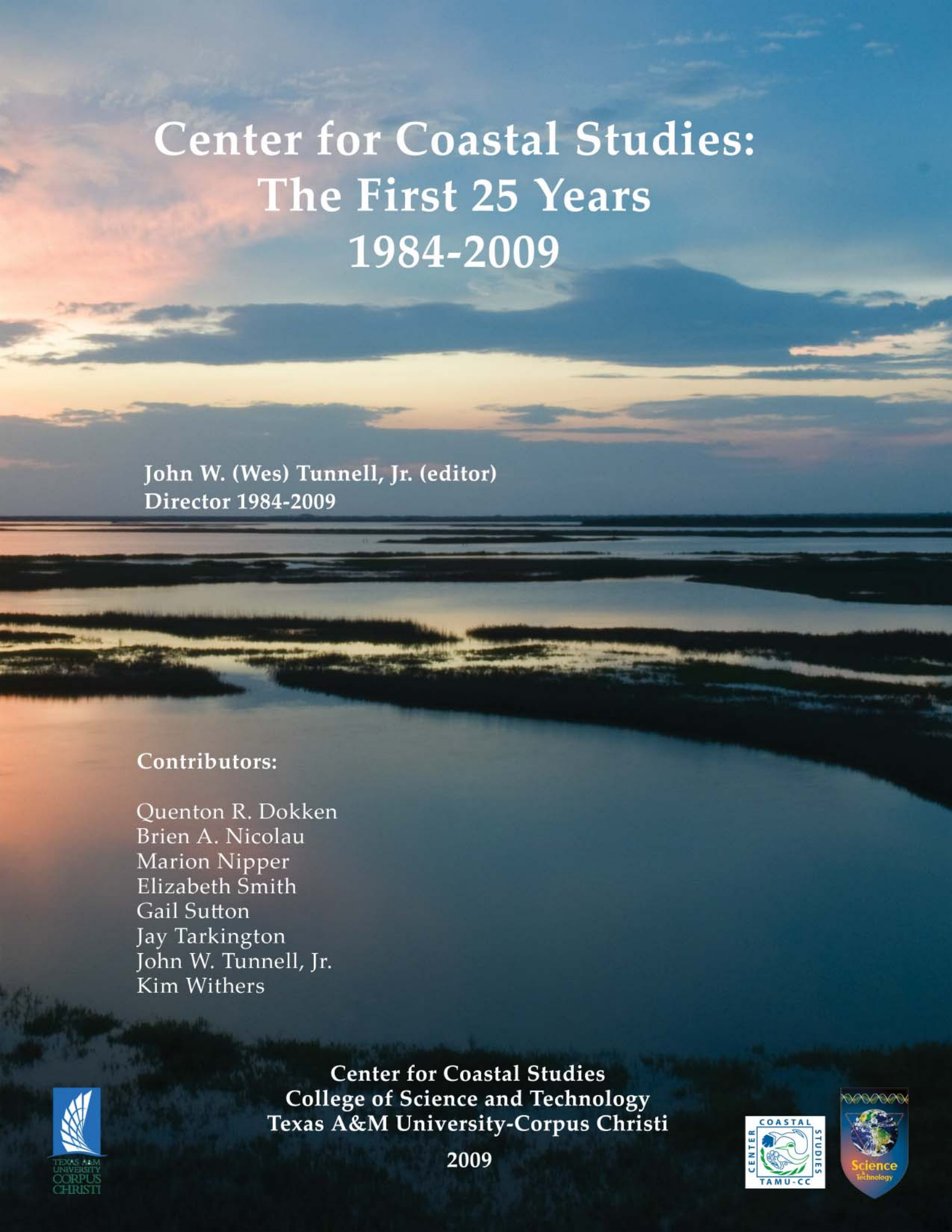

Center for Coastal Studies: The First 25 Years 1984-2009

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Director 1984-2009

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Center for Coastal Studies
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2009

Center for Coastal Studies: The First 25 Years, 1984-2009

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Front cover: Morning sun breaks through cloud cover at Black Point Marsh. Refugio County, Texas, USA. *Photo by Dave and Liz Smith*.

Inside front cover: After the sunset at Welder Flats. Calhoun County, Texas, USA. *Photo by Dave and Liz Smith*.

Inside back cover: Center for Coastal Studies *Lancha,* Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. *Photo by Dave and Liz Smith*.

Outside back cover: Dr. Wes Tunnell imparts final advice against a setting sun at Bahia Grande, Cameron County, Texas, USA. *Tunnell photo by Jeff Janko, background photo by Dave and Liz Smith.*

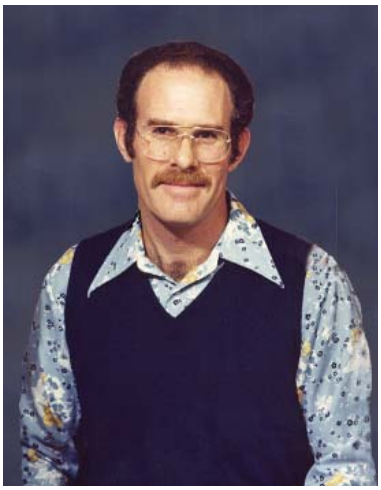
Contents

Preface

Our island university was a land of opportunity for developing new concepts and implementing new ideas during the 1970s and 1980s. There wasn't much money available, but there was a clear entrepreneurial spirit. After teaching four different classes each semester, as well as the summer sessions during my first year, (1974-75) and then three classes during each of those time periods for my first decade, I found there was little time for research. Combining the entrepreneurial spirit and my love for discovery and exploration research, we created the Center for Coastal Studies.

The Center for Coastal Studies (CCS) was created in 1984 as the first research center on campus and to simply provide a mechanism for handling grants and contracts for research in the College of Science and Technology. In 1992 CCS received its first state funding, and in 1996, we moved into new facilities in the Natural Resources Center. I decided in 2008 that after founding and directing the Center for 25 years, it was time to turn over that responsibility to a new director. This book gives the history of the founding, development, and successes of CCS for its first 25 years. Each researcher gives an overview (chapter) of their research program and students, the education-outreach program is reviewed, and summaries of CCS graduate education, scholarships, financial history, and publications are given. This chronicle of CCS should be of great assistance to the new director as well as a reference for others in the future.

—Wes Tunnell
Director, 1984 – 2009
August 2009



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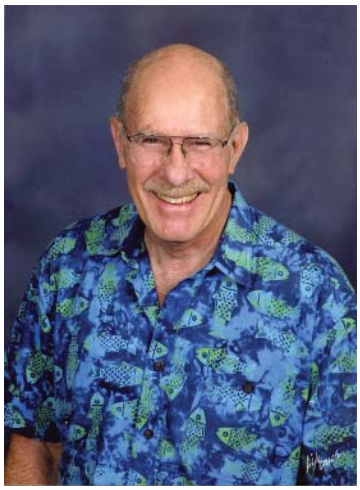

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Acknowledgements

As with any successful and productive organization, there have been many people who positively impacted the development and growth of the Center for Coastal Studies (CCS). Many of these are mentioned in the chapters that follow, so I will only briefly thank those who made major contributions during the first 25 years of our history. Drs. Brian Chapman and Steve Barnes helped me with the original concept of a research center, and then University President B. Alan Sugg agreed to let us establish the Center for Coastal Studies with a small seed grant. Then College of Science and Technology Dean Ruth Bakke allowed me to have ¼-time release from classes in the 1980s at a time when "release time" for research was unknown on our campus.

In the early 1990s Dr. Robert Furgason and State Representative Todd Hunter secured the first Special Item Funding for CCS, and Dr. Furgason continued his support and encouragement of CCS operations during his time as President of TAMUCC. Current long-time CCS staff members Drs. Marion Nipper, Elizabeth "Liz" Smith, and Kim Withers, along with Brien A. Nicolau contributed significantly to CCS development. Former employees Dr. Quenton Dokken, Gloria Krause, and Gail Sutton added to what CCS is today. My sincerest gratitude is offered to each.

Linda Price-May started our first CCS scholarship in honor of her late husband David May. Other memorial scholarships were started for: 1) Dr. Millicent Quammen by Dr. Chris Onuf (Millicent's husband), family, and friends; 2) Karen Dodson by James Dodson (Karen's husband), family and friends; 3) Dr. Henry Hildebrand by colleagues, family, and friends; and 4) Dr. Carl Beaver by colleagues, family and friends. Pat Suter established the Hans and Patricia Suter Endowment in CCS, and Dr. Harley Moody founded and strongly supported the Caribbean Connection fund annually from 1997-2009. Dr. Wayne Fagan and Jim Copeland also consistently supported the Caribbean Connection, allowing Coral Reef Ecology class students to travel on the field trip to Mexico each year. Many, many students have benefited from the generosity and foresight of these friends, and they are sincerely thanked.

Dixie Smith helped immensely with the preparation of this book manuscript, Noe Barrera did the design and layout for the book, and Liz Smith contributed her creative talents with the covers and images throughout.

It has been an honor, privilege, and pleasure to work with all. Thank you very much.

Introduction

Wes Tunnell

The Center for Coastal Studies (CCS) is a small, but highly active, research center within the College of Science and Technology on the campus of Texas A&M University-Corpus Christi (TAMUCC). It is located within the Natural Resources Center (NRC), a multi-purpose research and services facility on Ward Island between Corpus Christi and Oso bays in Nueces County, Texas. Founded by Drs. Steve Barnes, Brian Chapman and I in September 1984 as TAMUCC's first scientific research center, the original mission of CCS was "to provide an administrative unit within the College of Science and Technology to manage coastal and marine ecosystem research and contract work for faculty and graduate students". The geographic region of focus was primarily the Texas Coastal Bend (Figure 1), Padre Island, and the Laguna Madre, but it also included the entire Texas coast and the broader Gulf of Mexico. From the beginning, researchers always included graduate students in their research projects, realizing that "hands-on" research experience would serve the graduates best in their future careers or further graduate studies. Providing hands-on, field work experience and opportunities for graduate students, and later undergraduate students, became a hallmark of CCS research. Early studies during the 1980's primarily involved coastal ecological studies and water quality monitoring conducted for state and federal agencies in the region and on campus. Other than an initial $4,000 start-up grant from the University President (Dr. B. Alan Sugg), ¼ release-time for its Director (Tunnell), and a fraction of one secretary's time (Fran Treviño), CCS did not receive university or state support funding during its first eight years of operation. The CCS maintained an office in the Center for Sciences one day per week during the first six years, and 1½ – 2 days per week when it was moved to the Old Science Building (renamed Center for Environmental Studies and Services) in January 1990.

