February and June periods of 2005, 2006 and 2007. Fish species occurrence, relative abundance, and weight and length were recorded. Species of importance for local consumption were noted. An initial project report included details and photographs of the species observed in 2005. Records based on interviews with local residents are noted. Sixteen “Species of Special Concern” are proposed, considering both economic and ecological factors that may be relevant to a future national fish management strategy in Iraq.

Keywords

Key biodiversity areas, inland water fish, Iraq

Introduction

The Mesopotamian marshlands are a part of the Tigris-Euphrates Basin, considered by many as the “cradle of civilization”. The Basin, the largest river system in southwest Asia, has been the focus of the Key Biodiversity Areas Project since 2005, as summarized by Rubec and Bachmann (2008).

Some 106 species of fish (including freshwater and marine entrant species) have now been recorded in the non-marine waters of Iraq (Coad et al. in preparation), significantly expanding earlier species lists published by Al-Daham (1988) and Coad (1991) for Iraqi freshwaters. Additional marine fish species also occur in the marine territorial waters of Iraq but are not yet the focus of new studies in Iraq. The native fish of the southern marshes have historically been dominated by cyprinid species (*Barbus* spp.). In 1990, prior to major drainage of the southern marshes of Iraq, the United Nations Food and Agriculture Organization (FAO) estimated that the inland catch of fish in Iraq was 23,600 tonnes/year with about 60% of this catch coming from the southern marshes of the country. Since that time, inland catches were seriously reduced, this being directly related to habitat destruction and water quality decline. In addition, coastal fisheries in the Gulf, historically depended on portions of these marshes as spawning grounds and nursery areas for penaeid shrimp and many marine fish species, were seriously disrupted (Richardson and Hussain 2006).

These marshes, a natural refuge for aquatic organisms especially fish and birds, were characterized by their high primary productivity of aquatic plants including phytoplankton (Al-Hilli 1977, Al-Zubaidy 1982). The desiccation of the vast Mesopotamian marshlands, one of the world's most significant wetlands and a centre of global importance for biodiversity, took place primarily in the 1990s (Partow 2001). This was a specific policy of the previous Iraqi regime, aimed at thwarting an uprising in the south of the country that occurred following the 1991 Gulf War. In a few short years, the marshlands were nearly destroyed and effects on the marshes and the Gulf were severe, with significant reductions in population size of all fish and shellfish species important to fisheries. After the end of the previous Iraqi regime in 2003, water was restored to much of the marshland area. Biodiversity surveys, suspended in the area for several decades, were resumed. This has included the KBA Project as a key component.

Methodology

The KBA surveys used a rapid assessment approach during the winter and summer periods of 2005, 2006, and 2007. Rapid assessment focused on limited sampling, speed, and efficiency in terms of costs and logistics – all being practical requirements for field studies in Iraq due to the security and evolving political situation in Iraq since 2003. Fish surveys, as an integrated component of the KBA project along with other disciplines, have generated samples collected from fishermen who used various methods, including:

- Fixed nets: 1.5 m high by 200–1000 m long with mesh size ranging from 2 cm to 8 cm, which are set and retrieved in a two-person process. These nets are locally-made.
- Seine nets: 10 m high by 500 m long, which require 12 people to set and gather.
- Electro-shocking: 220–300 V appliances are used to create a localized electrical field using a 2 m electrified net with a 0.5 cm mesh size usually attached to a pole. The appliances used are either truck batteries or small gas generators.
- Poisons of various kinds and gill netting.

Fish collected from the local markets and interviews held with fishermen and other local residents were additional sources of information. The field team purchased the fish samples directly from fishermen; after the field trips these fish were transported to the lab in an ice-chest. Fish were identified to family, genus and species, and counts, weights and lengths were recorded. Species were identified using Khalaf (1961), Mahdi (1962) and Al-Daham (1982), and then verified against keys prepared for the forthcoming book by Coad et al. (in preparation) as well as the Canadian Museum of Nature's Middle East database maintained by Coad (www.briancoad.com).

