An expedition by Duke University Wetland Center director Curtis Richardson to evaluate damage to Iraq’s storied Mesopotamian Marshlands revealed an environmental disaster of vast proportions. However, he also found the potential for restoring a significant portion of the marshes and with them the Marsh Arab culture.

On his June 14-28 trip, he encountered dust-bowl-level desiccation within the former wetlands, a destroyed date palm industry, a drinking water crisis, wrecked laboratories, and a pressing need to train a new generation of environmental researchers.

Richardson, the only university researcher on the trip, was joined by Peter Reiss, an anthropologist from Development Alternatives, Inc. of Bethesda, MD, who served as team leader; Azaam Alwash, a hydrologist and engineer with the Eden Again Project and Iraq Foundation; and Doug Pool, an agronomist with the U.S. Agency for International Development’s (USAID) Iraq Office.

Together, they are developing with Iraqi experts a plan to restore a portion of the marshlands, which some legends identify as the site of the Garden of Eden. The formerly pristine wetland ecosystem of more than 20,000 square kilometers has been reduced by an estimated 90 percent through a combination of upstream damming, protracted warfare, and deliberate draining. The draining was done by Saddam Hussein’s government, both for land development and to suppress an indigenous 5,000-year old Marsh Arab culture that opposed his regime.

For Richardson and his colleagues who made the USAID-sponsored visit, there was potential danger starting with an early morning armed convey racing across the Iraqi border from Kuwait and continuing with his first night on the third floor of his hotel in Basra. “I was lying there hearing machine gun fire getting closer and closer, and wondering if we would ever get to see the marshes,” he recalled in an interview.

The group traveled up to hundreds of miles daily, sometimes under the protection of armed U.S. military guards, occasionally under hired local Iraqi guards in the region north of Basra. Often unarmed, the four scientists were led by the Assisting Marsh Arabs and Refugees (AMAR) international charitable foundation into the small villages in marsh areas. There, they made initial damage assess-
When summer break began this past May, I had no idea that in little more than a month I would be standing on the Kuwaiti border waiting to enter southern Iraq with an armed convoy. Our instructions were clear. Guards prepared to shoot would be placed on the north and south ends of the convoy, and our vehicles were to be maintained in a tight formation as we crossed the Iraqi border. We were not to stop under any circumstances. The adventure of a lifetime was about to begin.

I was part of a USAID-sponsored group of four researchers entering southern Iraq to assess the restoration potential of the Mesopotamian marshes that Saddam Hussein’s regime had severely damaged over the past decade. The first few days of our expedition made it clear that we would be working under the harshest conditions I had encountered in over 30 years of fieldwork. The heat was a brutal constant, some days reaching over 130 degrees. The scientists taking soil and water samples from the marsh thought it unusual—not to mention unnerving—to go about their work protected by bodyguards armed with AK47s and often being told, “No, no, don’t sample there, it is a mine field!” At times, I wondered if going on the trip had been a wise decision especially the day we passed near Majar al-Kabir, a small village north of Basra where less than 24 hours before six British soldiers had been attacked and killed. But seeing the region’s extremely poor but amazingly friendly people and witnessing for the first time the remaining marshes, still fantastic although only about 10 percent of their original size, I knew I was right in going. The Madan, the marsh dwellers who have lived in this area for over 5,000 years, had suffered for decades. Yet they were upbeat, and their children showed us that there would be a bright future in Iraq. I also knew these marshlands and the Madan culture had to be restored if possible. They are ecological and cultural treasures not just for the marsh Arabs but for the world.

While we read daily in the paper about ongoing unrest in the northern part of Iraq, our experience in the country’s southern regions was completely different. In dozens of small communities, we saw people trading in open farmers markets, children playing in the streets, and other such signs that some normalcy was returning to village life. Of course, it is always easier for the rural areas to bounce back because of their simpler agrarian lifestyle. I am convinced that stability can be brought to southern Iraq at a much lower cost than in the cities, which require large energy supplies, much infrastructure repair, and intensive security forces to maintain law and order. In our travels through the south, families with young children met our group, eager to have us help them restore the marshes. Their livelihoods—fishing, rice agriculture, the making of mats from the phragmites reed grass that dominates the area—depend on this ecosystem.

