Application of International Water Law in Eden: Environmental Protection of the Mesopotamian Marshes in Southern Iraq

Michelle Stevens[1], Environmental Studies Department, California State University, Sacramento, Sacramento, CA and Nadir A. Salman, Department of Fisheries & Marine Resources, College of Agriculture, University of Basra, Iraq

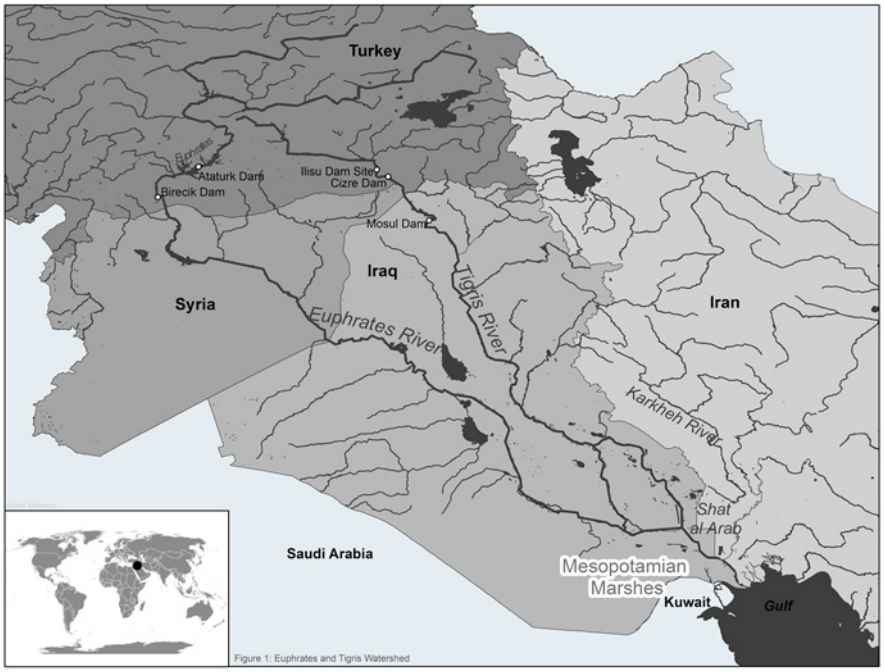
INTRODUCTION

Southern Iraq's Mesopotamian Marshes are fed by the Tigris and Euphrates watercourses. Conflicts in the Tigris-Euphrates Basin over water use and quality are among the most contentious in the world. Increased upstream water withdrawals exacerbated by desertification and regional changes in precipitation and temperature have created a serious water shortage that is becoming increasingly severe. These wetlands need cooperation, reasonable use, and no harm by all watercourse states, especially Turkey, in order to guarantee their survival and conservation. Recent history has not been kind to the Mesopotamian Marshes of southern Iraq or the people that inhabit them. The area has been the scene of three wars and military conflicts over water. The Iran-Iraq War (1980–1988) was fought over international borders, ending where it began at the thalweg of the Shatt-al-Arab. After the Gulf War (1990–1991), over 90% of the marshes were destroyed for military purposes by diverting the Tigris and Euphrates Rivers to destroy the wetlands and indigenous Marsh Arab inhabitants, who became internally displaced persons during this time period (UNEP 2001; Brasington 2002; Naff and Hanna 1993). In 2003, the demise of the previous regime brought renewed flooding to the marshes (Stevens 2011). From 2004-2008, good water years and Iraqi restoration efforts reflooded approximately 58% of the marshes, and many Marsh Arabs returned with their water buffalo (*Bubalus bubalis*) to life in the marshes (Stevens 2011; Al-Handal and Hu 2015). Sadly, the marshes are again desiccated to 2003 levels due to upstream dam construction in Turkey and drought. Civil unrest continues and is escalating with tragic consequences.

Application of international water law by water managers and policy makers may help prevent harm to the human and ecological health indigenous to the Mesopotamian Marshes of southern Iraq, sustained by the Tigris and Euphrates watersheds (Figure 1). Environmental protection is accomplished through application of the 1997 United Nations (UN) Convention on the Law of Non-Navigational Uses of International Watercourses, the Ramsar Convention, and customary principles of international water law. As with other international transboundary rivers—the Nile, Zambezi, Mekong, Amazon, and Colorado—upstream water diversions, dams for irrigation and hydroelectric development, and increasing human populations and related water consumption result in loss of downstream water for human welfare, biodiversity and ecosystem function.

The purpose of this article is to describe the physiographic and socioeconomic conditions that characterize the Mesopotamian Marshes and demonstrate how upstream water diversions are harming downstream ecosystems, biodiversity, and human well-being. The discussion includes background on the past failures of water agreements, clarifying the root causes and national perspectives of each co-riparian state over the flows of the Euphrates and Tigris Rivers and emphasizes the importance of using

FIGURE 1.
Tigris and Euphrates Basin. (Arlette Marenco 2015)



[1]Corresponding author, email: stevensm@csus.edu

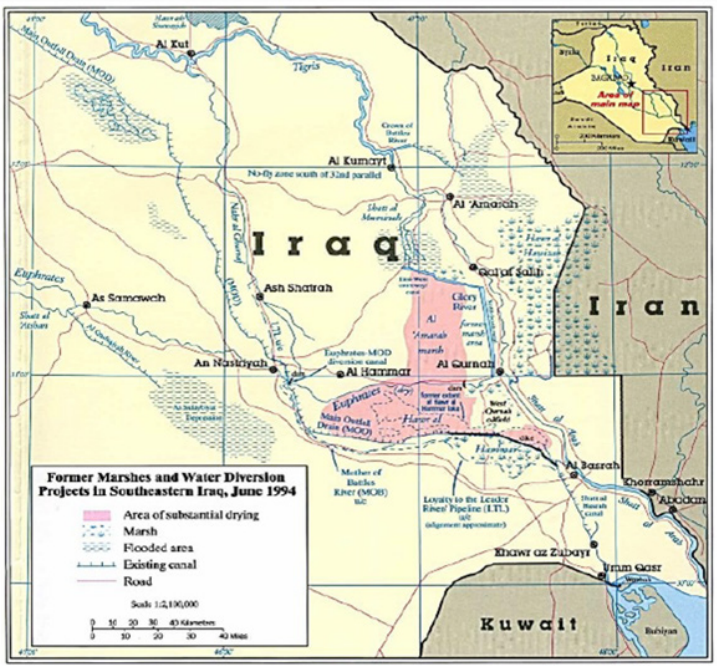
international water law to protect, preserve, and conserve the Mesopotamian Marshes and Gulf. The Tigris-Euphrates Basin is an analog for other international transboundary river systems and should be viewed as a prequel for the need to assess current water management practices and implement a wiser approach.

PHYSIOGRAPHIC BACKGROUND / HYDROLOGIC CONSIDERATIONS

The headwaters of the Euphrates and Tigris Rivers form in the Taurus Mountains of southeastern Turkey (Figure 1). The 2,700 km Euphrates River and 1,900 km Tigris River flow through Syria and Iraq, joining together in the 193 km Shatt al Arab, then discharging into the Gulf (FAO 1999; El-Fadel et al. 2002). The headwaters of the Tigris-Euphrates watershed in Turkey, Syria and Iran support approximately 70% of the water entering the basin. Historically, the downstream Mesopotamian Marshes thrived from pulsed flood flows in the spring that renewed soil fertility, deposited sediment, and eliminated concentrated salts at the marsh surface. Unfortunately, upstream water diversions now eliminate the seasonal flooding that drove the ecological dynamics of the marshlands (Al-Ansari et al. 2012, 2013).