Figure 1. – Map of the Texas Coastal Bend, primary geographic focus area for Center for Coastal Studies research. Map prepared by A. Reisinger

In FY 1992 the State of Texas recognized CCS and awarded Special Item Funding for the first time. This funding was acquired by then new university Presi-

dent Robert Furgason working with State Representative Todd Hunter. Although $200,000 per year of the biennium was approved, only $150,000 and $179,000, respectively, was received annually during the first two years. Additional staff, including an Associate Director (Dr. Quenton Dokken), Secretary (Gloria Krause), and Business Coordinator (accountant, Jeff Foster), were added at this time. All of these were housed in the Center for Environmental Studies and Services (CESS) among state and federal agencies that fully occupied that facility by July 1990. Simultaneously with the first State funding for CCS the Texas Legislature allocated $10 million to build a new 100,000 sq. ft. CESS building on the west side of campus, due to the successful cooperation and collaboration of CCS with other agencies dealing with environmental issues on the Texas coast. When opened in June 1996, the new facility, renamed the Natural Resources Center, housed 19 different State of Texas, TAMUCC, and Texas A&M University System entities, primarily dealing with coastal and environmental issues (Appendix I).

The purpose of this compilation is to document the first 25 years of the Center for Coastal Studies (1984-2009). The objectives for this document are:

- to provide a history of the founding and development of CCS;
- to provide an overview of CCS researchers and research programs;
- to provide a history of the development of the CCS education-outreach program;
- to provide a listing of graduate students trained or advised at CCS;
- to provide a summary of the CCS scholarship program;
- to provide a financial history of CCS; and
- to provide a list of CCS publications and technical reports.

Research and Operations History

The first full-time Research Scientist hired in CCS (Dr. Roy Lehman) started in 1993, but when he accepted a faculty position the following year, Drs. Liz Smith (1994) and Kim Withers (1995) accepted the single 9-month position at half time each to help "launch" CCS into full-time activity. Both Smith and Withers had received earlier degrees at TAMUCC and were strong proponents of the hands-on, field oriented model. A full-time Business Coordinator (Dawn Bennett) and a full-time Operations Manager (Brien A. Nicolau) were also added to the CCS staff when the new NRC building opened. In addition, a cooperative agreement was established to house the Marine Ecotoxicology Research Station (MERS) of the U.S. Geological Survey (USGS) (previously occupying part of the old CESS building)

within CCS facilities in the NRC. This latter arrangement added one additional "soft money" CCS Research Scientist position (Dr. Marion Nipper) in collaboration with the USGS.

Research focus areas flourished along the lines of the five Research Scientists (including the Director and Associate Director) and one Research Associate (the Operations Manager, Nicolau) in CCS: coastal and coral reef ecology, molluscan studies, artificial reef ecology, wetlands ecology, conservation science/Geographic Information Systems (GIS), benthic ecology, shorebird ecology, water and sediment quality monitoring, and marine ecotoxicology. Two Physical and Life Sciences Department (now Department of Life Sciences) faculty members (Drs. Roy Lehman and Joanna Mott) consistently used CCS to manage their grants as Research Associates in the study areas of estuarine and marine microbiology, bacterial source tracking, antibiotic resistance, and pulse field gel electrophoresis. Several other College of Science and Technology faculty (Drs. Grady Price-Blount, Stacey Lyle, David McKee, and Robert Benson) also used CCS for some of their grants and contracts.

The gift endowment of the Harte Research Institute (HRI) for Gulf of Mexico Studies was given to TAMUCC in September 2000, and my subsequent joint appointment as Associate Director of HRI significantly affected the management and research efforts/production of CCS during FY 2002 through 2005. In addition, two CCS Research Scientists (Smith and Dokken) had increasing administrative duties during this time, thereby decreasing their research activity. This circumstance was a temporary involvement of CCS staff, while HRI was being planned and developed. HRI was temporarily "housed" within CCS facilities during September 2001 to November 2005, while the institute concept was being developed and the HRI building was being constructed.

Dr. David Hicks joined CCS as a Research Scientist during FY 2002-2003, assisting me with teaching and research, as well as developing a research program in invertebrate physiological ecology. Erin (Albert) Hill and Alex Nuñez, TAMUCC MS graduates, were hired as Research Specialists during this time frame to assist with the Nueces Delta Monitoring/Allison Wastewater Diversion projects and Regional Coastal Assessment Program, respectively. Numerous other graduates, like Susan (Cox) Childs, Suzanne (Dilworth) Bates, Carl Beaver, and Leslie Smith, initiated their scientific careers working at CCS.

Campus History

Texas A&M University-Corpus Christi started on the 243-acre Ward Island campus in 1947 as the University of Corpus Christi. This small liberal arts university, a part of the Southern Baptist Convention, was started after World War II and the sale of the island for one dollar (as the story goes?) to start the new university at the no-longer-needed radar training station. The young school was operated out of

the old Naval facilities for years with some new buildings added in time. In 1970 Hurricane *Celia* almost completely destroyed the island's infrastructure, and, since it had already been damaged by previous hurricanes (*Carla* in 1962 and *Beulah* in 1967), the Baptists decided to give it up, and the State of Texas took it over. The new state institution, Texas A&I University at Corpus Christi, became a part of the University System of South Texas, and started as an upper-level (junior, senior and graduate only) university in 1973. Due to name confusion with the long-standing Texas A&I University at Kingsville, the Corpus Christi campus changed its name to Corpus Christi State University in 1977 in honor of its home town that helped get it started. Both campuses became a part of the Texas A&M University System in 1989, and the Texas A&M University-Corpus Christi name was adopted in 1993. TAMUCC then became a four-year, comprehensive university in 1994. With the name change, the 4-year status, and a new, development-minded president (Dr. Robert Furgason), TAMUCC began a dramatic, explosive growth phase, going from 3000 students in 1990 to over 9000 in 2009. Likewise, research increased from $500,000 in 1990 to almost $15 million in 2009. Campus infrastructure grew with the infusion of over $350 million during this timeframe.

Marine Science History

Marine science was first introduced to campus in 1957 when Dr. Henry H. Hildebrand started teaching at the University of Corpus Christi. Dr. Hildebrand had recently received his PhD from the new University of Texas Marine Science Institute in Port Aransas under Dr. Gordon Gunter.

Dr. Hildebrand was a firm believer in hands-on, field oriented marine science, so his students were frequently on field trips around the Texas Coastal Bend, primarily Corpus Christi Bay, the Laguna Madre, and Mustang and Padre Islands. He also started taking students on extended field trips to Belize and its offshore coral reefs (Figure 2).

The Center for Coastal Studies embraced this research and teaching philosophy, almost always taking on field oriented research and contract work. The following list itemizes the marine science history at TAMUCC during the past several decades, with CCS researchers and students being integral parts of most of this history:

1957 Dr. Henry Hildebrand started Marine Science Program
1967 USGS Office of Marine Geology moved to campus
1970 Hurricane *Celia* severely damaged campus facilities
1973 Dr. Hildebrand moved to Texas A&I University at Kingsville
1974 Dr. Wes Tunnell came to continue development of marine science program
1975 MS Degree in Biology with coastal and marine emphasis started
1978 New science building built/moved into (Center for Sciences)
1978 USGS expanded into Old Science Building
1984 CCS created

1980s	(Mid to Late) State and Federal agencies moved into Old Science Building (renamed Center Environmental Studies and Services)
1987	Conrad Blucher Institute for Surveying and Science endowed and started
1988	Mariculture MS degree started
1989	Texas Coastal Ocean Observation Network started; University became part of Texas A&M University System
1992	Environmental Science BS and MS degrees started with coastal and marine emphasis possible
1996	NRC opened with state agencies (focused on Texas coast) and university research centers
2000	HRI endowment announced ($46 million)
2005	Coastal and Marine System Science PhD started
2005	HRI building ($18 million) opened
2008	Marine Biology PhD started

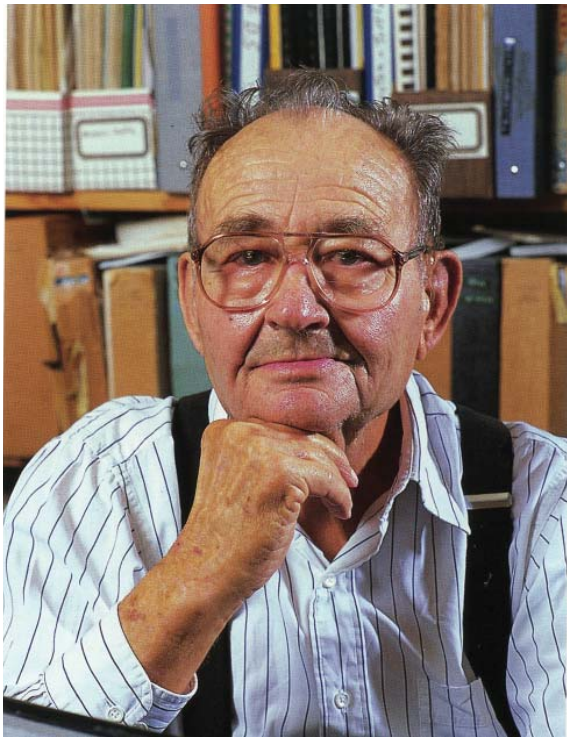


Figure 2.- Dr. Henry Hildebrand, founder of the hands-on, field oriented marine science program at TAMUCC. Photograph by J. Hiney.