In the next phase of our work, it is proposed that we return to southern Iraq in December for additional assessment of restoration potential. A number of pilot projects are currently being designed. One plan aims to help local universities such as the University of Basra to train Iraqi scientists in modern Wetlands Ecology and Management and to work with the marsh Arabs in restoring areas of the marshes critical to this ancient culture. What the future will bring for Iraq nobody can predict, but I believe if we can help reestablish the agricultural system closely integrated with the Mesopotamian Marsh ecosystem then we will have gone a long way in stabilizing one portion of the country.

—Curtis J. Richardson
Director, Duke University Wetland Center

DUWC 2003-04 Distinguished Speaker Series Begins

Dr. Mark D. Bertness, Robert P. Brown Professor of Biology at Brown University, opened the Duke University Wetland Center’s 2003-04 Distinguished Speaker Series on November 7 with a lecture entitled “Why Experimental Community Ecology Matters to Conservation Biology.”

Dr. Bertness’ research is focused on understanding the organization and dynamics of natural communities. He uses manipulative field experiments in marine shoreline communities to examine how patterns in natural communities are generated and maintained. His recent book *The Ecology of Atlantic Shorelines* (Sinauer, 1999) discusses his interests in and approach to studying marine intertidal communities.

The DUWC Distinguished Speaker lectures are held during the academic year in the Levine Science Research Center (LSRC) at Duke University. Each lecture features a speaker with internationally recognized expertise on an important current issue of wetlands ecology. These lectures are open to the public. More information on the series can be found online at http://www.nicholas.duke.edu/wetland/speaker.htm.
DUWC Joins Iraqi Marsh Restoration Project

continued from page 1

ments by collecting soil and water samples, many of which are now being analyzed at the DUWC laboratory.

“Saddam Hussein was a master ‘brown field generator,’” said Richardson, referring to a term for environmental decimation. “He churned that country upside down. It looks like you let a child loose in a sand box with hand grenades.”

Of the three remnant marsh areas, he found the Central Marsh to be in the worst shape. “It’s just a complete dust bowl,” he said. Locals had broken a Hussein-built drainage dike in one area in an effort to return some water, but “nothing was growing there yet,” except for a few remaining desert plants, he added. In another recently re-flooded area, too much salt had been drawn out of the long-dry soils to support freshwater vegetation, and this area was now turning into a salt-flat.

His group found the Hammar Marsh area, nearest Basra, to still have some remaining lush areas where some stately date palms are still in cultivation. But Richardson said Hussein, in his vendetta against the Marsh Arabs, “basically wiped out” the local date palm industry, once the world’s largest exporter. The largest remaining wetland areas are the Haweizeh Marshes along Iraq’s border with Iran. That’s where Richardson and his colleagues reached a place where locals had reintroduced their traditional water buffalos and were seen fishing.

While Marsh Arab villages are beginning to be reconstituted in areas adjacent to the Haweizeh marsh, in some cases reoccupying still-roofless former dwellings, “all of the communities we talked to are desperate for clean water,” he reports. That’s because rivers feeding the marsh areas are currently contaminated, and upstream utilities could take years to repair.

“They’re having all these problems with poor water, and they’re surrounded by the answer,” he said. That’s because, with the proper knowledge, Iraqi scientists and engineers could build special “constructed wetlands” within marsh areas, he added. By so engineering nature there, the filtering properties of natural vegetation could be harnessed to clean some of the polluted water.

First, however, Iraqis will have to overcome the aftermath of war and 30 years of neglect that has decimated the country’s research infrastructure, Richardson said. He and his colleagues witnessed the destruction firsthand at the University of Basra’s marine science center, where looters had stripped many classrooms of their contents as well as smashed vital scientific equipment.

Richardson quickly learned that Iraqis also lack needed training. “They have excellent marine biologists and zoologists who are very competent in what they’re doing,” he said. “But they had been completely out of the field of environmental science, which took off in the ‘70s. They are not trained in wetlands ecology and management. They’ve completely missed that. They have lost a generation of researchers.

“We’re developing a program with the USAID where we would help restore some of the marshes through some pilot projects,” he said. “We know, for example, that we would use the Haweizeh Marshes as a seed source.”

“If this goes through and is approved, we’re also going to work with some of the universities there to bring some Iraqi scientists to Duke for some environmental and wetland training,” he added. “Then we’re going to do some training in Iraq.”

In the end, Richardson predicted that Iraqis “will not be able to restore all the marshes, because they won’t have enough water. There has been a long process of draining. Maybe they can get 15 or 20 percent back.”