External water sources are critical to maintain marshes in southern Iraq, which is a desert with an average annual rainfall of 154 mm. Precipitation ranges from less than 100 mm over 60% of the country in the south to 1200 mm in the northeast. Evaporation and evapotranspiration vary depending on temperature and wind velocity, with overall evapotranspiration and transpiration losses averaging 1900 mm per year (Al-Ansari 2013).

FIGURE 2.
Mesopotamian Marshes in southern Iraq. (US-AID Report 2004)



At one time, the Mesopotamian Marshes of southern Iraq (*Al-Ahwar*[2] in Arabic) were the largest wetland ecosystem in the Middle East, covering 15,000–20,000 km^2 (UNEP 2001). This area has been inhabited since the dawn of civilization by ancient agricultural and civilized communities, including the Sumerians and Akkadians during the period 4000–6000 BCE (Ochsenschlager 2004; Hritz et al. 2012). The marshes are a cultural heritage center of global importance, having supported the traditional lifestyles of approximately 500,000 indigenous people — the Marsh Arabs (Stevens et al. 2011).

Wetlands within the Mesopotamian Plains of Iraq form an island of vegetation within a matrix of desert vegetation and dunes (Al-Hilli et al. 2009). These wetlands play a vital role in the maintenance of biodiversity in the Middle East primarily because of their large size, the richness of their aquatic vegetation, and their isolation from other comparable systems (Stevens 2011; Douabul et al. 2013). The marshes form a river of very tall grass dominated by the common reed (*Phragmites australis*), an ecological and cultural keystone species (Stevens 2007). A total of 371 plant species were recorded by Al-Hilli et al. (2009), of which approximately 40% were wetland obligate or facultative species. Tall emergent plant communities define the marshes, and are dominated by *P. australis, Typha domingensis*, *Scirpus littoralis*, and *Cyperus papyrus* (Al-Hilli et al. 2009). The marshes have become more saline and biodiversity has declined with reduced inflows.

The wetlands of Lower Mesopotamia comprise shallow lakes and marshes, formed on two large, flat, and active fan deltas fed by the flows and floods of the Tigris and Euphrates Rivers and their distributaries (Al-Ansari et al. 2012). Figure 2 illustrates the three geographic areas of the Mesopotamian Plain: the Hammar wetlands to the west of the Euphrates; the Central Marshes; and the Al-Hawizeh and Al-Azim transboundary marshes straddling the Iran-Iraq border. Conditions that shape the biotic communities of the Mesopotamian Marshes include 1) fluvial flood pulses and sediment deposition, 2) influences from the distributary rivers, 3) tidal estuarine mixing of salt-and freshwater in the Shat al-Arab, and 4) groundwater in the southern marshes (Altinbilek 2004).

The marshes are legendary for their birdlife. In the fall months up to 10 million migratory waterfowl and shorebirds make their way from Siberian nesting grounds to the Mesopotamian Marshes and northern Africa (Scott 1995; Stattersfield et al. 1998; Porter and Aspinall 2010). Surveys by Nature Iraq from 2005 confirmed 190 breeding bird species for Iraq (Nature Iraq 2010b; Ararat et al. 2011). This area supports 22 globally endangered and 66 at-risk avian species (Birdlife International 2010). The endemic Iraq babbler (*Turdoides altirostris*) and the Basra reed-warbler (*Acrocephalus griseldis*) breed only in the marshes.

[2]The term "al ahwar: is derived from Aramaic meaning "whiteness" or "the illumination of sunlight on water".

The marsh ecosystem sustains an economically important local and regional fishery, providing spawning habitat for migratory finfish and penaid shrimp from the Gulf (Salman 2011b). Over 58 freshwater fish species occur in Iraqi inland waters, whereas 53 marine species frequent both estuarine and fresh water (Coad 1996, 2010), and 125 fish species and five species of shrimp reside in the Iraqi marine waters (Mohamed et al. 2001).

Fish populations are diminishing and habitat is being lost from enormous hydrologic modifications from the Tigris and Euphrates rivers (Mohamed et al., 2012). Dampening of annual high-water flood pulses has removed natural spawning cues of fishes and reduced the annual deposition of silt-borne nutrients to the floodplains. Within the marshlands, manmade canals exclude the natural habitats required by fish for their reproduction and growth. Remaining marsh habitats have been embanked and partitioned, restricting the connections between the various habitats required by fish for their different life stages.

SOUTHEASTERN ANATOLIA PROJECT (GAP PROJECT)

In 1977, the Turkish Government started the GAP Project, one of the largest river basin development projects in the world. The GAP Project includes 22 dams and 19 hydraulic power plants that are to irrigate 17,103 km^2 of land with a storage capacity of 100 km3, three times more than the capacity of Iraq and Syrian reservoirs (Al-Ansari and Knutsson 2011). The GAP Project will reduce the Euphrates River water flow to Syria by 40–50%, leaving Syria and Iraq in conflict over the residual water. The estimated water reduction to Iraq is approximately 80% (Bagis 1997).

A regional crisis occurred with the building of Ataturk Dam in 1990 and Birecik Dam in 1996, resulting in reduced flows and impaired water quality in the Euphrates River (Kibaroglu and Unver 2000). In 1998, Turkey pledged a release of an amount of 500 m^3/s to the Euphrates River at the Syrian border (Bagis 1997). In April 2009, only 230 m^3/s were trickling through the Euphrates River at Iraq's northern border (Alwash 2013).

Prior to 1972, the mean water discharge of the Euphrates River at Hit and Haditha cities was 967 m^3/sec and dropped to 553 m^3/sec after 1985 (Figure 3), resulting in a 43% decrease in river water discharge (Al-Ansari and Knutsson 2011). The decrease is attributed to the construction of the Ataturk and Birecik Dams. Note that flood pulses were also dampened.

Reduced flows of the Tigris River is of even more cultural and political significance to the Iraq. Historically, the Tigris River carried an average of 22 BCM (billion cubic meters) annually into Iraq, and its tributaries within Iraq contributed an additional 28 BCM (Alwash 2013). The proposed Ilisu Dam on the Tigris River is one of the world's most controversial hydropower projects. Ilisu Dam will create an 11 billion m^3 reservoir with a surface area of 31 km^2, providing 2% of Turkey's electricity needs (Scheumann et al. 2011; UN-ESCR 2011). Unfortunately, the Ilusu Dam will internally displace an estimated 55,000 Anatolian people in 199 settlements, creating human rights violations in southeastern Turkey (Ibid.). The Ilusu Reservoir will also flood more than 30,000 hectares of land (74,000 acres), destroying archaeological sites and regional biodiversity. Of particular concern is the inundation of the 10,000-year-old proposed World Heritage Site of Hasankeyf.

The Tigris River, unlike the Euphrates, has several tributaries. Prior to 1984, Iraq received 20.9 km^3/year of water from the Tigris River (a discharge rate of 701 m^3/sec

FIGURE 3.
Water discharge of River Euphrates at Haditha Dam for the period 1960-2008. (Al-Ansari and Knutsson 2011)