Natural Resources Center

The concept of co-location of state and federal agencies on the Ward Island campus began in the late 1960s when the USGS, Office of Marine Geology, moved into a building on the western side of campus built specifically for it. This very active office/lab continued to increase in research activity in the Gulf of Mexico and Caribbean Sea, until they needed more space in the late 1970s. When we (the sciences) moved out of the Old Science Building, which was left over from UCC days, the USGS asked then President B. Alan Sugg if they could have part of the Old Science Building for expansion of their programs. His first response was "no", because the building was unsound, needed much repair, and wasn't fit for future occupancy. However, after much begging and pleading, President Sugg gave in and said "yes". Because of the building's condition, however, he said they could have it RENT FREE, but they would need to pay custodial fees, utilities, and any building modifications. Soon, word got out about the rent free status of the old building, and the U.S. Fish and Wildlife Service (USFWS)-Ecological Services Office moved in during 1982 just before we created the Center for Coastal Studies.

I then began promoting the old building as a good place to be for synergistic work with other agencies, researchers, and student interns. By the late 1980s the old science building was full of state and federal agencies: USFWS-Ecological Services; USFWS-Fisheries Resources Office; USFWS-National Wetlands Research Center, Corpus Christi Field Station; USFWS-National Fisheries Contaminant Research Center; Minerals Management Service; and Texas Parks and Wildlife-Resource Protection Division. Because of the win-win success of this co-location concept, we renamed the building the Center for Environmental Studies and Services, and I wrote a prospectus for a new building. This new facility was to be a multiagency center for applied environmental studies, research, and services within mainland, coastal, and offshore South Texas.

Fortunately, State Senator Carlos F. Truan, who had always been a proponent of environmental issues, worked with TAMUCC's new President Robert Furgason to write a bill during the 1991 legislative session to fund a new $10 million, 100,000 sq. ft. building. Unfortunately, due to state law, the new building had to be 95% state entities, leaving out all but one federal unit from the new building. This unit, the USFWS contaminants group (now USGS-MERS), formed a Cooperative Agreement with CCS and moved into the new building in summer 1996. Other federal entities remained in the old Center for Environmental Studies and Services building and the new building was renamed the Natural Resources Center. In 2003 the building was renamed the Carlos F. Truan Natural Resources Center in honor of the senator who wrote the enabling legislation. The building is a State of Texas building managed and operated by the university (Figure 3).

The new NRC building added other State agencies, including the Texas Commission on Environmental Quality, Texas General Land Office (3 different division offices), Texas Health Department's Shellfish Sanitation Division, and the Texas

Figure 3. – Carlos F. Truan Natural Resources Center (NRC) on the Texas A&M University- Corpus Christi campus: a) Front view to southwest and b) aerial view to the southeast of the Ward Island campus between Corpus Christi Bay (left) and Oso Bay (background) showing the NRC building that houses the Center for Coastal Studies and the Harte Research Institute for Gulf of Mexico Studies (HRI). Photos courtesy of TAMUCC.

Forest Service. An office of the Texas Sea Grant Program was also housed in the building. University research centers included the Center for Coastal Studies, Center for Water Supply Studies, the Center for Bioacoustics, and the Division of Nearshore Research of the Conrad Blucher Institute for Surveying and Science. The latter group is the one which operates the Texas Coastal Ocean Observation Network, the densest system of tide gauges in the world, extending the length of the Texas coastline from Louisiana to Mexico. Other environmental parameters have been added to selected gauges (temperature, salinity, oxygen, currents, etc.) since the network was initiated in 1989. All data is telemetered to the campus via radio waves, cell phones, and satellites to provide near realtime data on the Internet (http://lighthouse.tamucc.edu).

Local businesses needing permit information and applications referred to the co-location concept as "one-stop-shopping" for gathering permit information or having agency meetings. The university benefited from the concept by obtaining research and contract work to answer questions to real-world environmental problems, and students gained agency experience as interns or gained employment after graduation. It was a true win-win operation for the community, the university, the students, and the agencies.

CCS Facilities

The Center for Coastal Studies has approximately 10,000 square feet of office and lab space in the Natural Resource Center. There are 8 labs, 10 offices, a large graduate carrell office space, library, and archive room on the third floor of the NRC, and a wetlab and 2 storage areas on the first floor near the loading dock.

In addition to campus facilities, CCS has the Estes Education Station in Redfish Bay and use of the Laguna Madre Field Station, which belongs to the TAMUCC College of Science and Technology. At a greater distance CCS has utilized a property along the Mexican Caribbean coast of Quintana Roo since 1996 for coral reef and other tropical studies. Rancho Pedro Paila is located on the beach in the Sian Ka'an Biosphere Reserve about 20 miles south of Tulum. There are three houses on the property, and they have primarily been used by the TAMUCC Coral Reef Ecology Class field expeditions.

Other Programs

In addition to our main research program focus areas mentioned above and following, CCS has sponsored or co-sponsored a number of university programs over years: NRC Memorial Conference Rooms; CCS Scholarship Program; the Laguna Madre Field Station; the Coral Reef Ecology Program; the annual National Ocean Science Bowl competition; and the CCS Aquatic Education Program. Most of these will be covered in subsequent chapters of this book.

New CCS Mission

With new State of Texas funding and the opportunity for new facilities in the new NRC building, CCS revisited its mission statement in the early 1990s and came up with a new one for the growing center. The current mission of the Center for Coastal Studies is "to increase knowledge and understanding of the marine ecosystems, habitats, flora, fauna, and socioeconomics of the Texas coast and Gulf of Mexico through education and research". As an interdisciplinary marine research institute within the College of Science & Technology, the CCS conducts basic and applied research, ecological monitoring, public education outreach, and graduate level education and research programs. Today, the primary goals and objectives of the Center for Coastal Studies are:

- to conduct relevant research on Texas coastal issues, particularly in the Texas Coastal Bend and South Texas;
- to train, advise, and mentor TAMUCC graduate students for further graduate education or as coastal and marine science managers for state and federal agencies, as well as industry;
- to provide hands-on undergraduate and graduate research assistantships and experiences in coastal and marine science;
- to disseminate research results and other activities to the scientific community and general public through press releases, websites, peer-reviewed publications, technical reports, and presentations in regional, national, and international meetings; and,
- to provide coastal and marine education outreach programs.

Research Programs

As with any marine research lab, research programs flourish along the lines of the lead researchers: Quenton Dokken, Brien A. Nicolau, Marion Nipper, Liz Smith, Wes Tunnell, and Kim Withers. In addition, several College of Science and Technology faculty utilized lab space or CCS grant management for their research at times, particularly before increased research activity within the college departments. Roy Lehman and Joanna Mott were the most active in this regard. The following chapters are dedicated to each major CCS research focus area.

1 Research Programs

Wes Tunnell

Research programs in the Center for Coastal Studies (CCS) have developed along the lines of researcher expertise primarily, but also in areas of need within the state and federal agencies, particularly those co-located on the TAMUCC campus. In fact, during the 1980s CCS got its start with funding for water quality monitoring/sampling within Corpus Christi Bay and the Laguna Madre for the Texas Water Development Board in Austin (for Gary Powell). Following that, a cooperative agreement was established with the U.S. Fish and Wildlife Services (USFWS) – Ecological Services Office on campus. Roy Perez and Tom Grahl were proponents of cooperative agreements with CCS, and they hired TAMUCC graduate students part-time to work on needed projects, such as fire ant problems with colonial water bird rookeries on dredge material islands along the Intracoastal Waterway or measuring the effectiveness of mitigation sites in the Nueces Delta.

The USFWS coop agreement led to others with the Texas Parks and Wildlife Department, Texas General Land Office, the USFWS-Fishery Resources Office, and several branches of the U.S. Geological Survey. All of these coop agreements provided bright young graduate students with energy and new training (in computer science and Geographic Information Systems, for example) that in turn benefited the agencies by answering questions via research projects on local issues or problems. Following graduation, many of the coop students were hired by the agencies as they were known quantities. Robyn Cobb, Beau Hardegree, Clare Lee, Amy (Kolterman) Nuñez, and Kathryn (Harvey) Tunnell are examples of Biology MS students who followed this path and still work within agencies on campus. Other students like Carl Beaver, David Hicks, Jim Tolan, and Robert Vega went on for their PhD degrees after their graduate experiences in CCS.

Beyond the agencies, some local engineering personnel and firms, like Joe Moseley at Shiner Moseley and Associates, were also strong proponents of the educational experience and the co-location concept of agencies and research together. They often referred to it as one-stop-shopping, where they could come and get advice on developing projects and programs from multiple state and federal agencies and researchers. They too, in turn, hired our graduates. Kim (Halbrook) Ellis and Chemaine (Sahadi) Koester are examples.

One other significant circumstance occurred which benefited almost all researchers with projects in the mid 1990s, just as State of Texas funding was kicking in to develop CCS personnel and facilities. The Corpus Christi Bay National Estuary Program was established by the U.S. Environmental Protection Agency in 1994 and infused CCS with grant funding focused on the Texas Coastal Bend, and it offered opportunity for engagement with regional stake holders on the research

agenda for the area. What was known, what wasn't known, and what needed to be known in order to manage this newly designated National Estuary Program. The subsequent Coastal Bend Bays & Estuaries Program, Inc. is still in existence today, implementing their Bays Plan for management and restoration of the region. They also have hired a number of our graduates over the years and continue to fund CCS projects. Although other graduates have worked there in the past, Jace Tunnell is a current example.

Table 1.1 and the following chapters list the research scientists and their research focus areas. Some have been fairly narrowly focused over the years, such as Marion Nipper in her marine ecotoxicology program, but most have been quite varied and flexible in their research, sometimes expanding into new areas as opportunities avail.

Table 1.1 – Research Scientists and research focus areas in the Center for Coastal Studies, 1984-2009 (alphabetical order by scientist).