“The trip gave me hope that we can make a difference in the marshes and give some of the marsh Arabs a chance to return to their culture. These people, like most rural populations, are survivors, and with a little help they will be able to return to their rice farming, fishing and mat-making from freshwater reeds.”

—Monte Basgall

Duke Office of News & Communication

Left. Arabs carry goods on boats and wash clothes in the water in one of the few remaining healthy areas along canals near Basra. The date palms are among the few survivors of a once productive date palm industry destroyed when the marshes were drained. Right. Deserted Madan dwellings slowly collapse in a drained marsh where dust-bowl-like conditions allow only a few desert plants to grow. Photos by Curtis Richardson.
The Wetlands of China—An Overview
Part 1: Introduction and The Sanjiang Plain

Editor's note: Dr. Curtis Richardson and Dr. Mengchi Ho represented the Duke University Wetland Center at the Nanjing International Wetland Symposium in September 2002. In this issue of WetlandWire, Richardson and Ho begin a series of articles on China’s wetlands inspired by that visit.

INTRODUCTION
During a month-long visit to the People’s Republic of China in the fall of 2002, we had the rare opportunity to travel more than 3000 km within the country to study many of China’s diverse wetlands. China’s wetlands make up approximately 1% of that country’s 960,000,000-hectare (ha) area; however, little detailed information about them has been available in the West despite their importance. This article is the first of a series in which we will describe the wetlands that we toured, offering some highlights of their ecological characteristics. We will also look at some of the wetland management issues being faced by China today as the country moves towards being a modern agricultural and technological society.

While writing this overview, we have drawn heavily upon information from a recent volume edited by Prof. Kuiyi Zhao, (variously translated “Wetland Record of China” or “China Mire Record”). This book—published in 1999 by Science Press of Beijing—presents the most up-to-date account of China’s wetlands.

The Chinese system of wetland classification has four levels, and it is based on the dominant characteristics of the wetland, quantitative and qualitative measures of wetland characteristics, and a hierarchical structure in terms of group, type, form, and unit (Table 1, right).

The top-level classification (Group) divides wetlands into freshwater and brackish wetlands. The freshwater group has salinity no greater than 1 part per thousand (ppt) and the brackish group has salinity greater than 1 ppt. The second level of classification (Type) subdivides freshwater and brackish wetlands into two distinct types: peatland and gley (black or blue-grey mineral soil). A third level of classification (Form) is based upon physiognomy of the vegetation cover. The bottom level of classification (Unit) is based on dominant species and reflects the local environmental factors and growth conditions for these species.

Chinese scientists have divided the country into eight wetland regions further subdivided into forty subregions (Figure 1). Wetlands occur in every region of China, from the coast to the

1Chinese scientists include lakes and rivers among natural wetland areas, a practice not followed in the U.S. Using this more inclusive definition, China’s 250,000 km² of natural wetlands makes up 2.5% of the country’s area (Lu 1995. Vegetatio 118:49-56). In addition, many estimates of China’s total wetland area include constructed wetlands, fishponds, and rice paddies. FAO (2002) currently estimates the area of Chinese rice paddies at 28,360,000 ha.
interior, from the lowland plain to the highland plateaus. While wetlands are distributed widely, they are not distributed evenly. For example, environmental conditions optimum for peat formation are found in western China, where nearly 80% of all of China’s peat deposits are found. In contrast, only 20% of the peat is located in eastern China. Collectively, the natural wetland area of China amounts to 93,973 km², approximately 1% of the total territorial area of China.

The distribution of wetlands varies greatly across the country. Three of China’s provinces—Qinghai, Heilongjiang, and Jilin—have wetlands amounting to approximately 3.5% of their land area. Conversely, in more than 20 provinces, wetlands make up less than 0.5% of each province’s land area. The wetlands of Tibet, Qinghai, and Heilongjiang combined amount to more than 60% of the total wetland area of China (Table 2). Most of China’s remaining wetlands are located in the Sanjiang Plain (I on Figure 1); the Zoigê Plateau; the Tibet-Qinghai Plateau (VIII), where the Yangtze and Yellow Rivers originate; the Greater and Lesser Khingan Mountains along the Korean border; and Changbai Mountains along the coastal China coast (V). The first of these areas discussed in this series of articles is the Sanjiang Plain.