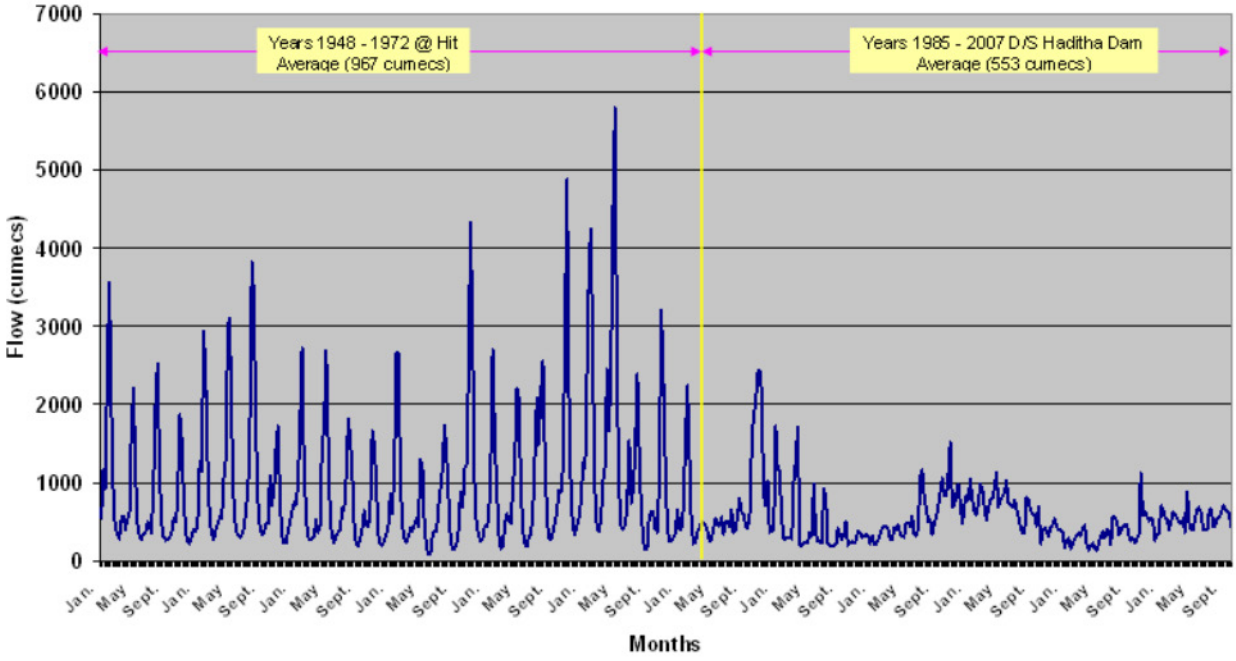
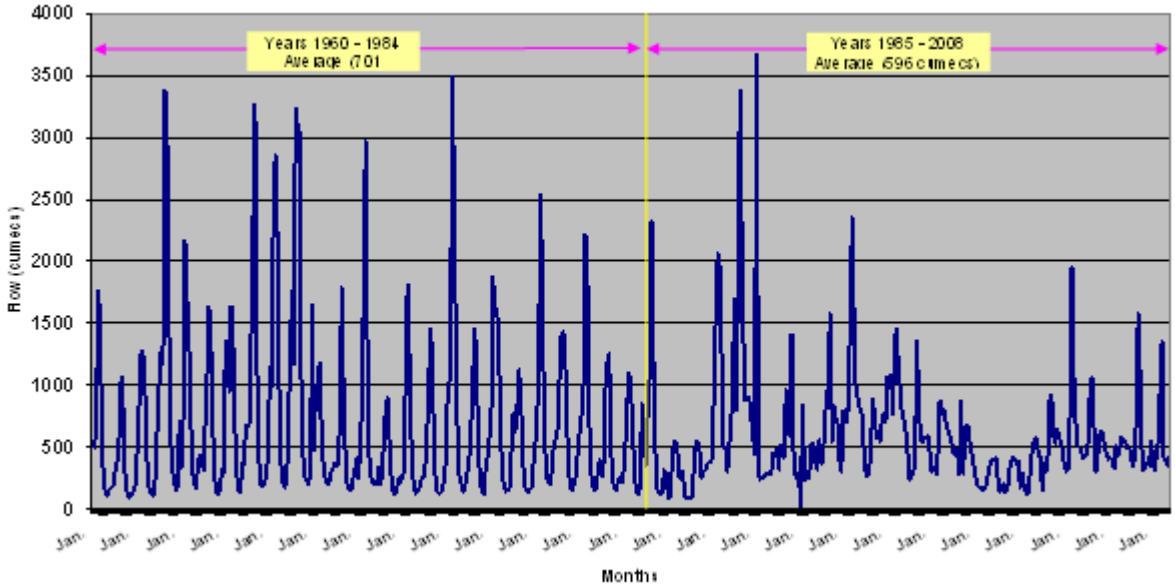


FIGURE 4.
Water discharge of River Tigris at Mosul City for the period 1960-2008. (Al-Ansari and Knutsson 2011)



at Mosul City). After 1984, this rate dropped to 596 m^3/sec (Figure 4) for a decrease of 15% (Al-Ansari and Knutsson 2011). Once Ilisu and Cizre Dams are constructed, flows are likely to drop to 9.7 km^3, a reduction of 47% (Al-Ansari and Knutsson 2011), affecting some 670,000 hectares of arable land in Iraq.

Without an effective international water management strategy, Turkey is free to act unilaterally; as the upstream water user, dams and diversions will determine downstream flows of the Tigris and Euphrates Rivers (Salman 2004; Wolf and Newton 2007; UNEP 2008). Downstream users, with little available surface water, are forced to deplete their non-renewable groundwater reserves, intensifying saltwater intrusion from the Shat al-Arab and contamination of freshwater.

The Gravity Recovery and Climate Experiment (GRACE) satellite mission evaluated freshwater storage in the Tigris and Euphrates River Basins and western Iran from 2003 to 2009 and provided a tool for water management decision-making at a transboundary scale (Rodell et al. 2004; Voss et al. 2013). Water storage in the region shows a clear decline after 2007 which marked the beginning of a regional drought and upstream water diversions. The GRACE model showed that the rate of water loss in the Euphrates River is among the largest liquid freshwater losses in the world. The 143.662.8 km^3 loss during the 7-year study is nearly equivalent to the volume of the Dead Sea (Voss et al. 2013). Between 2003 and 2009, groundwater use increased in response to the drought and declining surface water availability (Famiglietti et al. 2011).

Climate change models project lower water availability in the future. By the end of this century, mean temperatures in the Middle East North African (MENA) region are projected to increase by 3° to 5°C, while precipitation will decrease by about 20% (Elasha 2010). By 2050, water runoff will decline by 20% to 30% in most of the MENA region, and water supply might decline by 10% or more (Milly et al. 2005).

The goal of the Iraq Ministry of Water Resources (MOWR) and Center for Restoration of Iraqi Marshes and Wetlands (CRIMW) was originally to restore 75% of the original area of the marshes (UN-IWTF 2011). This translates into an area of 1,800 km^2 for Al-Hammar Marsh; 1,800 km^2 for the Central marshes; and 2,425 km^2 for the Al Hawizeh and Central Marshes, respectively (Al-Ansari et al. 2012). Therefore, the quantity of water required for each marsh is 3,262 m^3, 5,495 m^3 and 4,128,106 m^3, respectively (Al-Ansari et al. 2012). There is not enough available water to meet restoration goals, necessitating revision to reflect reduced water supply (Salman 2004; Chenoweth et al. 2011).

WATER SUPPLY AND WATER QUALITY

Water quality degradation throughout the Mesopotamian marshes is caused by reduced flows, saline drainage from direct discharge of irrigation return flows, retention of sediment and nutrients behind dams, and discharge of industrial waste and raw sewage to surface waters (UNEP 2001). The heavy use and contamination of water by the oil industry has exacerbated water quality problems (Rubec 2013). Salinity of the Chubayish marshes increased from 0.4–0.6 g/dm^3 in the 1970s (Al-Saadi et al. 1981) to 6.3 g/dm^3 during 2008–2009 (Abd 2010). Increased salinity correlates to reduced vegetation productivity and decreased biodiversity (Hamdan et al. 2010).

The depletion of water flow and poor-quality water in Iraq (unusable for agriculture or homes) is a national tragedy. Over one third of the population of Iraq has no access to potable water and the quantity of water production is decreasing to 53% of the demand (Al-Ansari 2013). Alleviation of this environmental crisis can only be achieved

by an internationally facilitated accord and legal agreement between the transboundary countries on the Tigris and Euphrates Rivers.