Research Scientist	Research Focus Areas/Specialty
Quenton Dokken	Artificial and coral reefs, fisheries, Gulf of Mexico sustainability and management, regional socioeconomics
Brien A. Nicolau	Wetland ecology, marine/estuarine benthic ecology, water resource issues, water and sediment quality
Marion Nipper	Marine ecotoxicology
Liz Smith	Coastal ecology (wetland, barrier island, and riparian systems), coastal resource managment, habitation conservation planning, restoration and enhancement, and geographic information systems applications for resource management
Wes Tunnell	Coastal and coral reef ecology; systematics, distribution, and ecology of molluscs; oil spill impacts; invasive molluscan species; marine biodiversity
Kim Withers	Wind-tidal flat ecology; shorebird ecology; invertebrate communities of tropical and subtropical estuarine habitats, coral reefs, and offshore platforms; juvenile fish communities of sea grass and mangrove habitats; bay scallop biology and ecology

2 Coastal and Coral Reef Ecology

Wes Tunnell

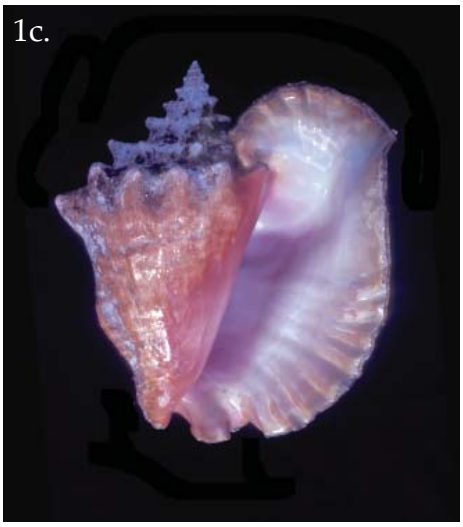
Coastal and coral reef ecology broadly defines my research focus areas over my 25 years with the Center for Coastal Studies (CCS), as well as the total 35 years with Texas A&M University-Corpus Christi (TAMUCC). My true loves in research are coral reef ecology and studies of the systematics, distribution, and ecology of mollusks. Unfortunately, there was not much research funding available in these areas when I started at TAMUCC in 1974, or when we started CCS in 1984. However, being an opportunist and primarily in favor of field work over lab work, I was able to find research opportunities along the South Texas coast, as well as in Mexico with student projects on coral reefs via our annual Coral Reef Ecology class field trip.

Ironically, before the first full year of CCS was complete, I was informed that I had received a Fulbright Scholar Award to move to the Yucatan Peninsula in Mexico for the academic year 1985-86. Steve Barnes agreed to be the Acting Director of CCS in my absence. This year in Mexico proved to be very fruitful for my professional career and family, as they all (wife, daughter, and two sons) moved with me. We lived on the beach in a summer home in Chicxulub Puerto, about 20 miles north of Merida, Yucatan, where the research lab I worked in was located. CINVESTAV (Centro de Investigación y de Estudios Avanzados) was a research lab of the Instituto Politécnico Nacional in Mexico City. I was in the Marine Ecology section with my colleague Ernesto Chávez. The purpose of my appointment at CINVESTAV was to conduct field research on the coral reefs around the Yucatan Peninsula.

Studies on the Campeche Bank reefs during my Fulbright year were accomplished with assistance from two CINVESTAV MS graduate students, Alicia Gonzalez and Mauricio Guarduño. The Mexican Navy would drop us off on reef islands for a week and then return to get us (we hoped). I drove to coral reef sites along the Mexican Caribbean because those reefs were easily accessible along the shores. That year in the Yucatan provided excellent study opportunities for coral reefs (Tunnell 1988, Tunnell 1992, Chávez and Tunnell 1993, Tunnell 1996, Lang et al. 1998, Hicks et al. 2001) (Figure 1) and island nesting seabirds (Tunnell and Chapman 1988, 2001) (Figure 2), ultimately leading to our book on the Coral Reefs of the Southern Gulf of Mexico (Tunnell et al. 2007) (Figure 3).

Back in Corpus Christi, CCS had been created simply to handle research grants and contracts for faculty and graduate students, and the Texas Water Development Board helped us get that element started. Graduate students John Gourley and Robert Vega led water quality monitoring trips once per month from Aransas Bay to Port Isabel as the first funded CCS projects. The first of many cooperative agreements was then established with the U.S. Fish and Wildlife Service (USFWS)

Figure 1. Views of Campeche Bank and coral reefs and islands during Tunnell Fulbright study year in Yucatan Peninsula: a) Alacran Reef lagoon; b) Alacran Reef platform shallows: c) queen conch *Eustrombus gigas*; and, d) Cayo Arenas leeward lagoon.



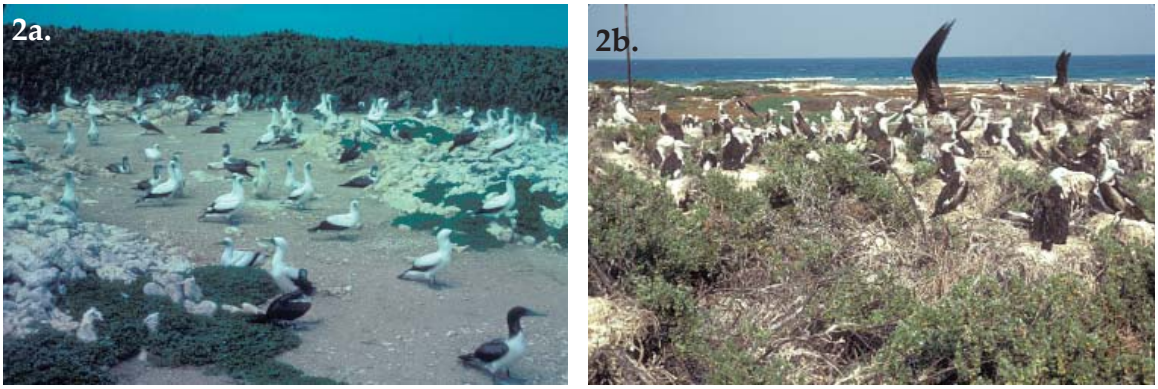


Figure 2. Colonial nesting seabirds on Campeche Bank islands: a) Masked Booby on Cayo Arenas and b) Magnificent Frigate Bird on Cayo Centro of Cayos Arcas.

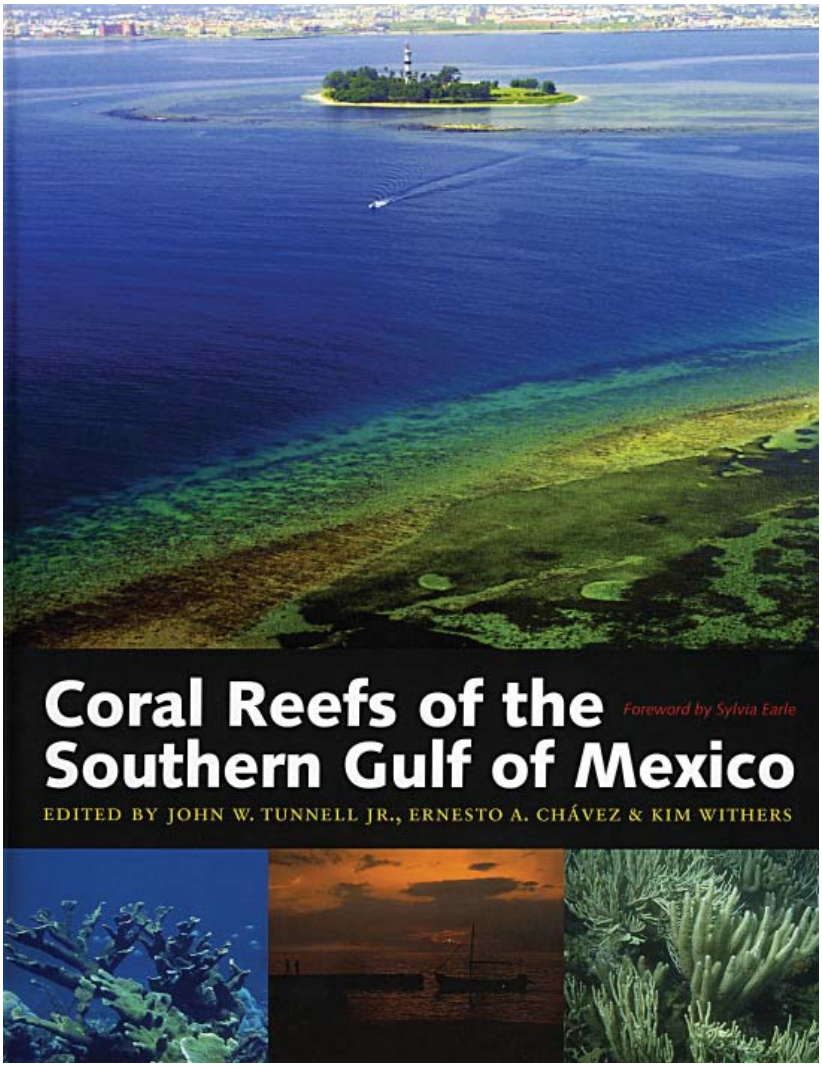


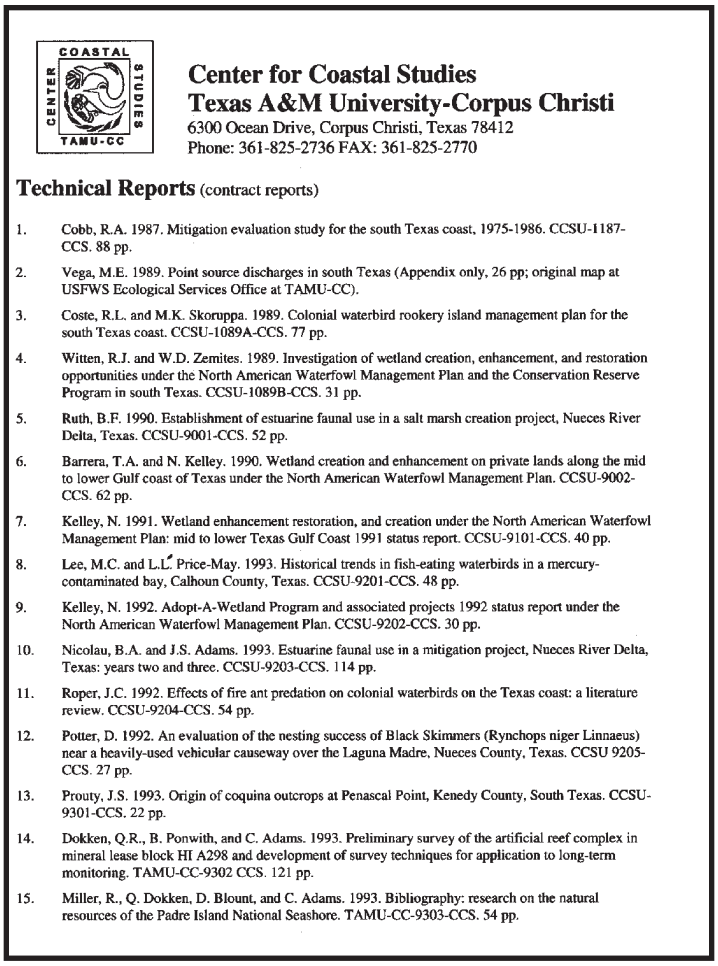
Figure 3. Cover of *Coral Reefs of Southern Gulf of Mexico* book, an outcome of the Tunnell Fulbright study year.