### The Sanjiang Plain

The Sanjiang Plain region, in China’s northeast corner, is primarily a sedge marsh. The word “Sanjiang” literally means “Three Rivers” in Chinese. The three rivers—the Amur, Songhua, and Ussuri—provide the major waterway system as well as alluvial deposits in this area. Since the onset of the Quaternary Period, landmass in the Sanjiang Plain has gradually evolved into the flat landscape of today. Covered continuously by a clay layer, the Sanjiang Plain has a slope grade of less than 1:10,000, which is favorable for wetland formation. A temperate climate with mean annual temperature of 3°C and precipitation of 500-650 mm also provide suitable conditions for wetland development. The total area of wetlands in the Sanjiang Plain today is 1,100,000 ha (nearly twice the size of the Everglades today), making it the most notable wetland in all of China. Although widespread, 80% of the wetlands on the Sanjiang Plain are located on the northeast corner (I on Figure 1). Intensive agricultural development since the 1950s has significantly diminished the coverage of natural wetlands from 49% in 1949 (5,300,000 ha) to 14% by 1994 (1,500,000 ha). Generally, fresh water sedge (Carex sp.) marshes are the major form of wetland in the Sanjiang Plain, where 60% of them belong to the gley wetlands, soils without significant peat formation (Figure 2a). Gley wetlands occur in the flood-

### Table 1. The Chinese wetland classification system, after Zhao 1999. The first level of this hierarchical system classifies all natural wetlands as either freshwater (salinity 1 ppt or less) or brackish (salinity > 1 ppt). Subsequent subdivisions indicate soil properties, plant habit (stem and branch structure), and dominant species.

<table>
<thead>
<tr>
<th>Province</th>
<th>Wetland Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Qinghai</td>
<td>2,553,400</td>
</tr>
<tr>
<td>2. Tibet</td>
<td>1,866,235</td>
</tr>
<tr>
<td>3. Heilongjiang</td>
<td>1,494,347</td>
</tr>
<tr>
<td>4. Jilin</td>
<td>630,056</td>
</tr>
<tr>
<td>5. Inner Mongolia</td>
<td>612,334</td>
</tr>
<tr>
<td>6. Xinjiang</td>
<td>585,514</td>
</tr>
<tr>
<td>7. Sichuan</td>
<td>386,699</td>
</tr>
<tr>
<td>8. Shandong</td>
<td>163,129</td>
</tr>
<tr>
<td>9. Jiangsu</td>
<td>151,263</td>
</tr>
<tr>
<td>10. Fujian</td>
<td>122,268</td>
</tr>
<tr>
<td>11. Liaoning</td>
<td>109,345</td>
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<tr>
<td>12. Hebei</td>
<td>98,699</td>
</tr>
<tr>
<td>13. Hunan</td>
<td>86,000</td>
</tr>
<tr>
<td>14. Gansu</td>
<td>84,849</td>
</tr>
<tr>
<td>15. Guangxi</td>
<td>61,857</td>
</tr>
<tr>
<td>16. Jiangxi</td>
<td>61,000</td>
</tr>
<tr>
<td>17. Guangdong</td>
<td>55,841</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>9,397,269</strong></td>
</tr>
</tbody>
</table>

### Table 2. Wetland area in China by province and municipality (Yang 1999, in Zhao 1999). Chongqing City was still part of Sichuan Province when the statistics were compiled. Data for Beijing City are not available (N/A).
plains among waterways of the “Three Rivers” (Figure 3a), where peatland development has been limited to ancient riverbeds and waterlogged depressions. Peat accumulation in the peatland area is usually less than 1 m thick, but a few places have been measured as thick as 4 m. Large expanses of sedge are found on the Sanjiang Plain. Major wetland plant species include wooly fruit sedge (*Carex lasiocarpa*), marsh raft sedge (*Carex pseudocu-raica*), marsh reed (*Phragmites australis*—Figure 2b), marsh sedge (*Carex meyeriana*), grey vein sedge (*Carex appendiculata*), and reed grass (*Calamagrostis angustifolia*). Among them, the wooly fruit sedge is the dominant species and the characteristic plant on the Sanjiang Plain. A number of rare birds and mammals breed in this area, including the Oriental White Stork (*Ciconia boyciana*—Figure 3b), the Japanese Crane (*Grus japonensis*), and the Red Deer (*Cervus elaphus*).

—Curtis J. Richardson and Mengchi Ho
Duke University Wetland Center

Figure 2a. A sedge marsh in the Honghe Nature Reserve (Ramsar Site of International Importance # 1149) on the Sanjiang Plain. *Phragmites australis* is highlighted in the foreground.

Figure 2b. The sun sets over the darkening Sanjiang Plain mire in northeastern China. *Phragmites australis* is highlighted in the foreground.