Fish fauna observations

Table 1 summarizes observations of fish species in 12 marsh sites surveyed in 2005, 2006 and 2007. The location of the Central Marsh, Hammar Marsh and Hawizeh Marsh relative to the full scope of KBA studies in the southern marshes of Iraq are shown in Fig. 1. Table 2 summarizes the number of fish species observed at all field sites in the summer and winter of the 2005–06, in the summer of 2006 and in the winter and summer of 2006–07. Five additional sites in southwestern Hammar Marsh were visited in 2005 but these sites were dry with no fish.

Twelve different fish species were recorded in the 2005 summer surveys. With the completion of the winter 2005–06 survey, the total number of fish species recorded

Table 1. Location of fish species observed in the central Hammar and Hawizeh Marshes of Iraq from 2005 to 2007. (Sources: Abd 2005, Abd 2006a, Abd 2006b)

Fish Species and Common Arabic Name†	Sampling Areas ‡ §				
	Central Marsh	Hammar Marsh-Northwest	Hammar Marsh-South	Hammar Marsh-East	Hawizeh Marsh
<i>Acanthobrama marmid</i> (Semnan arez)	CM1– CM2	HA6		HA14– HA16	HZ1, HZ2, HZ3, HZ4, HZ5, HZ6, HZ7
<i>Alburnus mossulensis</i> (Semnan tuyel)	CM1– CM2	HA6		HA14– HA16	HZ1, HZ2, HZ3, HZ4, HZ5, HZ6, HZ7
<i>Aspius vorax</i> (Shillik)	CM1			HA14– HA16	HZ1–HZ7
<i>Aphanius dispar</i> (Batrikh)	CM2			HA14– HA16	
<i>Barbus grypus</i> (Shabout)	CM1				HZ1
<i>Barbus luteus</i> (Himri)	CM1– CM2, CM3*	HA3, HA4*		HA14– HA16	HZ1–HZ7

Fish Species and Common Arabic Name†	Sampling Areas ‡ §				
	Central Marsh	Hammar Marsh-Northwest	Hammar Marsh-South	Hammar Marsh-East	Hawizeh Marsh
<i>Barbus sharpeyi</i> (Bunni)				HA14–HA16	HZ1–HZ5
<i>Barbus xanthopterus</i> (Gattan)	CM1				HZ1
<i>Carassius auratus</i> (Buj-Buj)	CM1, CM3*, CM4*	HA1–HA3, HA4*	HA9–HA12	HA14–HA16	HZ1
<i>Cobitis</i> sp. (Loach)					HZ1
<i>Ctenopharyngodon idella</i> (Carp Eshaby)	CM1	HA4*			
<i>Cyprinus carpio</i> (Samti)	CM1–CM2, CM3*	HA2, HA4*		HA14–HA16	HZ1, HZ2*, HZ4, HZ5
<i>Liza abu</i> (Khishni)	CM1–CM2, CM3*, CM4*	HA1–HA3	HA9–HA12	HA14–HA16	HZ1–HZ7
<i>Mastacembelus mastacembelus</i> (Abu Salambah)	CM1, CM3*	HA1		HA14–HA16	HZ1, HZ2, HZ3*, HZ4, HZ5
<i>Mystus pelusius</i> (Abu Al-Zummiar)	CM1, CM2, CM3*			HA14–HA16	HZ1, HZ2, HZ3*
<i>Silurus triostegus</i> (Jirri)	CM1, CM2, CM3*	HA2		HA14–HA16	HZ1, HZ2*, HZ3*, HZ4, HZ5
Total no. of Fish Species Observed	14	9	2	12	15

† Species here are listed alphabetically versus systematically.

‡ Records that are based on local interviews are marked with a single asterisk (*).