on the TAMUCC campus, housed in the Old Science Building (later named the Center for Environmental Studies and Services) (Figure 4). Roy Perez, and then Tom Grahl, of the USFWS really promoted the cooperative agreement concept and program with the university as a means of achieving information or answers to questions or problems they had in managing Texas Coastal Bend species and habitats. They also knew that this highly successful program gave them a good look at, and interaction with, MS Biology graduate students who performed the work and could become future employees. Examples of such students, who turned employees, and their projects include: Robyn Cobb (1987, see CCS Tech. Report #1); Mary Ellen Vega (1989, T.R. #2); Mary Kay Skoruppa (1989, T.R. #3); Barbara Ruth (1990, T.R. #5); Teresa (Barrera) Carrillo (1990, T.R. #6); and Clare Lee (1993, T.R. #8) (Figure 5).

Figure 4. Old Science Building renamed to Center for Environmental Studies and Services and used to house state and federal offices on the TAMUCC campus. Photograph by J. Janko.

One outgrowth of these early-funded projects was when Teresa Carrillo, (1990, T.R. #6) and Nivra Kelly (1991-1996, T.R. #7, 9, 16, 32) with funding from the North American Waterfowl Management Plan to the USFWS, led the development of the Adopt-A-Wetland Program (Figure 6). This highly successful education-outreach program at CCS eventually led to the development of the Aquatic Education Program that continues today (see Chapter 8 herein).

Another long-term success story and program developed from original USFWS coop funding, was the CCS focus on applied research in the Nueces River Delta, first with the Corps of Engineers mitigation site and then with the Allison Wastewater Effluent Demonstration Diversion Project and Rincon Bayou Diversion Project with the City of Corpus Christi. Barbara Ruth (now Florida Department of Environmental Protection), then John Adams (now Conrad Blucher Institute,



Center for Coastal Studies
Texas A&M University-Corpus Christi
6300 Ocean Drive, Corpus Christi, Texas 78412
Phone: 361-825-2736 FAX: 361-825-2770

Technical Reports (contract reports)

1. Cobb, R.A. 1987. Mitigation evaluation study for the south Texas coast, 1975-1986. CCSU-1187-CCS. 88 pp.
2. Vega, M.E. 1989. Point source discharges in south Texas (Appendix only, 26 pp; original map at USFWS Ecological Services Office at TAMU-CC).
3. Coste, R.L. and M.K. Skoruppa. 1989. Colonial waterbird rookery island management plan for the south Texas coast. CCSU-1089A-CCS. 77 pp.
4. Witten, R.J. and W.D. Zemites. 1989. Investigation of wetland creation, enhancement, and restoration opportunities under the North American Waterfowl Management Plan and the Conservation Reserve Program in south Texas. CCSU-1089B-CCS. 31 pp.
5. Ruth, B.F. 1990. Establishment of estuarine faunal use in a salt marsh creation project, Nueces River Delta, Texas. CCSU-9001-CCS. 52 pp.
6. Barrera, T.A. and N. Kelley. 1990. Wetland creation and enhancement on private lands along the mid to lower Gulf coast of Texas under the North American Waterfowl Management Plan. CCSU-9002-CCS. 62 pp.
7. Kelley, N. 1991. Wetland enhancement restoration, and creation under the North American Waterfowl Management Plan: mid to lower Texas Gulf Coast 1991 status report. CCSU-9101-CCS. 40 pp.
8. Lee, M.C. and L.L. Price-May. 1993. Historical trends in fish-eating waterbirds in a mercury-contaminated bay, Calhoun County, Texas. CCSU-9201-CCS. 48 pp.
9. Kelley, N. 1992. Adopt-A-Wetland Program and associated projects 1992 status report under the North American Waterfowl Management Plan. CCSU-9202-CCS. 30 pp.
10. Nicolau, B.A. and J.S. Adams. 1993. Estuarine faunal use in a mitigation project, Nueces River Delta, Texas: years two and three. CCSU-9203-CCS. 114 pp.
11. Roper, J.C. 1992. Effects of fire ant predation on colonial waterbirds on the Texas coast: a literature review. CCSU-9204-CCS. 54 pp.
12. Potter, D. 1992. An evaluation of the nesting success of Black Skimmers (Rynchops niger Linnaeus) near a heavily-used vehicular causeway over the Laguna Madre, Nueces County, Texas. CCSU 9205-CCS. 27 pp.
13. Prouty, J.S. 1993. Origin of coquina outcrops at Penascal Point, Kenedy County, South Texas. CCSU-9301-CCS. 22 pp.
14. Dokken, Q.R., B. Ponwith, and C. Adams. 1993. Preliminary survey of the artificial reef complex in mineral lease block HI A298 and development of survey techniques for application to long-term monitoring. TAMU-CC-9302 CCS. 121 pp.
15. Miller, R., Q. Dokken, D. Blount, and C. Adams. 1993. Bibliography: research on the natural resources of the Padre Island National Seashore. TAMU-CC-9303-CCS. 54 pp.

Figure 5. Center for Coastal Studies Technical Report list showing first several years (complete list is found in Appendix IV).

Division of Nearshore Research), then Brien A. Nicolau (now Center for Coastal Studies) all did Biology MS thesis projects within the mitigation site (Ruth 1990, T.R. #5; Nicolau and Adams 1993, T.R. #10) (Figure 7). Brien A. Nicolau subsequently became the operations manager and then Assistant Director of Operations for CCS, as well as a Research Associate. He continues today as an effective researcher with the Nueces Delta projects and others within the Texas Coastal Bend. He has sponsored numerous undergraduate and graduate students on his research projects, and his research program is covered in Chapter 7 of this book.

In the early 1990s three new opportunities for research took my students and colleagues in three different directions: coral reef characterization in southern Quintana Roo, Mexico; invasion of the Texas coast by the edible brown mussel *Perna perna*; and, burning of a high marsh oil spill.

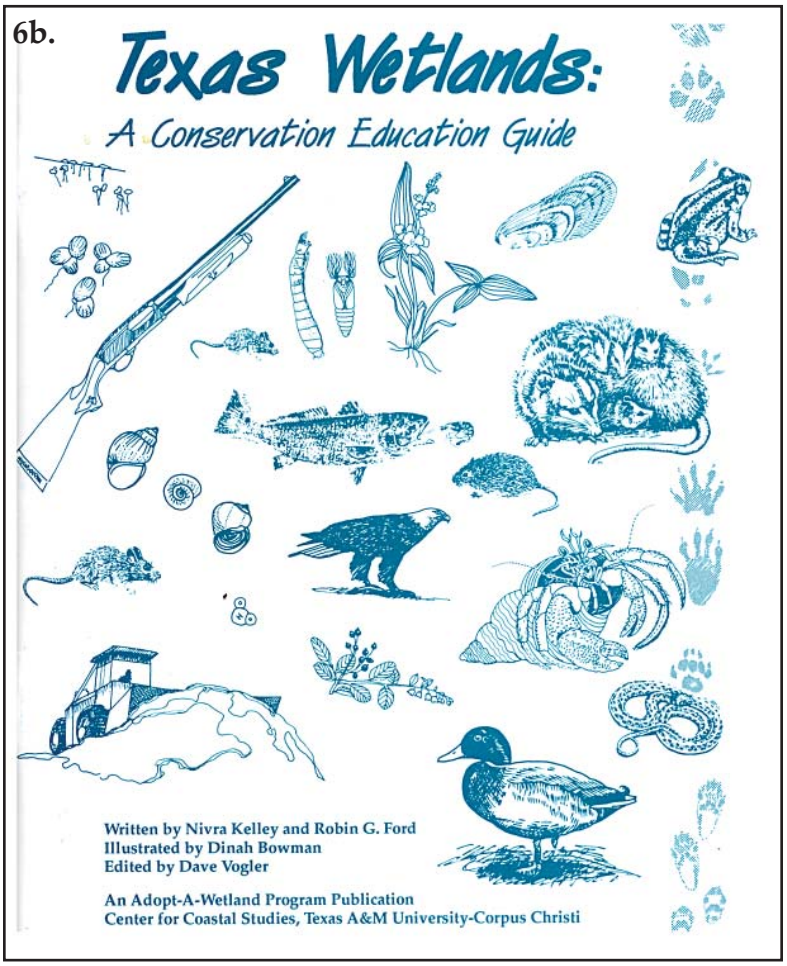


Figure 6. Adopt-A-Wetland Program (AAWP): a) homeschooled students monitoring AAWP site in Blind Oso adjacent to TAMUCC. Photograph by R. Smith, and b) *Texas Wetlands: A Conservation Education Guide* booklet developed for AAWP education and outreach.

Figure 7. Nueces Delta Mitigation Project. Photograph by Lanmon Aerial Photography, Inc.

Texas Sea Grant Director Tom Bright wanted an international coral reef project. So we put together an advanced coral reef ecology team of eight students (John Adams, Carl Beaver, Paul Choucair, Beau Hardegree, David Hicks, Clare Lee, Roy Lehman, and Jim Tolan), all with former diving and coral reef research experience. During the five-week expedition we drove from Corpus Christi to southern Quintana Roo near Majahual. We characterized two transects, one from a sandy beach and the other from a limestone rocky shore, extending from the shoreline to the deep reef at about 100 feet (Figure 8). In addition to the in-depth coral reef characterization (Tunnell et al. 1992), the students got to visit numerous Mayan ruins on the trip (Figure 9). Four of these students went on to receive their PhD degrees (Beaver, Hicks, Lehman, and Tolan) and the other four work for TAMUCC (Adams), CITGO Petroleum Corporation (Choucair), and the USFWS (Hardegree and Lee).