IMPACTS ON FISH PRODUCTION AND BIODIVERSITY

The Mesopotamian Marshes and its fisheries have suffered from the enormous hydrologic modifications summarized above (US-AID Report 2004). The fisheries productivity of healthy floodplain rivers is roughly proportional to the total area of the waters in the high-water flood season (US-AID Report 2004). In 2000, the total post-drainage flooded area of the Mesopotamian Marshes was only 14.5% of the pre-drainage marsh area in 1973–1976 (UNEP 2001). Most of the remaining wetland area was in Hawizeh Marsh, with 3% in Central Marsh, and 6% in Hammar Marsh. Even if there had been no other influences on the system, the fisheries productivity of these areas has declined in approximate proportion to this loss of floodplain areas.

Fish productivity was greatly reduced by impaired water quality, overharvesting, and loss of habitat (Richardson et al. 2005, 2006; Mohamed et al. 2012). Altered military diversions during the 1990s resulted in stagnation, lower water quality, lower dissolved oxygen levels, increased salinity, and low water elevation (FAO-Iraq 2010; Mohammed et al. 2012). Eutrophication has resulted in large fish kills, particularly during low-flow periods in summer and fall. The Tigris River is more vulnerable to salinity impacts than the Euphrates River due to lower dissolved mineral content (Hamdan et al. 2010).

Deterioration of water quality led to the disappearance of several cyprinid species even before desiccation (Coad 2010). Economically important fish species substantially decreased in number or became locally extirpated (e.g., gattan - *Barbus xanthopterus*, giant biz - *Barbus esocinus*, and shabout - *Barbus gyrpus*). Bunni (*Barbus sharpeyi*) - historically the most important endemic fish species with the highest commercial value – has greatly declined in numbers and size. The most abundant fish are now non-commercial, small-sized fish species (such as *Liza abu*), representing a serious deterioration of fish resources.

Marsh Arabs estimate that four truckloads of fish were sent daily to urban areas north of Al-Chubayish, the largest town in the marshes, until 1991 (US-AID Report 2004). Fish were originally caught with tridents and nets, with mesh sizes getting smaller as fish catches decreased. Fishing practices were non-sustainable. Some fishers used mesh or cloth from which nothing escaped; others used poisons and electric shocking to take the final fish remaining in the drying ponds. Environmental assessments detected many cases of toxicity in the water, plants, and fish (Salman 2011a). Many chronic effects of toxicity-related factors have been detected among fish populations.

The Al-Hawizeh Marsh provides a specific case study. During last the two decades, 65% of the permanent Al-Hawizeh Marsh was drained, which led to a substantial loss of native aquatic flora and fauna (Abdul-Razak et al. 2008; Abd 2010; Mohamed et al. 2012). The marsh was re-flooded in 2003. Fish assemblage characteristics were sampled from 2005-2006: a total of 4,715 fish representing 15 species were caught. Several cyprinid species disappeared from the restored marshes or decreased in abundance due to increased salinity, scarcity of benthic food resources, and competition with alien/introduced fish species.

FAO (1990) estimated that the total inland catch of fish in Iraq was 23,600 tonnes, with over 60% of this coming from the Mesopotamian Marshes (UNEP 2001). Fish production in the Iraq inland waters declined from an average of 21,000 tonnes during 1994-1997, to an average of 11,000 tonnes during 1998-2002 (FAO-Iraq 2010). Per capita fish supply (including marine fisheries and aquaculture) is 0.8 kg (in 2005) - very low compared to 14 kg internationally (FAO-Iraq 2010).

The loss of marshlands as fisheries habitat and a natural water quality filter between the Shat al- Arab and the Gulf has resulted in noticeable degradation of water quality along the coast of Kuwait (Al-Ghadban et al. 1999; Saeed et al. 1999; Al-Yamani et al. 2007). Several marine fish species of great economic importance in the Gulf are dependent on the estuarine systems and marshes for spawning (Hussain et al. 1994) or feeding (Hussain et al. 1987; Hussain and Ahmed 1995). The penaid shrimp (*Metapenaeus affinis*) migrates seasonally between spawning grounds in the Gulf and the nursery and feeding grounds of the East Hammar Marsh (Mathews et al. 1986).

ADVERSE SOCIOECONOMIC IMPACTS

Adverse socioeconomic impacts to marsh inhabitants demonstrate "harm" under international water law from upstream water diversions, reduced water supply and impaired water quality. The Mesopotamian Marshes are a landscape sustainably managed for thousands of years (Stevens 2011). To support a sustainable harvest of culturally important resources, the indigenous residents of the marshes, called Marsh Arabs, actively managed resources such as gathering reeds, fishing, bird hunting, and caring for water buffalo (Figure 5; Salim 1962; Ochsenschlager 2004; Jwaideh 2007; Stevens 2007). Water buffalo have played a cultural role similar to that of the camel in Bedouin Arab culture (Thesinger 1964). Agricultural activities included seasonal work growing grain and field crops, and date palm plantations. Without water, the Marsh Arab way of life and the marsh fauna and flora will end.

In the 1950s and 1960s, the main elements of the marshlands economy in southern Iraq were based on their biological diversity. Subsistence fishing was practiced widely, and fish were a major food item for people inhabiting the marshes (US-AID Report 2004). Although only a small number of tribes utilized fishing as a primary economic livelihood, fishing played an important role in the local economy when fishing markets were accessible.

FIGURE 5.
Marsh Arab women collecting reeds. (M. Stevens photo)

Most inhabitants of the Al-Huweiza Marsh today work as fishermen or with animal husbandry; few have other temporary jobs (FAO-Iraq 2010). The most serious problems are high unemployment and lack of job opportunities to earn a livelihood. Transportation to jobs is lacking. Most Al-Huwiza Marsh inhabitants lack financial ability to build suitable housing. Marsh inhabitants have a very low education level, likely related to lack of access to schools. In addition, poverty forces all individuals over 6 years old to work to support their families rather than attend school. The lack of basic services, such as potable water and regular supply of electricity, creates hardships and suffering (FAO-Iraq 2010).

Social instability, disintegration of community linkages, and direct dependence on diminishing local natural resources increases the vulnerability and insecurity of marsh inhabitants. (FAO-Iraq 2010). Marsh inhabitants face many health problems, and there is a shortage of nearby health clinics. Increased social and environmental instability has led to an increase in violence. A combination of conflicts, lack of water, and lack of jobs cause inhabitants to become internally displaced and flee their villages.

INTERNATIONAL WATER LAW

For over 4,000 years, the lands irrigated by the Tigris and Euphrates Rivers have been the scene of conflicts to divide and exploit them (Bagis 1997; Al-Ansari et al. 2012). International water law has the potential to develop a communication nexus to discuss water scarcity and regional water management in order to avert ecological and socioeconomic crises, and reduce the potential for conflict (McCaffery 2007). These laws and agreements can be used to develop a basin-wide planning instrument that protects the downstream co-riparian state's claim to the use of water.

The most significant transboundary issue in the Tigris-Euphrates watershed that needs to be resolved between the neighboring countries of Turkey, Syria and Iraq is declining water supply and water quality, with increased severity progressing downriver. Viable tools for the protection of the Mesopotamian Marshes include the UN 1997 Convention on the Law of Non-Navigable Uses of International Watercourses (UN-WC 1997) and the 1971 Ramsar Convention on Wetlands of International Importance (Ramsar Convention) (Ramsar 2013; UN-ECE 1992). Also, renewing or adapting a Joint Trilateral Committee between co-riparian countries on water allocation will do a great deal to promote communication and data sharing between countries, serving as de facto hydro-diplomacy (El-Fadel et al. 2002; Al-Ansari and Knutsson 2011; Kibaroglu and Scheumann 2013).