§ Sites sampled are listed below:

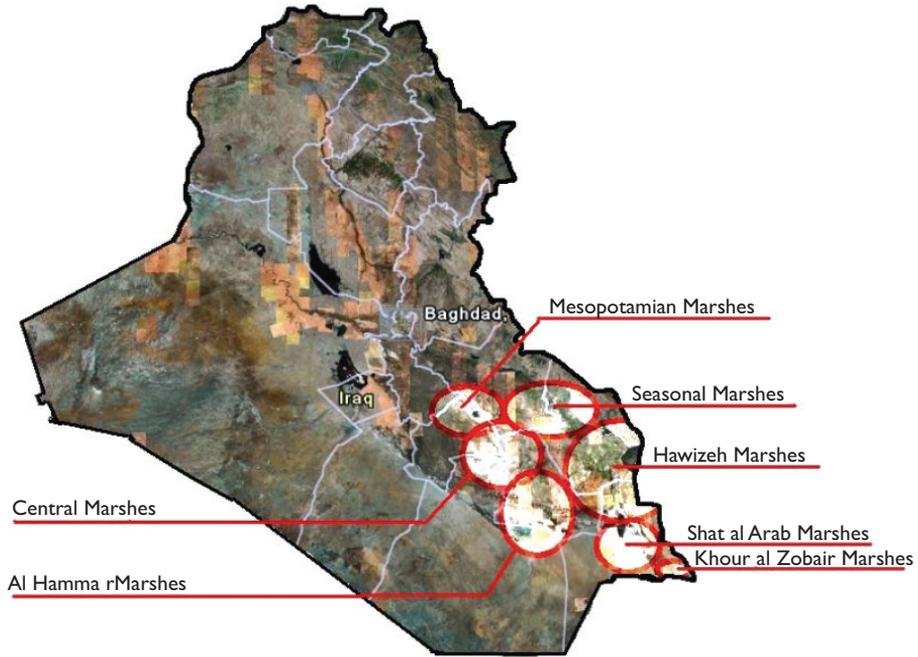
Central Marsh (CM): CM1 (Abu Zirig Marsh); CM2 (Chubayish Marsh); CM3 (Al Auda Marsh); and CM4 (Al Rayan Marsh) (Note: CM4 was dry from the summer of 2006 through the 2007 surveys).

Hammar Marsh (HA) – Northwest: HA1 (Northern ‘Teena); HA2 (Southern ‘Teena); HA3 (Buhaira Al Hilwa); HA4 (Umm Al Tiyaar near Al Buhaira); HA6 (Umm Nakhla); HA7 (Khwaysa Area in Al Kermaashiya Marsh); and HA8 (Kermaashiya Marsh).

Hammar Marsh (HA) – South: HA9 (Southern Hammar Marshes); HA10 (Western Sinaaf Marsh); and HA11 (Shuwaya’riya Area); HA12 (Eastern Sinaaf Marsh).

Hammar Marsh (HA) – East: HA14 (Mas’hab Area); HA15 (Sallal); and HA16 (Naggaara).

Hawizeh Marsh (HZ): HZ1 (Umm Ni’aaj Marsh); HZ2 (Udhaim Marsh); HZ3 (Sewaalf Marsh); and HZ4, HZ5, HZ6 and HZ7 (E’jayrda Marshes).



The 7 Major Wetlands, South of Iraq

Figure 1. Study areas for the KBA Project in Iraq.

and/or observed in the 2005–06 fiscal year rose to 44 (17 freshwater and 27 marine species). In the summer 2006 surveys, 41 species (16 freshwater and 25 marine species) were recorded with a different mix of the marine species that had been observed in 2005–06. Surveys in 2007 added five more freshwater species (*Cobitis* sp., *Alburnus caeruleus*, *Barbus esocinus*, *Cyprinion kais* and *Aphanius mento*), thus totaling 52 species recorded in the surveys in 2006–07.