During a class field trip to the Port Aransas jetties in 1992, we collected a juvenile brown mussel that was not part of the usual jetty fauna. It turned out to be the invasive edible brown mussel, *Perna perna* which resulted in an early publication noting its arrival by MS student David Hicks (Hicks and Tunnell, 1993) (Figure 10). Subsequent Sea Grant funding allowed us to study the ecology and dispersal of the mussel (Hicks and Tunnell 1994, 1995) (Figure 11), and it ultimately became the subject of David's PhD dissertation at the University of Texas in Arlington with Robert McMahon (Hicks et al. 2001, Hicks and McMahon 2002 a and b, Hicks and McMahon 2003). David is now a professor at the University of Texas in Brownsville.

Figure 8. El Placer, Quintana Roo, Mexico, study site (May 1992): a) shoreline and Zodiac; b) outdoor lab; and, c) groove and spur zone of reef.

Figure 9. Mayan Ruins visited during 1992 coral reef expedition: a) Tulum and b) Palenque.

Figure 10. The invasive edible brown mussel, *Perna perna.* Photograph by D. Hicks.

Figure 11. The invasive edible brown mussel, *Perna perna* covering the lower intertidal and upper subtidal zone on the Port Mansfield, Texas jetties (1994).

When an Exxon Pipeline Company underground pipe ruptured in a high salt marsh, burning was selected as the cleanup method to keep the oil from reaching Copano Bay (Figure 12). Since this was the first time burning had been used as a cleanup method in Texas, the General Land Office (GLO) funded a three-year study of the environmental impact and recovery of the marsh and burn site (Tunnell et al. 1994, 1995a, 1995b, 1997) (Figure 13). A freshwater lens from rainfall on the marsh allowed the burn to adequately remove the majority of the oil without severely damaging all of the marsh root systems, the water acting as a nice insulator. However, diversity was different in the new marsh, so GLO funded a year-five, post-spill study. Unfortunately, seismic activity in the marsh and a large population of feral hogs eliminated many study sites and negated a final conclusion on the long-term recovery (Hyde et al. 1997, 1998).

Figure 12. Burning as a cleanup method for the Exxon Pipeline Chiltipin Creek oil spill (January 1992), near Bayside, Texas. Photograph by T. Carillo.

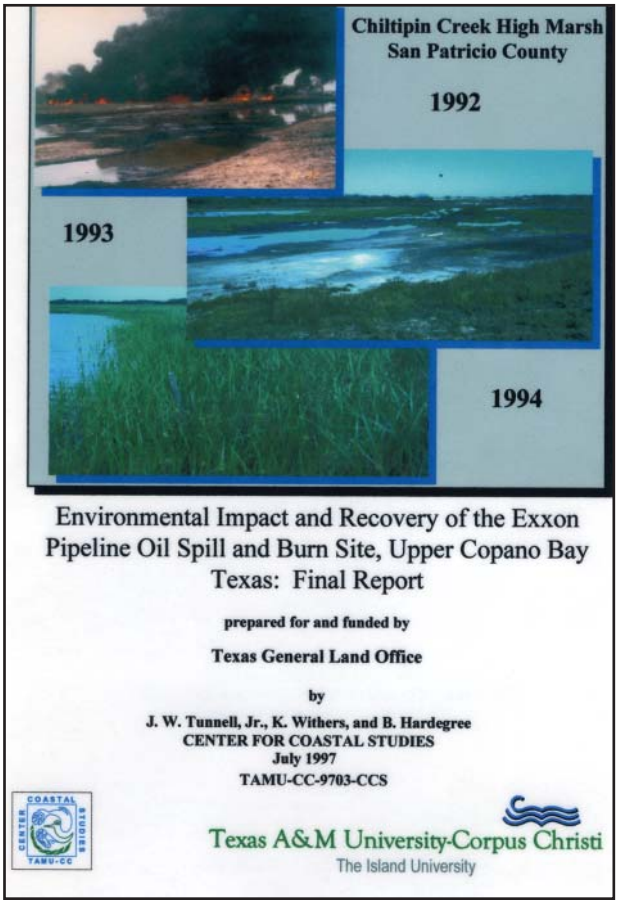


Figure 13. Final report of Chiltipin Creek oil spill and burn study site.

In the mid 1990s CCS established another strong and active cooperative agreement with the USFWS-Fisheries Resource Office (FRO), on the TAMUCC campus. This group sponsored a number of coop students studying and monitoring fishery resources in South Texas waters and on wildlife refuges. Students benefiting from these experiences included Noe Barrera, David Hoke, Michelle (Phillips) McGrath, and Troy Schleman (Figure 14).

Figure 14. Michelle Phillips working for FRO a) collects data on her MS thesis project and b) displays the byssus of the edible brown mussel, *Perna perna.* Photographs courtesy of USFWS/FRO.

Simultaneous with this timeframe the Corpus Christi Bay National Estuary Program was established. This four and a half year program provided numerous opportunities to characterize and assess the natural resources of the Texas Coastal Bend. I was appointed Co-Chair, along with Dr. Joan Holt of the University of Texas Marine Science Institute at Port Aransas, of the Science and Technology Action Committee. Although all CCS researchers were engaged in various projects during this time period, our largest collective effort was the Living Resources Project. I was Co-PI with Quenton Dokken, and we had major contributions from Kim Withers and Liz Smith plus many students (Sandra [Alvarado] Arismendez, Carl Beaver, Susan [Cox] Childs, Gene Douglas, Al Drumright, David Hicks, Kendall [Keyes] Kelly, Bonnie Ponwith, Dennis Rocha, Ron Smith, and Terri [Wood] Nicolau). This four volume work was more than 1500 pages in length and summarized all of the living resources (species and habitats) from the 12-county study area (Tunnell et al. 1996) (Figure 15).

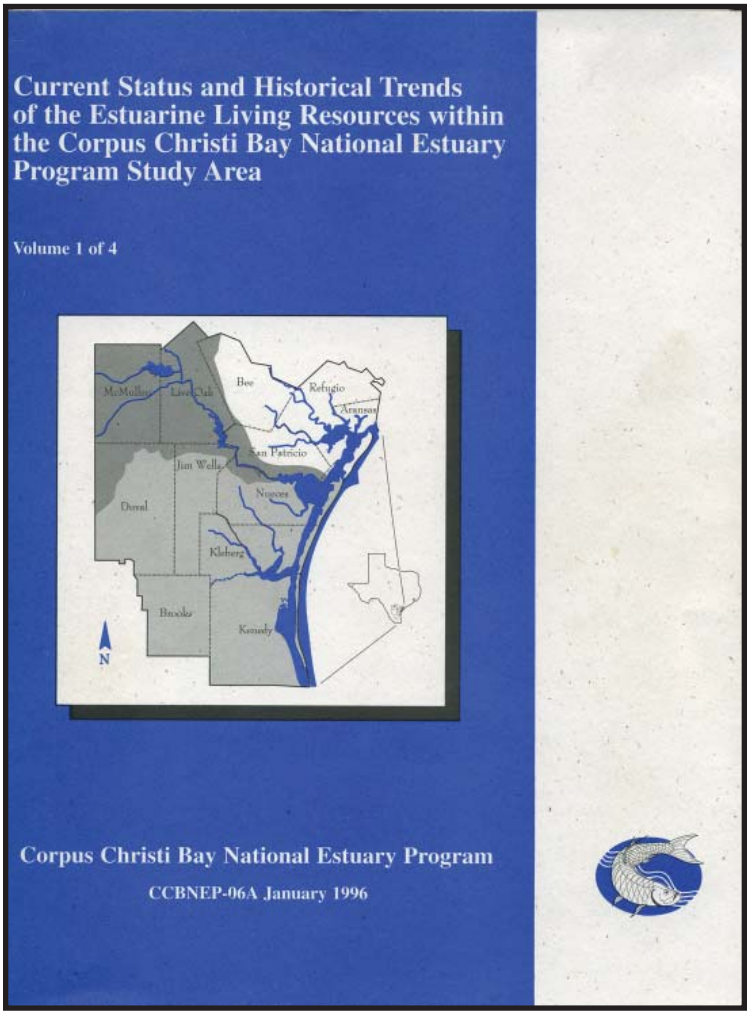


Figure 15. Living Resources Report for Corpus Christi Bay National Estuary Program, included 4 volumes and over 1500 pages.

In June 1996 we moved into our new facilities in the Natural Resources Center (NRC) (Figure 16). This was an exciting time for CCS, something like a dream coming true for a fledgling research center. We now had our own space for developing our research programs and bringing on more students as we expanded. We dedicated one large room for graduate carrels and one large lab for graduate project research.

Figure 16. Carlos F. Truan Natural Resources Center where CCS occupies 10,000 square feet of office and lab space on third floor. Photograph by J. Janko.

One of our most successful and continuous cooperative agreements was started with the GLO just after our move. Manuel Freytes, the head of that office, was, and still is, a strong proponent of graduate coop students. He would hire two coop students at a time to learn, and then assist, in their coastal permitting and assessing work along the South Texas Coast (Figure 17). Numerous students worked in this program, many of which went on to become agency personnel, or specialists in coastal engineering and environmental companies (Kathryn [Harvey] Tunnell, Chemaine [Sahadi] Koester, Kara Vick, and Lisa Vitale).

In the late 1990s I decided that it was time to do a book on Texas seashells, patterned after the highly successful books of Jean Andrews (Andrews 1971, 1977). However, just after starting on that project, I was approached by The Nature Conservancy to do a compendium of knowledge about the Laguna Madre of Texas and Tamaulipas. They were starting an international focus in this region and wanted to gather all known information first. This compendium was a major effort of several CCS staff (Smith, Withers) and students (Susan Childs, Suzanne [Dilworth] Bates, Nancy Hilbun, and Amy [Kolterman] Nuñez), and it led to the publication of our first book, *The Laguna Madre of Texas and Tamaulipas* (Tunnell and Judd 2001) (Figure 18). This book became No. 2 in the new Gulf Coast Studies book series sponsored by TAMUCC and published by Texas A&M University (TAMU) Press in College Station. TAMU Press Director Charles Backus asked me to be the General Editor of the series, which now has a growing list of titles on various Gulf coast subjects (Figure 19).