Figure 3a. Zhuaji, the easternmost township in China, sits on a tributary of the Ussuri River, one of the Sangjian Plain’s “Three Rivers.” Agricultural land use of this wetland area in Zhuaji contrasts with the protected wetland area area just across the river, Ramsar site # 1152. The mountains in the background are across the border in Russia. Figure 3b. Endangered Oriental White Storks (*Ciconia boyciana*) are strictly protected by Chinese law. Proposed development will put many of the this migratory bird’s wintering grounds at risk.

photos by Curtis Richardson/Duke University Wetland Center

photos by Mengchi Ho/Duke University Wetland Center

Curtis J. Richardson, Director of the Duke University Wetland Center, has been named a Fellow of the Society of Wetland Scientists. SWS Fellows are chosen based on outstanding contributions in research, teaching, management, service, and/or administration as well as public, commercial, or private service activities. Fellow is the highest recognition of membership bestowed by the Society. The award was presented in a ceremony at the group's annual meeting June 2003 in New Orleans, LA. While at the SWS meeting, Richardson gave the presentation “Selection of wetland restoration sites in rural watersheds to improve water quality.” Other recent presentations by Richardson at national and international meetings include “Successful Everglades restoration is not a river of grass.” at the Ohio State University Wetlands Invitational, Olentangy River Wetland Research Park, Columbus, OH, in May; “Organic phosphorus in wetlands: An assessment of mechanisms controlling storage, availability and transport” at the Organic P 2003 Conference, Ascona, Switzerland, in July; “A Bayesian estimation of phosphorus thresholds in the Everglades” at the 88th annual meeting of the Ecological Society of America held in August at Savannah, GA; and “Phosphorus In wetlands: An assessment Of mechanisms controlling storage, availability and transport” at the Eighth Symposium on Biogeochemistry of Wetlands held in Ghent, Belgium during September 2003.

Greg Bruland, a Duke University Wetland Center doctoral candidate, gave two oral presentations at conferences during summer 2003. In June, he presented “Spatial variability of soil properties of paired mitigation and natural wetlands in North Carolina” at the 24th annual meeting of the Society of Wetland Scientists in New Orleans, LA. “Using Mantel tests to investigate spatial variability, soil properties, and phosphorous sorption in riparian wetlands” was the title of Bruland’s talk at the August meeting of the Ecological Society of America in Savannah, GA.

Wyatt Hartman, a Duke University Wetland Center doctoral student, was awarded an Honorable Mention by the National Science Foundation Graduate Research Fellowship Program. Recipients of this distinction from the highly competitive program earn the ability to use resources at a Partnership for Advanced Computational Infrastructure facility. In August 2003, Hartman gave the poster presentation “Linking microbial community dynamics to soil biogeochemistry along wetland disturbance gradients” at this year’s Ecological Society of America national meeting.

Ariana Sutton-Grier, a DUWC doctoral student, was awarded a 2003 National Science Foundation Graduate Research Fellowship. The highly competitive program, administered by Oak Ridge Affiliated Universities, awards fellowships for graduate study leading to research-based master's or doctoral degrees in science-related fields. Sutton-Grier received a three-year, twelve-month fellowship in support of her doctoral research proposal, “Optimizing wetland restoration site selection in the landscape to maximize ecosystem function.”

Amy Upgren (MEM 2004) has been awarded a Foreign Language and Area Studies Fellowship for the 2003-04 academic year. The fellowship program is administered by the Duke University's Center for Latin American & Caribbean Studies with funding provided by the U.S. Department of Education. The purpose of the fellowship is to encourage the study or use of foreign languages in combination with international or area studies. Upgren will use the award to study wetland, river, and flood plain management in Brazil's Pantanal, one of the largest wetlands in the world currently threatened by development.

Freeze Frame

Two Madan marsh Arabs steer their boat through the Mesopotamian wetlands in southern Iraq. The Madan culture thrived in this region near the Tigris and Euphrates for 5,000 years until Saddam Hussein’s regime drained the marshes. DUWC is collaborating in a USAID-sponsored program to restore the marshes. Read more about the project in this issue of WetlandWire.

photo by Curtis Richardson/Duke University Wetland Center

The Duke University Wetland Center is dedicated to providing sound scientific knowledge that will lead to sustainable wetland functions and values for the nation and for the world. The center works towards this goal by conducting, sponsoring, and coordinating research and teaching on critical wetlands issues.