Freshwater fishes of Iraq – a new field guide

In 2009, it is hoped that a new book, *The Freshwater Fishes of Iraq*, will be published (Coad et al. in preparation). It will include line drawings, species status, biological descriptions and selected photographs of 43 freshwater, 10 exotic, and 53 species of marine origins, in total 106 species of fish that are found in the inland waters of Iraq.

The book project has received support from Nature Iraq; the Italian Ministry of Environment, Land and Sea; the Canadian International Development Agency; and the Canadian Museum of Nature. The book will also include information on the economic importance and conservation concerns for each species of fish listed. An interpretation of the data in this forthcoming book for Iraqi fish species is here

Table 2. Number of fish species observed in 2005–2007 surveys (all sites).

Family	Number of Species Observed in Summer 2005 and Winter 2005/06	Number of Species Observed in Summer 2006	Number of Species Observed Winter 2006/07 and Summer 2007
Freshwater Species			
Cyprinidae	11	10	14
Cobitidae (new record in southern Iraq)	--	--	1
Bagridae	1	1	--
Siluridae	1	1	1
Heteropneustidae	1	1	1
Cyprinodontidae	--	--	1
Mugilidae	2	2	2
Mastacembelidae	1	1	1
Marine Species			
Engraulidae	1	1	2
Chirocentridae	1	1	1
Clupeidae	4	3	3
Synodontidae	--	--	--
Exocoetidae	--	--	1
Belonidae	1	1	1
Platycephalidae	--	1	1
Serranidae	1	1	3
Sillaginidae	--	1	1
Carangidae	1	--	2
Lutjanidae	--	1	--
Gerreidae	1	--	--
Haemulidae	--	--	1
Nemipteridae	1	1	--
Lethrinidae	2	--	1
Sparidae	3	2	5
Polynemidae	1	1	1
Sciaenidae	3	3	3
Drepaneidae	--	--	1
Chaetodontidae	--	1	1
Siganidae	2	1	--
Scombridae	1	2	--
Stromateidae	--	1	1
Bothidae	2	2	--
Soleidae	1	--	1
Cynoglossidae	1	1	1
Total Number of Species Observed	44	41	52

offered as a preliminary listing of fish species that may require conservation management in Iraq. Sixteen proposed “Species of Special Concern (SSCs)” (as prepared by Rubec and Coad 2007) are presented in Table 3. The concept of “SSC” is used here in the same context as protocols developed by organizations such the World Conserva-

tion Union (IUCN) and BirdLife International for birds, mammals and other fauna. This would include species that are identified as globally endangered, threatened, near threatened or vulnerable. The most recent global listings are noted in IUCN (2009) but these do not recognize species at risk that are identified only at a national scale. Coad et al. (in preparation) provide data on the economic importance of fish species in Iraq, while Rubec and Coad (2007) have developed an interpretation of ecological importance of fish species. Regrettably, no national or current fisheries assessment is available in Iraq which would permit official listing of species at risk in that country. Thus, in this current paper, particular fish species are noted by the authors as possible “SSCs” because they are generally ranked “high” in economic importance and also “high” or “possibly high” due to conservation concerns, are believed or known to be “rare” or “endangered” as a species in Iraq or elsewhere (such as in bordering nations), or are on the IUCN Red List (IUCN 2009). The data presented in Table 3 is meant only as a starting point for ongoing development and review in Iraq. It could provide guidance for further development of fish species and fishery stocks conservation and management measures.