Figure 17. GLO Coop students in the field: a) assessing shoreline structure and b) measuring coastal pier. Photographs courtesy of GLO.

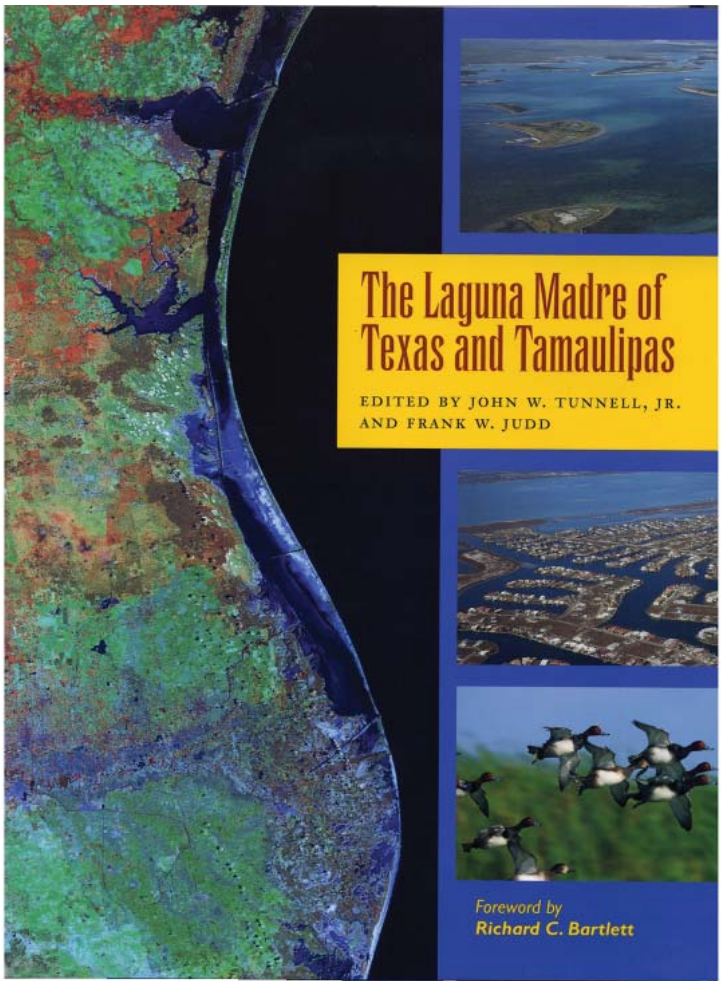


Figure 18. Cover of *The Laguna Madre of Texas and Tamaulipas* book published by TAMU Press in the Gulf Coast Studies Series at TAMUCC.

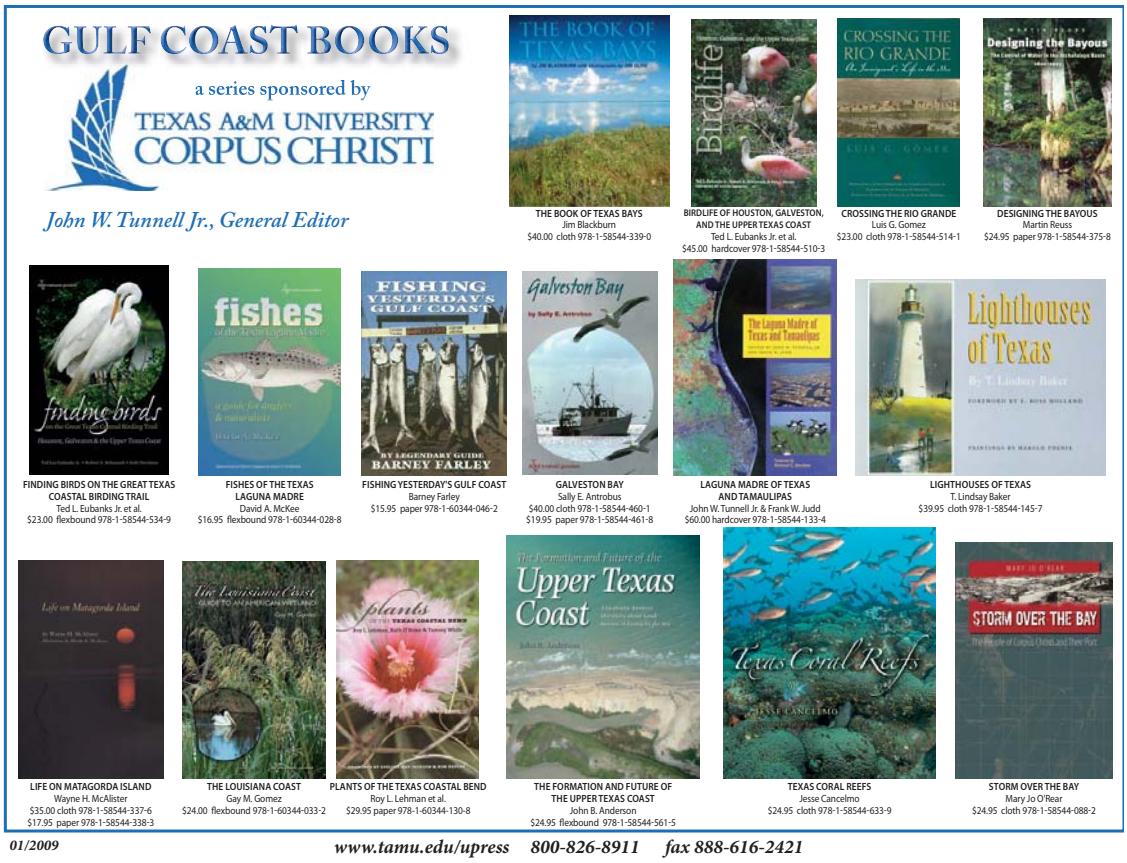


Figure 19. TAMUCC Gulf Coast Studies book series published by TAMU Press.

In September 2000 Mr. Ed Harte announced his $46 million endowment to TAMUCC to start the Harte Research Institute (HRI) for Gulf of Mexico Studies. After a year of university paperwork establishing the frame work for starting the institute, and then President Robert Furgason obtaining state funding for a building, I was asked to be Associate Director to help develop the new institute, design the new building, and develop a new PhD program. These new duties pulled me away from CCS administration, so Quenton Dokken and Liz Smith both helped with the research oversight of the Center, and Gail Sutton and Brien A. Nicolau handled financial administration and operations, respectively. I hired David Hicks to teach my classes and help with research, as David was a known quantity to us (a former MS student), a newly minted PhD, and well-respected teacher and researcher.

I spent the academic year 2001-2002 traveling the U.S. looking at the larger, more successful marine labs to get ideas on organization and structure for HRI, as well as new buildings. Carl Beaver was finishing up his PhD at this time and was very helpful in generating marine lab and PhD program data and information.

Carl also assisted me greatly with his first love, like mine, teaching and studying coral reefs. This class, Coral Reef Ecology, actually began before CCS. I was inspired

on a University of Miami cruise to the Bahamas, early in my PhD education, how field studies, first hand, could be so rewarding and educational. I vowed at that time, summer of 1971, that if possible, I would teach a graduate class on coral reefs wherever I got my first job. Corpus Christi wound up being the perfect place for such, so two years after I began at the University, we offered the first Coral Reef Ecology summer class with a two week field trip to a Mexican coral reef in June 1976 (Figure 20).

Figure 20. Coral Reef Ecology Class to Isla de Lobos (1976-77): a) four-hour shrimp boat ride from Tuxpan to Lobos; b) camp; and c) view of leeward reef and lagoon from lighthouse.

The first two years, we went to Isla de Lobos off Cobo Rojo in northern Veracruz state, one of my PhD dissertation study sites. The logistics of those two trips proved too much with leasing a shrimp boat for the four hour ride from Tuxpan to Lobos, so we switched to Enmedio Reef an Island in 1978 (Figure 21). It added an extra travel day, but we could use our own boats to access the island and mainland, only about five miles out.

These trips continued throughout the 1980s and became an integral part of CCS life and activity each summer. Many of our TAMUCC Biology and later, Environmental Science, graduate students took the class. Most knew they would never work in coral reef research or management, but they relished the expedition experience to another country, and the opportunity to study in the biodiverse tropics. It became my most rewarding class, as I would see students from 10-20 years ago, who had taken the class, and they would tell me that it was by far the most educational experience of their academic career.

Figure 21. Coral Reef Ecology Class to Enmedio Reef (1978-1993): a) 2-day drive, Tuxpan; b) Enmedio lighthouse; c) camp; d) returning Pancho's boat; e) Topatillo Island, collecting shells; and f) photo sampling of reef flat.

When the reefs of southern Veracruz continued to degrade environmentally, I began looking for a location in the Yucatan, where the reefs were healthier. In 1992 we took a special advanced coral reef class trip to southern Quintana Roo on a research trip, instead of doing the regular class. Although the trip was very successful as a research expedition, it was not appropriate for a class, as we would have to spend about eight days on the road (See Figure 8).

We returned to Enmedio the last time in 1993, and in 1994 we sent the van to Quintana Roo with all the heavy equipment (scuba tanks, compressor, zodiac, motor) and flew the students into Cancun. We held the field trip experience at

Playa Blanca in the middle of Sian Ka'an Biosphere Reserve on an island. It was a great place for study, but it was logistically too difficult to continue. We laid off in 1995, while I looked for a better site, and in 1996 went to Rancho Pedro Paila, a property on the beach in the northern Sian Ka'an Reserve. This site, owned by my friend Peter Watson from Minneapolis, Minnesota, proved to be the perfect spot. Peter has one large two-story house and two smaller one-story ones that were ideal for a class of 12-15 students, plus several assistants (Figure 22).