Traditional Islamic law has treated water as a communal resource since the Code of Hammurabi (pre-1750 BCE). *Al-Hima (*meaning protected area or place) is a traditional Islamic system of resource tenure, and is the

most widespread and long-standing indigenous conservation institution in the Middle East (Kilani et al. 2007; Stevens 2013). The *al-Hima* tradition has the potential to promote sharing and allocation of water for the benefit of the whole society. The recently established Mesopotamian Marshlands National Park is a successful example of well-planned conservation and water use. Local stakeholder involvement is promoted for capacity building, education, health, and wise use.

The first treaty that established harmonious relations among the co-riparian states was the 1946 Treaty of Friendship and Good Neighbourly Relations. In the 1950s, management plans were developed (mainly between Iraq and Turkey) to control flooding and provide water storage (Carkoglu and Eder 2001; Kibaroglu 2007). This simplified the path toward developing major water and land resources projects. Since the 1960s, major developments in the region include Turkey's development of the Southeastern Anatolia Project (GAP), Syria's development of the Euphrates Valley Project, and Iraq's development of the Thartar Canal Project (Kibaroglu 2007).

Co-riparian states hold conflicting positions on international water law and terminology that have prevented a basin-wide agreement, with the exception of the 1987 Protocol for Technical and Economic Cooperation (PTEC) (Altinbilek 2004). The PTEC is an interim agreement on water quantity, which states that an annual 16 BCM (500 m^3/s) is to be released at the Syrian-Turkish border. This was the only agreement achieved by the Joint Technical Committee (JTC), which met continuously from 1981 to 1992. The substantive issue at stake that defeated the JTC negotiations was that Turkey considers the Tigris and Euphrates Rivers a single transboundary river, and refuses to consider co-sovereignty with downstream countries. Iraq and Syria consider the Euphrates River to be an integrated system that should be shared.

Turkey's claims on the Euphrates and Tigris Rivers are based on the acknowledgement that the headwaters are located in Turkey and, therefore, it has the sovereign right to utilize water resources in any way it desires (Kibaroglu 2007). Turkey considers the Euphrates and Tigris Rivers as a single transboundary river system that crosses a common political border (Kibaroglu and Unver 2000), and emphatically does not consider downstream countries as having the rights of co-sovereignty. Turkey says that under international water law, each co-riparian state of the transboundary watercourse has the sovereign right to make use of the water that flows through its borders, and that each co-riparian state has the option of "equitable and optimal utilization" of such waters provided that such utilization does not create appreciable harm to other co-riparian states. Turkey states that building dams, including diversion of irrigation water for agriculture and hydroelectric generation, constitutes equitable utilization (Kibaroglu and Scheumann 2013).

It is Iraq's position that the Euphrates and Tigris Rivers are "international watercourses," and they have special "acquired rights" relating to its ancestral irrigation practices, with special emphasis on the Tigris River (Kibaroglu and Unver 2000). Iraq argues that for thousands of years these rivers have given life to Mesopotamia, and thus represent an acquired or "historical" right of the Iraqi people. Iraq regards the Tigris River as their sovereign right and rejected the Turkish offer to compensate for scarcity of water in the Euphrates River by surplus in the Tigris River. Therefore, Iraq believes Turkey should neither obtain nor decide alone on the quantity of water that should flow to Iraq and Syria. Iraq's second argument for acquired rights is the presence of prior use of existing water development projects, such as dams, irrigation systems, and water installations. Turkey argues against the waste, antiquity, and poor repair of the existing Iraqi water systems. Iraq does have a problem with inefficient and antiquated infrastructure.

Both Syria and Iraq consider the Euphrates River as an "international river" that should be treated as an integrated system that is to be shared (Kibaroglu and Unver 2000). Both Iraqi dams (at Haditha and Mosul) function at reduced capacity due to upstream dams on the Euphrates River. Mosul Dam was built on highly soluble, fractured, and jointed gypsum beds; it is in a high risk condition and close to complete collapse (Al-Ansari et al. 1997; Muir 2007). Three Syrian dams on the Euphrates River have flaws in construction and operation, leading to reduced water availability and power generation.

Mosul Dam is also the staging area for recent conflicts with ISIS, making either engineering or political solutions impossible at this time. Another variable has entered the equation: security analysts say the outcome of the Iraq and Syrian conflicts may rest on who controls the region's dwindling water supplies, which are now military targets. Wars of the next century may be over water, which is at the top of the international political agenda (Berman and Wihbey 1999; Samson and Charrier 1997).

Unfortunately, there is no formal agreement between all three countries concerning the Euphrates and Tigris Rivers. The Euphrates River is subject to two bilateral accords: 1) an agreement between Syria and Turkey specifies the minimum average flow of 500 m3/sec at the Syrian-Turkish border, and 2) the 1990 Syrian-Iraqi Water Accord - Iraq is supposed to receive 58% of the Euphrates River flow, which crosses the Turkish-Syrian border, while Syria is to receive 42% (Al-Ansari 2013). Turkey promised minimum flows of 9 km^3/year to Iraq; however, only 0.03 km^3/year is available (Al-Ansari and Knutsson 2011).

Most recently, the 2009 Iraq-Turkey Memorandum of Understanding (MOU) established an accord to improve water quality and the number of shared water pumping stations and dams (Al-Ansari 2013). Syria and Turkey agreed to cooperate in controlling pollution of common Euphrates River waters and to decide on methods to determine the

reasonable and appropriate water flow that each country needs. Syria and Turkey also agreed to share hydrological and meteorological data and expertise (Kibaroglu 2007). These agreements did not include Iraq. The current civil war in Syria, and resulting refugees flooding across the borders into Turkey has created an impasse to water allocation discussions.

1997 UNITED NATIONS WATERCOURSE CONVENTION

The 1997 UN Watercourse Convention on the Law of the Non-Navigational Uses of International Watercourses is the most comprehensive, authoritative, and universally applicable framework of international water law. It pertains to the uses and conservation of all waters that cross international boundaries, including both surface and groundwater (UNWC 1997; Milanes Murcia et al. 2013; Kibaroglu et al. 2013). Entered into force on August 17, 2014, the convention has been ratified by 36 states, including Iraq, Syrian Arab Republic, Jordan, Lebanon, and the State of Palestine. Unfortunately the key upstream states on the Tigris and Euphrates Rivers of Turkey and Iran are not signatories.

The principles codified in the 1997 UN Watercourse Convention provides a management approach to apply to each watercourse, requiring all watercourse states to ensure the protection and preservation of ecosystems through cooperation, reasonable utilization, and causing no harm along the entirety of each basin (UNWC 1997; Murcia Milanes et al.2013). The Convention emphasizes cooperation between co-riparian states toward achieving a regime of equitable and reasonable utilization for the international watercourse system as a whole. An analysis of these instruments reveals the best practices to sustainably manage the Tigris and Euphrates transboundary basin.

The Convention sets forth "limited territorial sovereignty" as the international standard and seeks to prevent significant harm to downstream co-riparian states while allowing equitable utilization by upstream coriparian states.

International water laws propose the equitable and reasonable allocation of water, taking into account various factors including: natural physiographic factors; socioeconomic needs of each water course state; population; past and present utilization; existing and potential use of water; and the extent to which the needs of each coriparian state can be met without damage to the needs of other states (El-Fadel 2002). International water law often fails to include ecological functions and services, biodiversity, culturally significant resources, and social justice in consideration of equitable and reasonable allocations of water.

INSTRUMENTS FOR WETLAND PROTECTION

The Ramsar Convention (formerly called the Convention on Wetlands of International Importance, especially as Waterfowl Habitat) focuses on wetlands protection and conservation. The mission of the Ramsar Convention is "the conservation and wise use of all wetlands through local and national actions and international cooperation" (Ramsar 2013).