In Coad et al. (in preparation) and as summarized in Table 3, five *Barbus* species are identified as under ecological or economic pressure, particularly in neighbouring countries. It is speculated that this also applies to Iraq. It should be noted that *Aphanius mento* is locally abundant but does not appear to be widely distributed, so it could also be a species at risk nationally in Iraq (it is rarely collected and easily missed as surveys have tended to concentrate on the larger commercial species). The marine species, including the families Carcharhinidae (except *Carcharhinus leucas*), Engraulidae, Clupeidae (except *Tenualosa ilisha* which spawns in freshwater), Ariidae, Mugilidae (except *Liza abu*, a freshwater resident), Hemiramphidae, Belonidae, Platycephalidae, Sillaginidae, Sparidae, Sciaenidae, Gobiidae, Scatophagidae, Stromateidae and Soleidae are all represented by marine populations which are in their “normal” habitat. This is because the economic importance, numbers and conservation needs of these marine species are generally not assessed in Coad et al. (in preparation) which is focused on the species occurring in the freshwater biome of Iraq. However, as many of the marine fish are rare or occasional migrant species to those freshwaters, they are generally not breeding or maintaining large populations in the freshwaters of Iraq. There are also some marine species that have been introduced into saline lakes of Iraq such as *Acanthopagrus latus* (Coad, personal observation).

Discussion of fish fauna in the southern marshes of Iraq

In three years of surveys from 2005 to 2007, the KBA project fish surveys have recorded observations in a range of 41 to 52 fish species (including freshwater and marine entrant species) in the marshes of southern Iraq. The dominant fish in the marshes as recorded by Abd (2005, 2006a, b) for the Nature Iraq Key Biodiversity Areas surveys from 2005–2007 are from the family Cyprinidae. This was also reported

Table 3. Economic importance and potential conservation priority for 16 proposed Iraqi fish “Species of Special Concern” (Sources: Coad et al. in preparation, Rubec and Coad 2007).

Species	Common Names in Arabic and in English [in square brackets] †	Economic Importance	Proposed Priority for Conservation Action
<i>Tenualosa ilisha</i>	Sbour; zoboos; soboor; sobour [hilsa, Indian shad or river shad]	High	High.
<i>Alburnoides bipunctatus</i>	None [spirlin, riffle minnow or riffle bleak]	Moderate	High possibly; “vulnerable” in Europe.
<i>Barbus barbulus</i>	Abu-barattum; abu baratem; abu bratum; nabbash	High	High possibly.
<i>Barbus esocinus</i>	Bizz; farkh; farch; farkh-el-biz; mangar [Tigris salmon, Euphrates salmon, pike barb].	High	High possibly; under severe threat in the Syrian Euphrates; part of a world survey to assess the status of large freshwater fish species by the World Wildlife Fund and the National Geographic Society.
<i>Barbus grypus</i>	Shabout; shabbout; hamrawi [large-scaled barb]	High	High in some regions of Iraq; it is in need of conservation in some parts of its range
<i>Barbus subquincunciatus</i>	Abu khazzama; a’djzan; agzan; adzan. [black spot barb, leopard barbel]	Low	Unknown, possibly High; it is now very rare in Iran and “critically endangered”. Syrian populations in the Euphrates River and parts of its tributaries are also in a perilous state.
<i>Barbus xanthopterus</i>	Gattan; ghattan; kattan; khattan; nobbash; thekar	High	High; this species is now relatively rare.
<i>Caecocypris basimi</i>	None	None	High; listed as Vulnerable (D2) in the 2004 IUCN Red List of <i>Threatened Species</i> .
<i>Cyprinion kais</i>	Bunni saghir; bnaini; kais	None	Moderate; this species appears to be rare.
<i>Typhlogarra widdowsoni</i>	Samak aa’ama [Iraq blind barb]	None	High; listed as Vulnerable (D2) on the 2004 IUCN Red List of <i>Threatened Species</i>
<i>Cobitis taenia</i>	Lakh mukhattat [spined or spiny loach, stone loach, weatherfish, spotted weatherfish, Siberian loach]	Low- moderate	Unknown, possibly high; this species is classified as rare in Europe.
<i>Glyptothorax kurdistanicus</i>	None	None	Moderate-high possibly; poorly known in Iraq and may be rare enough to warrant conservation efforts
<i>Glyptothorax steindachneri</i>	None	None	High possibly; this species is poorly known in Iraq and may be rare enough to warrant conservation efforts should it prove to be a valid taxon.

Species	Common Names in Arabic and in English [in square brackets] †	Economic Importance	Proposed Priority for Conservation Action
<i>Liza abu</i>	Khishni; hishni; hosoon or hashoun; maid; abu-khraiza; abu sukkanejn [abu mullet, freshwater mullet]	High	Moderate; a ban on fishing from mid-January to mid-May has been recommended.
<i>Liza klunzingeri</i>	Maid; biah; biah zahbee; beyah zhabee [Klunzinger's mullet (keeled mullet and back keeled mullet)]	Moderate	Moderate; this species needs to be carefully monitored as it is part of a fishery.
<i>Acanthopagrus latus</i>	Shanak; shagoom; shaam; sha'm; shaem; sheim; sha-om [yellow-finned porgy or seabream, yellow-finned black porgy, Japanese silver bream]	High	Moderate; the status of natural freshwater populations is unclear as they appear quite rare.

† Various versions of Arabic and English common names exist for each species, even within Iraq. This listing does not imply that any of these names are more accurate than those in the next.

by Partow (2001). These remain the most important species in terms of commercial fishery production for the marshes. In terms of dominance in numbers in 2005 to 2007, the leading three species are *Carassius auratus* (locally known as buj-buj), *Liza abu* (khishni) and *Barbus luteus* (himri). The fish that ranks first in catch weights is *Silurus triostegus* (jirri) but this is a species not eaten by local residents for cultural reasons (absence of scales).

These results are comparable to those reported in Richardson and Hussein (2006) – their highest recorded number of species was 23 species in Hammar Marsh, and the lowest was 15 species in Hawizeh Marsh in their 2005 surveys. Those authors also reported greatly reduced catches of the popular, endemic species *Barbus sharpeyi* (bunni), and significant inclusion of marketable but introduced species such as *Carassius auratus* as well as unpopular species such as *Silurus triostegus*. Twenty-two species of fish have been separately reported in the southern reaches of the Tigris River near the city of Qurna (Mohammed 2007) – most of these species were also observed in these KBA surveys. Hussain et al. (2008) report a total of 25 fish species (18 freshwater and seven marine species) in studies of fish composition and ecological indices at three re-flooded marshes in southern Iraq (Suq Al-Shuyukh, Hawizeh and east Hammar marshes) noting the dominant species were *Liza abu* and *Carassius auratus*.

Barbus xanthopterus (gattan) appears to have decreased in abundance in the last several decades which is attributed to drainage of marshes and damage to nursery areas. *Barbus grypus* (shabout) was absent in the 2006 summer KBA survey of all the southern marsh areas. However, Abd (2006b) noted that *B. grypus* has been observed elsewhere in Iraq, notably in the Umm Ar Risaas area near the city of Abadan along the border with Iran.

Of the 16 proposed SSCs in Table 3, *Barbus grypus*, *B. esocinus*, *B. xanthopterus*, and *Liza abu* are also included. *Barbus sharpeyi*, a fish species further noted in the KBA

marsh surveys, may also be of some concern as it is part of the overall *Barbus* family of fish that are all generally under pressure in neighboring countries.

Several areas, where future study and fisheries program development are needed, include:

1. As this aspect of the KBA work was necessarily tied to the field schedule for birds, sampling in other periods of the year with more time for field work is advisable.
2. An assessment of fish food safety needs to be done, as water quality remains poor in many of the areas surveyed.
3. Fish sampling in other regions of Iraq, where field surveys have not yet been possible, is urgently needed.
4. Species that are now observed to be low in abundance will require particular conservation management attention, reduction in fishing, and supplementary production through fish hatcheries and fish farming.
5. National criteria and a listing of fish “Species of Special Concern” should be officially developed for Iraq to assist in targeting conservation and management measures and regulations, both for fisheries stocks and for species at risk.
6. Electro-shocking of fish is practiced in many areas in southern and northern Iraq. Poison and explosives have also been used in certain areas. Particular attention to the introduction of sustainable fishing methods, proper nets and training for local communities and fishermen is urgently needed. This will assist in improving the economic situation for local people and protecting the resource for future generations.