Hawizeh Marsh, the largest wetland in the region, was Iraq's first Wetlands of International Significance in 2007 for its historical, cultural and environmental legacy (Nature Iraq 2010a, 2010b, 2012).

In June 2010 due to disruption of water inflows, the Hawizeh Ramsar Site was placed on the Montreux Record - a list of Ramsar sites where changes in ecological character have occurred or are likely to occur (Rubec 2013). Reduced inflows and impaired water quality have had a significant negative impact on the Hawizeh Marshes and the northern Gulf marine environment (UN-IWTF 2011). Inflows from the Karkheh River into the southern marshes were diverted via construction of an upstream dam and dike inside Iran, effectively bisecting the transboundary marshes (see Figure 1; Al-Handal and Hu 2015). Inflows from the Tigris River into the northern marshes are threatened by construction of Ilusu and Cizre Dams in Turkey. In January 2009, the Key Biological Area assessment team found a total of 49 avian species and over 25,000 individuals in a single site in the northern marshlands (Nature Iraq 2010b; Alwash 2013). By the fall of 2009, the southern Hawizeh Marsh had completely disappeared, and the habitats for thousands of waterfowl were gone—a clear tragedy under the Ramsar convention.

As of this date no urgent action has been taken to save the Hawizeh Marsh wetlands, the southern Hawizeh remains dry, and northern section is threatened with destruction. In January 2014, CRIMW and MOWR invited the Ramsar Secretariat to review the status of the Hawizeh Marsh Ramsar site (Rubec and Young 2014). A meeting was held with representatives from Iraq government ministries, governorates, non-profit organizations, Nature Iraq, the oil sector, academics, and local stakeholder's organizations (Nature Iraq 2010a; UN-IWTF 2011; Rubec 2013; Rubec and Young 2014). The key recommendations from the 2014 meeting were to implement the Hawizeh Marsh Management Plan and to improve collaboration and communication among stakeholder groups. Upstream water withdrawals and oil development in the Majnoon oilfields adjacent to the southern marshes makes it unlikely that the marshes will ever be flooded to their original area.

Rubec and Young (2014) recommend that Turkey and Iraq find an economic model that both countries could agree on to facilitate the sale of oil to turkey in exchange for water for Iraq. They also recommend that small steps be taken to build trust and cooperation between relevant agencies in Iraq and the Islamic Republic of Iran to promote the conservation of both the Al-Hawizeh Marsh (Iraq) and the Al-Azim Marsh (Iran).

While Ramsar designation does not provide legal protection for the Hawizeh Marsh Ramsar Site, the advantages to Iraq for designating the Wetlands of International

Significance include increased community engagement, improved management planning and scientific research, access to funding and capacity building, and increased public visitation and appreciation (Rubec 2013). At some point in the future, the Hawizeh Marsh Ramsar site may provide public focus for conservation and "green tourism." Hope remains for a peaceful future, where the legacy and heritage of the Hawizeh Marsh Ramsar Site may be enjoyed by future generations.

MESOPOTAMIAN MARSHLANDS NATIONAL PARK

Iraq's first National Park, designated in 2013, not only represents history as Iraq's first national protected area, but also serves as an inspiring solution for people and nature in an area once decimated by conflict and destructive policies. Azzam Alwash, founder of Nature Iraq, said:

With this action, Iraq has acted to preserve the cradle of civilization. It is now the duty of the world to help Iraq maintain these wetlands for the future generations by helping Iraq, Turkey, Syria, and Iran to reach an equitable agreement on the sharing of the waters in the basin of the Tigris and Euphrates.

CONCLUSION

The application of international water law is essential to sustain human well-being, biodiversity, and ecosystem functions in the Mesopotamian Marshes (Eden) and northwestern Gulf. Application of the standards of international water law includes cooperation, reasonable use, and no harm by all watercourse states in the Tigris-Euphrates Watershed. Implementation of the 1997 UN Convention on the Law of Non-Navigational Uses of International Watercourses, the Ramsar Convention, and customary principles of international water law will contribute to water resource and wetlands conservation, and improve regional security in transboundary river systems. International rivers and wetlands are at risk for the causal factors of upstream water diversions, increasing water consumption, and impacts of climate change resulting in the loss of life-giving waters. The most important first step is renewing a Joint Technical Committee with co-riparian countries to promote regular communication, exchange of data and expertise, determine reasonable and appropriate water flows to meet each country's needs, and to move toward creation of a legally binding agreement for fair and equitable water use of the transboundary river waters. ■

ACKNOWLEDGEMENTS

I would like to thank the CSU Sacramento Provost's Research Incentive Fund Program for support for this project.

REFERENCES

Abd, I.M. 2010. Ecological assessment of Chybaesh marsh using ecological and biological indices. Ph.D. thesis. Basrah University, Iraq.

Abdul-Razak, M., N.A. Mohamed, S.S. Hussain, F.M. Al-Noor, I.M. Mutlak, I.M. Al-Sudani and A.M. Mojer. 2008. Ecological and biological aspects of fish assemblage in the Chybayish marsh, southern Iraq. *Ecohydrology & Hydrobiology* 12(1):65–74.

Al-Ansari, N.A., M. Abdellatif, S.S. Ali and S. Knutsson. 2014. Long term effect of climate change on rainfall in Northwest Iraq. *Cent Eur J Eng* 4(3):250–263.

Al-Ansari, N.A. 2013. Management of water supplies in Iraq: Problems and prognosis. *Engineering* 5:667–684.

Al-Ansari, N.A., S.Knutsson and A. Alis. 2012. Restoring the Garden of Eden, Iraq. Journal of *Earth Sciences & Geotechnical Engineering* 2(1):53–88.

Al-Ansari, N.A. and S. Knutsson. 2011. Toward prudent management of water resources in Iraq. *J Adv Sci Eng Res* 1:53–67.

Al-Ansari, N. A. and O. Rimawi. 1997. The influence of the Mosul dam on the bed sediments and morphology of the River Tigris. IAHS Publications-Series of Proceedings and Reports-*Intern Associated Hydrological Sciences* 245:291–300.

Al-Ghadban, A.N., T. Saeed, A.M. Al-Dousari, H. Al-Shemmari and M.A. Al-Mutair. 1999. Preliminary assessment of the impact of draining of Iraqi marshes on Kuwait's northern marine environment. Part 1. Physical manipulation. *Water Science & Technology* 40(7):75–87.

Al-Handel, A. and C. Hu. 2015. MODIS Observations of human-induced changes in the Mesopotamian Marshes in Iraq. *Wetlands* 35:31–40.

Al-Hilli, M.R.A., B.Warner, T.Asada and A.Duabul. 2009. Vegetation and environmental controls in the former wetlands of southern Iraq. *Wetlands Ecol Manage* 17:207–223.

Al-Saadi, H.A., S.R.Antoine and A.K.M. Nurl Islam. 1981. Limnological investigation in Al-Hammar marsh area in southern Iraq. *Nova Hedwiga* 35:157–166.

Al-Yamani, F.Y., J.M.Bishop, K.Al-Rafaie and W. Ismael. 2007. The effects of the river diversion, Mesopotamian marsh drainage and restoration, and river damming on the marine environment of the northwestern Arabian Gulf. *Aquatic Ecosystem Health & Management* 10(3):277–289.

Altinbilek, D. 2004. Development and management of the Euphrates-Tigris Basin. *Water Resources Development* 20(1):15–33.

Alwash, S.R. 2013. Eden again: Hope in the marshes of Iraq. Tablet House Publishing. Fullerton, California, USA. 242 pp.

Ararat, K., O. Fadhil and M. Salim. 2011. Breeding birds in Iraq: important new discoveries. *Sandgrouse* 33:12–33.

Bagis, A. 1997. Turkey's hydropolitics of the Euphrates-Tigris Basin. *Water Resource* 13(4):567–581.

Berman, I. and P.M. Wihbey. 1999. The new water politics of the Middle East. *Strategic Review* 27:45–52.

Birdlife International. 2010. IUCN Red List for Birds. http://www.birdlife.org/news/country/iraq. Accessed March 25, 2015.

Brasington, J. 2002. Monitoring marshland degradation using multispectral remote sensed imagery. ed. E. Nicholson and P. Clark. The Iraqi Marshlands: a human and environmental study. Politico's, London. pp. 151–168.

Çarkoğlu, A. and M. Eder. 2001. Domestic concerns and the water conflict over the Euphrates-Tigris River Basin. *Middle Eastern Studies* 37(1):41–71.

Coad, B.W. 2010. Freshwater fishes of Iraq. PenSoft, Sofia-Moscow. 274 pp.

Coad, B.W. 1996. Zoogeography of the fishes of the Tigris-Euphrates Basin. *Zoology in the Middle East* 13(1):51–70.

Chenoweth, J., P. Hadjinicolaou, A. Bruggeman, J. Lelieveld, A. Levin, M.A. Lange, E. Xoplaki and M. Hadjikakou. 2011. Impact of climate change on the water resources of the eastern Mediterranean and Middle East region: Modeled 21st century changes and implications. *Water Resources Research* 47:1–18.

Douabul, A.A., H.T. Al-Saad, D.S. Abdullah and N.A. Salman. 2013. Designated protected marsh within Mesopotamia: Water quality. *American Journal of Water Resources 1(3):39–44.*

Elasha, B.L. 2010. Mapping of climate threats and human development impacts in the Arab region. United Nations Development Programme. Arab Human Development Report (AHDR). Research Paper Series. http://www.grid.unep.ch/FP2011/step1/pdf/040_UNEP_2010_a.pdf.

El-Fadel, M., Y. El Sayegh, A. Abou Ibrahim, D. Jamali and K. El-Fadl. 2002. The Euphrates-Tigris Basin: A case study in surface water conflict resolution. *J Nat Resour Life Sci Educ* 31:99–101.

Famiglietti, J.S., L. Murdoch, V. Lakshmi and J. Arrigo. 2011. Establishing a framework for community modeling in hydrologic science. Report from the 3rd workshop on a community hydrology modeling platform (CHyMP): A Strategic and Implementation Plan. Tech. Rep. 10. Irvine, California. doi:10.4211/techrpts.20110317.tr10.

FAO. 1999. Fishery country profile. FID/CP/IRQ Rev. 2. http://www.fao.org/fi/oldsite/FCP/en/IRQ/profile.htm. Accessed March 26, 2015.

FAO-Iraq. 2010. Baseline survey of Huweza marsh (water quality, hydrology, fish ecology and socio-economic status). Ed. N.A. Salman. FAO Project No. OSRO/IRQ/583/UDG in collaboration with Fisheries Department, Agriculture College, Basrah University. 128 pp.

Hamdan, M.A., T. Asada, F.M. Hassan, B.G. Warner, A. Douable, M.R.A. Al-Hilli and A.A. Alwan. 2010. Vegetation response to re-flooding in the Mesopotamian wetlands, southern Iraq. *Wetlands* 30:177–188.

Hritz, C., J. Pournelle and J. Smith. 2012. Revisiting the sealands: Report of preliminary ground reconnaissance in the Hammar District, Dhi Qar and Basra governorates, Iraq. Iraq 74:37-49. doi:10.1017/S0021088900000243.

Hussain, N.A. and S.M. Ahmed. 1995. Seasonal composition, abundance and spatial distribution of ichthyoplankton in an estuarine subtropical part of the north western Arabian Gulf. *Marine Research* 4(2):135–146.

Hussain, N.A., M.K. Jabir and U.H. Yousif. 1994. On the biology of sbour *Tenualosailisha* (Hamilton) in the Shatt Al-Arab River, south of Iraq, with notes on their distribution in the Arab Gulf. *Marina Mesopotamica* 9(1):115–139.

Hussain, N.A., H.A. Hamza and K.D. Saud. 1987. Some biological aspect of the fresh water population of Shanag acanthopagruslatus (Houttuyna) in Shatt Al-Arab River, Iraq. *Marina Mesopotamica* 2(1):29–40.

Jwaideh, A. 2007. The marsh dwellers of southern Iraq: Their habitat, origins, society and economy. University of Toronto. 40 pp.

Kibaroğlu, A. and W. Scheumann. 2013. Evolution of transboundary politics in the Euphrates-Tigris river system: New perspectives and political challenges. *Global Governance: A Review of Multilateralism and International Organizations* 19(2):279–305.

Kibaroğlu, A. and W. Scheumann. 2011. Euphrates-Tigris rivers system: Political rapprochement and transboundary water cooperation in Turkey's water policy. Springer Berlin Heidelberg. pp. 277–299.

Kibaroğlu, A. 2007. Socioeconomic development and benefit sharing in the Euphrates-Tigris river basin. Water Resources in the Middle East. Springer Berlin Heidelberg. pp. 185–191.

Kibaroğlu, A. And I.H.O. Unver. 2000. An institutional framework for facilitating cooperation in the Euphrates-Tigris River Basin. *International Negotiations: A journal of Theory and Practice* 5(2):311–330.

Kilani, H., A. Serhal and O. Llewlyn. 2007. Al-Hima: A way of life. IUCN West Asia Office, Amman, Jordan. SPNL, Beirut Lebanon. 72 pp.

Mathews, C.P., J.M.B. Bishop and S. Salman. 1986. Stocks of *Metapenaeus affinis* in Kuwait Safat.

McCaffery, S.C. 2007. The Law of International Watercourses. Oxford University Press.New York. 573 pp.

Milanes Murcia, M.E., S.S. Solis and M.L. Stevens. 2013. The environmental protection of wetlands under international law. *Wetlands Science and Practice* 1: 9–26.

Milly, P.C.D., K.A. Dunne and A.V. Vecchia. 2005. Global patterns of trends in streamflow and water availability in a changing climate. *Nature* 438: 347–350.

Mohamed, A.R.M., N.A. Hussain, S.S. Al-Noor, F.M. Mutlak, I.M. Al-Sudani and A.M. Mojer. 2012. Ecological and biological aspects of fish assemblage in the Chybayish marsh, Southern Iraq. *Ecohydrology & Hydrobiology* 12(1): 65–74.

Mohamed, A.R.M., N.A. Hussain and T.S. Ali. 2001. Estuarine components of the ichthyofauna of the Arabian Gulf. *Marina Mesopotamica* 16: 209–224.

Muir, J. 2007. Iraqi dam 'at risk of collapse'. BBC News. http://news.bbc.co.uk/2/hi/middle_east/7069109.stm. Accessed August 15, 2015.

Naff, T. and G. Hanna. 1993. Conflict and water use in the Middle East. Ed. R. Roger and P. Lydon. Water in the Arab Word: Perspectives and Prognoses, Harvard University. pp 253-284.

Nature Iraq and Iraqi National Marshes and Wetlands Committee. 2012. Management plan for the Hawizeh Marsh Ramsar Site of Iraq. Volume 1: Background, vision, principles and annexes. Volume 2: Management issues and recommendations. Report prepared for the Iraq National Marshes and Wetlands Committee. ed. C. Rubec. Sulaimania, Kurdistan, Iraq. http://ar.natureiraq.org/uploads/9/2/7/0/9270858/_hawizeh_plan_2nd_draft_volume_2_dec_1_2008.pdf Accessed March 27, 2015

Nature Iraq. 2010a. Proposal of an operational program to facilitate the start-up of the Hawizeh Marsh Ramsar Site. Report prepared for the Iraqi National Marshes and Wetlands Committee. Sulaimania, Kurdistan, Iraq. http://www.biodiv.be/iraq/biodiversity/Studies%20and%20Reports/operational_program_hawizeh_-_rev_26_june.pdf Accessed March 27, 2015

Nature Iraq. 2010b. Key biodiversity areas survey of Hawizeh Marshes. Excerpt from the 2009-2010 Site Review. ed. A. Bachmann. Sulaimania, Kurdistan, Iraq.