Conclusions

The Key Biodiversity Areas project, based on a rapid assessment approach by Nature Iraq from 2005 to 2007, has identified significant information on the status and distribution of ecologically and economically critical fish species for Iraqis. In three years of surveys, a range of 41 to 52 species (including freshwater and marine entrant species) were recorded in marshes in southern Iraq. Several recommendations are presented for further scientific and management studies. Sixteen fish species are proposed as possible “Species of Special Concern” in consideration of the design of a fisheries management strategy for Iraq based on ecological and economic factors.

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References

- Abd IM (2005) Report on 2005 Fish Surveys in Iraq. Project Report. Baghdad, Iraq: Nature Iraq.
- Abd IM (2006a) KBA Overview. Presentation to KBA Review Meeting. November 6–7, 2006. Damascus, Syria: Nature Iraq and BirdLife International.
- Abd IM (2006b) Fish fauna of southern Iraq. Presentation to KBA Review Meeting. November 6–7, 2006. Damascus, Syria: Nature Iraq and BirdLife International.
- Al-Daham NK (1982) The Ichthyofauna of Iraq and the Arab Gulf. Publication No. 1 (4). Basrah, Iraq: Basrah Natural History Museum. 102 p. (In Arabic).
- Al-Daham NK (1988) Development of fishes in the marshes, south of Iraq – obstacles and solutions. *The Arab Gulf* 20(2): 85–97 (In Arabic).
- Al-Hilli MR (1977) Studies on the plant ecology of the Ahwar region in southern Iraq. Ph.D. thesis. Cairo, Egypt: University of Cairo.
- Al-Zubaidy AJM (1982) Ecological study on algae (phytoplankton) of the marshes near Qurna, southern Iraq. M.Sc. thesis. Basrah, Iraq: Basrah University. 95 p. (In Arabic).
- Coad BW (1991) Fishes of the Tigris-Euphrates Basin: A critical check list. *Syllogeus* No. 68. 31 p.
- Coad BW et al. In preparation. *The Freshwater Fishes of Iraq*. Ottawa, Canada: Canadian Museum of Nature.
- Hussain NA, Saoud HA, Al Shami EJ (2008) Species composition and ecological indices of fishes in the restored marshes of southern Mesopotamia. *Marsh Bulletin* 3(1) (2008) 17–31.
- IUCN (2009) The IUCN Red List of Threatened Species. Gland, Switzerland: The World Conservation Union (IUCN). See: <http://www.iucnredlist.org>.
- Khalaf KT (1961) *The Marine and Freshwater Fishes of Iraq*. Baghdad, Iraq: Al-Rabitta Press. 164 p.
- Mahdi N (1962) *Fishes of Iraq*. Baghdad, Iraq: Iraq Ministry of Education. 82 p.
- Mohammed ARM (2007) Analysis of the fisheries of the Euphrates River, west Qurna, Basrah, Iraq. Proceedings of the Arabian Seas International Conference on Science and Technology of Aquaculture, Fisheries and Oceanography. 10–13 February 2007. Kuwait City, Kuwait.
- Partow H (2001) *The Mesopotamian Marshlands: Demise of an Ecosystem*. Nairobi, Kenya: Division of Early Warning and Assessment, United Nations Environment Program.
- Richardson CA, Hussain NA (2006) Restoring the Garden of Eden: an ecological assessment of the marshes of Iraq. *BioScience* 56(6): 477–489.
- Rubec CDA, Bachmann A (2008) *The Key Biodiversity Areas Program in Iraq: Objectives and Scope 2004–2008*. Project Report. Sulaimani, Kurdistan, Iraq: Nature Iraq.
- Rubec CDA, Coad BW (2007) Economic Importance and Proposed Conservation Priority for Iraq Fish Species. Paper prepared for the Canadian International Development Agency. Gatineau, Canada: Environment Canada and Canadian Museum of Nature.