Ochsenschlager, E. 2004. Iraq's Marsh Arabs in the Garden of Eden. University of Pennsylvania Museum of Archaeology and Anthropology. Philadelphia, PA.

Porter, R. and S. Aspinall. 2010. Birds of the Middle East. Christopher Helm, London.

Ramsar. 2013. The Ramsar Convention on Wetlands, Iraq http://www.ramsar.org/wetland/iraq.

Richardson, C.J. and N. Hussain. 2006. Restoring the Garden of Eden: An ecological assessment of the marshes of Iraq. *BioScience* 56:477–489.

Richardson, C. J., P. Reiss, N. Hussain, A. Alwash and D. Pool. 2005. The restoration potential of the Mesopotamian marshes of Iraq. *Science* 307:1307–1311.

Rodell, M., J.S. Famiglietti, J. Chen, S.I. Seneviratne, P. Viterbo, S. Holl, and C.R. Wilson. 2004. Basin scale estimates of evapotranspiration using GRACE and other observations. *Geophysical Research Letters* 31(20).

Rubec, C. and L. Young. 2014. Report on a Ramsar team visit to the Hawizeh Marsh Ramsar Site, Iraq. Ramsar Advisory Mission, Ramsar Secretariat, and Center for Restoration of Iraqi Marshes and Wetlands (CRIMW) of the Iraq Ministry of Water Resources. http://archive.ramsar.org/pdf/Report_of_Ramsar_Team_Iraq%20_140815.pdf

Rubec, C. 2013. A wetland future for Iraq? *Marsh Bulletin* 8(2):114–130.

Salim, S. 1962. Marsh dwellers of the Euphrates delta. University of London. 157 pp.

Saeed, T., N. Al-Ghandban, H. Al-Shemmari, M. Al-Mutair and H. Al-Hashash. 1999. Preliminary assessment of the impact of draining of Iraqi marshes on Kuwait's northern marine environment, part II: sediment associated pollutants. *Water Science and Technology* 40:89–98.

Salman, M. 2004. The Euphrates and Tigris: South Boundary Utilization and Views, IPTRID, Food and Agriculture Organization (FAO), Rome, Italy.

Salman, N.A. 2011a. Assessment of environmental toxicity in Iraqi Southern Marshes using fish as bio-indicators. *Ekologija* 57(1):21–29.

Salman, N.A. 2011b. Suggested methods for enhancement of aquaculture in the Southern Marshes of Iraq. *Iraqi J. Aquaculture* 8(2):157–177.

Samson, P.R. and B. Charrier B. 1997. International freshwater conflict: issues and prevention strategies (p. 6). Geneva: Green Cross International.

Scheumann, W., V. Baumann, A.L. Mueller, D. Mutschler, S. Steiner and T. Walenta. 2011. Environmental impact assessment in Turkish dam planning. pp. 139-159. In Turkey's Water Policy. Springer Berlin Heidelberg.

Scott, D.A. 1995. A directory of wetlands in the Middle East. International Waterfowl and Wetlands Research Bureau and IUCN, Gland, Switzerland and IWRB, Slimbridge, U.K.

Stattersfield, A., M.J. Crosby, A.J. Long and D.C. Wege. 1998. Endemic bird areas of the world, Priorities for biodiversity conservation. Birdlife International, Cambridge, U.K.

Stevens, M.L. 2013. HIMA Mesopotamia: Community generated conservation in the Tigris

Euphrates watershed. ed. M.Khalil Suleiman, W. Saleh, M. Hashemi, and N.R. Bhat. KISR Workshop: Towards an Implementation Strategy for the Human Integrated Management Approach Governance System: Theories, Concepts, Methodologies, Case Studies and Action Plans. Kuwait Institute of Scientific Research. http://hima.kisr.edu.kw/main/assets/publications/HIMAProceedings.pdf Pp 220-238.

Stevens, M.L and A. Hamid. 2011. Case study: cultural and ecological restoration of the al-ahwar wetlands, Mesopotamian Marshes, Iraq. ed. D.E. Egan, E. Hjerpe, and J. Abrams. Exploring the Human Dimensions of Ecological Restoration. Integrating Science, Nature and Culture. Island Press.

Stevens, M.L. 2007. Iran and Iraq reconsidered: the Mesopotamian marshes and the Al-Ahwar peace park. ed. S. H. Ali. Peace Parks: Conservation and Conflict Resolution (Global Environmental Accord: Strategies for Sustainability and Institutional Innovation). MIT Press.

Thesinger, W. 1964. The Marsh Arabs. Updated 2007. Penguin.

UN Committee on Economic, Social and Cultural Rights (UN-ESCR). 2011. Dam construction in Turkey and its impact on economic, cultural and social rights. Parallel report in response to the initial report by the Republic of Turkey on the implementation of the international covenant on economic, social and cultural rights. http://m-h-s.org/ilisu/upload/PDF/2011/CESCR_Parallel_report_by_CounterCurrent_on_Turkish_dams_2011-03-14_f.pdf. Accessed August 15, 2015. 38 pp.

UN Economic Commission for Europe (UN-ECE). 1992. Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Helsinki, 17 Mar. 1992, 31 ILM 1312 (1992). http://www.unece.org/env/water.html Accessed August 15, 2015

UN Environmental Programme (UNEP). 2009. Support for environmental management of the Iraqi Marshlands 2004-2009. http://www.unwater.org/wwd10/downloads/Support_for_EnvMng_of_IraqiMarshlands_2004-9.pdf. Accessed August 15, 2015. 104 pp.

UN Environmental Programme (UNEP). 2008. Vital water graphics – an overview of the state of the world's fresh and marine waters, 2nd Ed., UNEP, Nairobi, Kenya. http://www.unep.org/dewa/vitalwater/ Accessed August 15, 2015.

UN Environmental Programme (UNEP). 2001. The Mesopotamian marshlands: demise of an ecosystem, early warning and assessment. Early warning and assessment. UNEP Technical Report 47. Nairobi, Kenya. http://eoimages.gsfc.nasa.gov/images/imagerecords/1000/1716/meso2.pdf. Accessed August 15, 2015. 46 pp.

UN Integrated Water Task Force for Iraq (UN-IWTF). 2011. Managing change in the marshlands; Iraqi's critical challenge. United Nations white paper. United Nations Integrated Water Task Force for Iraq. FAO, UNAMI, UNDP, UNEP, UNESCO Office for Iraq, UN Habitat, UNICEF, World Health Organization. http://iq.one.un.org/documents/Marshlands%20Paper%20-%20published%20final.pdf Accessed August 15, 2015. 41 pp.

UN Watercourse Convention (UNWC). 1997. United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses, United Nations, New York. http://www.unwatercoursesconvention.org/ Accessed August 15, 2015.

US-AID Report. 2004. The Iraq marshland restoration program. United States Agency for International Development. www.usaid.gov/iraq. Accessed April 20, 2015. Page 7

Voss K.A., J.S. Famiglietti, M.H. Lo, C. deLinage, M. Rodell and S.C. Swenson. 2013. Groundwater depletion in the Middle East from GRACE with implications for transboundary water management in the Tigris-Euphrates-Western Iran region. *Water Resources Research* 49:914–914.

Wolf, A.T. and J.T. Newton. 2007. Case study transboundary dispute resolution: multilateral working group on water resources (Middle East), Transboundary Freshwater Dispute Database (TFDD), Oregon State University. http://www.transboundarywaters.orst.edu/