Over the years, we had 8 students do thesis MS thesis projects on the Veracruz reefs (Ray Allen, Paul Choucair, Donna Henkel, Teri Nelson, Nick Ricono, Ken Roberts, Terri Stinnet, and Robert White) and one do his PhD dissertation (Roy Lehman). In Sian Ka'an, so far, we have 11 MS thesis projects completed (Carl Beaver, Matt Campbell, Gary Haralson, Nancy Hilbun, Addie [Frets] Reed, Talley Keeny, Amy Nuñez, Chris Ledford, Scott Milroy, Kathryn Tunnell, Scott Van Sant). Gary Haralson is now (2009) doing his PhD dissertation research there. Drs. Kim Withers, Liz Smith, and Roy Lehman went on trips to Sian Ka'an and sponsored some of these MS student thesis projects as graduate committee advisors.

Although the class is temporarily suspended now after 32 years, we are hopeful it will be returned to the class line up for future students to experience. Along these coral reef study lines, we were able to bring my colleague Ernesto Chávez, a coral reef and fisheries expert, from Mexico for a sabbatical year as a HRI Visiting Research Scientist during 2002-2003. Ernesto was officed in CCS, along with other HRI personnel, while the new HRI building was being designed and built. Ernesto and I began a long awaited project to produce a book on the coral reefs of the southern Gulf of Mexico while he was in Corpus Christi. We had discussed this possibility for years and were happy to finally get it started. Ernesto had studied Lobos Reef early in his career in the late 1960s with classes from Mexico City. He later helped me get permits to study the Veracruz reefs for my dissertation and later with my students from Corpus Christi. In 2007 we published *Coral Reefs of the Southern Gulf of Mexico* (Tunnell et al. 2007) as the first volume in the new Harte Research Institute book series via TAMU Press.

The training gained in the Coral Reef Ecology class, as well as in Quenton Dokken's scientific diving class provided many students with the skills to join Quenton's offshore diving program. This program on artificial and natural reefs became one of the most active scientific diving programs in the United States (see Chapter 6 for more details).

In summary, I was fortunate to advise or co-advise over 50 MS students and several PhD students during my tenure as director/scientist/professor with CCS. I raised over $5 million in extramural funding during this timeframe to support students and other CCS staff.

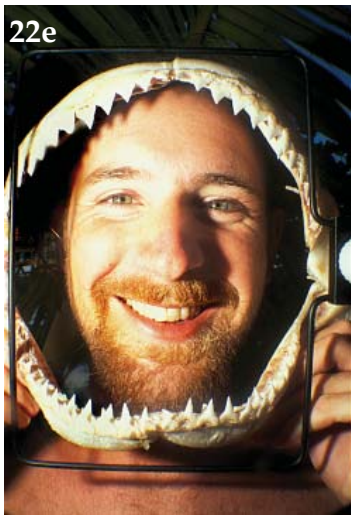


Figure 22. Coral Reef Ecology Class to Sian Ka'an Biosphere Reserve at Rancho Pedro Paila (1996-2007): a) Reserve map; b) view from Casa Blanca to Caribbean; c) heading out for dive; d) group photo (1999); e) clowning around; and f) dive on shallow reef.

3 Shorebird and Benthic Ecology

Kim Withers

When people I don't know well ask me my specialty, I usually tell them "coastal ecology." But in a more relaxed setting I'm just as likely to tell people I'm a "jack of all trades" that typically works "from the edge of the water to about neck deep" (Figure 1). The diversity of studies I've been involved in and students I have mentored make it hard for me to define my research "program." Then I think of how I answered Dr. Doug Slack, my PhD advisor, when he asked me during my final oral exam "what do you call yourself?" I answered "a community ecologist" and looking back over my body of work, that's as close to defining my program as I can get.

I came to the Center for Coastal Studies (CCS) in 1995 after a brief stint in a tenure-track position at the University of West Florida in Pensacola. It wasn't my first time working for the Center; I had worked as a field/lab technician during several summers while working on my PhD in Wildlife and Fisheries Sciences at Texas A&M University. Wes Tunnell was one of my committee members, and he kindly helped out a "starving student" with a job for a little extra cash. My dissertation research had been on the relationships between shorebirds and their invertebrate prey on wind-tidal flats in the upper Laguna Madre. My interest in shorebirds began while I was an undergraduate and I assessed the prospects of continuing that work in the Florida Panhandle as "poor." So, I jumped at the chance to return to the Coastal Bend and the Laguna Madre when I had the opportunity to come back to the Center.

Figure 1. Dr. Kim Withers with her Biology of Estuarine Organisms class in Redfish Bay, Texas.

The invertebrate community of the wind-tidal flats had been at the center of my dissertation research. Over 5000 benthic cores later, rather than hating the little beasts, they became the real focus of the work I have continued to this day. Although I have had several students work on shorebird projects (Figures 2, 3, and 4), most of these projects also included an invertebrate component. My students and I have worked on invertebrate communities associated with red mangrove prop roots (Figures 5 and 6), seagrass meadows (Figures 7 and 8) unvegetated bay bottoms, tidal flats (Figure 9), and rocky shores in Texas and Mexico (Figure 10). Invertebrate organisms of specific interest have included bay scallops (Figure 11), and blue crabs (Figure 12). Throw in a couple of larval fish projects (Figure 13), some coral reef work (Figure 14), and a terrapin or two (Figure 15), and it's easy to see why I tend to refer to myself as a "jack of all trades."

In addition to a lot of field work, over the years I've also been involved in several large book projects. The first was *The Status of the Living Resources in the Corpus Christi Bay National Estuary Program Study Area* for the Corpus Christi Bay National Estuary Program. This four volume, 1400-page compendium of the habitats, species and fisheries of the Coastal Bend was edited by Wes Tunnell, Quenton Dokken, Elizabeth Smith and myself. I also authored two chapters. Although a part of the "gray" literature, this is an important review of the ecology of the coastal habitats in the area. The next book was a review of the ecology of the Laguna Madre in Texas and Tamaulipas. *The Laguna Madre of Texas and Tamaulipas* was edited by Wes Tunnell and Frank Judd and published in the Gulf Coast Studies book series by Texas A&M University Press in 2001. I authored six chapters including seagrass meadows, open bay habitats, wind-tidal flats, shorebirds and wading birds, fish and invertebrate fisheries organisms, and red and brown tides and co-authored the chapter on conservation issues and recommendations with Wes Tunnell and Liz Smith. The most recent book was an overview of the ecology, geology, oceanography, and conservation of the coral reefs in the southern Gulf of Mexico. *Coral Reefs in the Southern Gulf of Mexico* was published in the Harte Research Institute book series by Texas A&M University Press in 2007. I co-edited this book with Wes Tunnell and Ernesto Chávez and co-wrote two chapters. In addition, I contributed a chapter entitled "Shells in Texas Coastal History" for the forthcoming *Encyclopedia of Texas Shells* by Wes Tunnell, Jean Andrews, Noe Barrera, and Fabio Moretzohn that will also be published in the Harte Research Institute book series by Texas A&M University Press in 2010. Another very large project that I shared with Marion Nipper, another research scientist at the Center, was editing the English translation of the *Diagnóstico Ambiental de Golfo de México*, entitled *Environmental Analysis of the Gulf of Mexico*. The latter is No. 1 in the Harte Research Institute Special Publication e-book series.

Throughout my 15-year tenure as a research scientist at CCS, my focus has always been on training graduate students for careers in ecology and environmental science or to continue their studies as PhD students.

Figure 2. a) Graduate student Michelle Kolar, searching for Snowy Plover nests. b) One of the nests Michelle followed during her thesis project on the nesting success of Snowy Plovers at two sites in the Coastal Bend.

Figure 3. Graduate student Shannon Rowell-Garvon, conducting a shorebird/wading bird survey at Sunset Lake park, Texas during her thesis fieldwork. Shannon's thesis project was a detailed study of shorebird and wading bird habitat use and behavior in a coastal habitat mosaic consisting of marsh, bayshore, and tidally influenced ponds.

Figure 4. Graduate student Maren Harding mapping shorebird distribution in the Blind Oso, Oso Bay, Texas, during her thesis fieldwork. Maren studied the relationship of shorebird distribution to prey distribution on the Blind Oso wind tidal flat for her thesis project.

Figure 5. Graduate student Kathryn (Harvey) Tunnell cutting a red mangrove root during her thesis fieldwork in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. Kathryn's thesis project was a comparison of the community structures of red mangrove root faunas in Quintana Roo and Veracruz, Mexico.

Figure 6. Kim Withers (left) and graduate student Merrilee Thoresen, sitting on the porch at Rancho Pedro Paila in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico, picking invertebrates from red mangrove prop roots collected for a Coral Reef Ecology class project.

Figure 7. a) Graduate student Jennifer Davidson (left) and Kim Withers collecting benthic cores from seagrass beds in Redfish Bay, Texas. b) Jennifer sorting and identifying the mollusks in the samples taken from Redfish Bay, Texas. Jennifer's thesis explored the impact of propeller scarring on molluscan communities in seagrass beds.

Figure 8. Graduate student Amy Thurlkill collectintg seagrass core samples

Figure 9. Wind-tidal flat study area on Mustang Island, Texas.

Figure 10. a) Caribbean rocky shore ("iron shore") study area in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. b) Graduate students Erin (Albert) Hill (left) and Amy (Koltermann) Nuñez collecting data on the distribution of Caribbean iron shore gastropods for Amy's thesis project.

Figure 11. Graduate student Matt Hubner retrieving a spat trap during fieldwork for his thesis project on bay scallop recruitment in the Laguna Madre, Texas.

Figure 12. Graduate student Matt Schweitzer deploying a crab trap during fieldwork for his thesis project on blue crab population structure in the Nueces Estuary, Texas.

Figure 13. a) Graduate student Matt Campbell pulling a neuston net to collect juvenile fish in Laguna Boca Paila, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. b) Graduate students (from left to right) Tom Bates, Matt Campbell and Erin Hill, sitting on the porch at Rancho Pedro Paila in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico, sorting larval and juvenile fish collected in light traps and neuston nets. Matt described the community structure of larval and juvenile fish in Laguna Boca Paila and Laguna Campechen for his thesis project.

Figure 14. Graduate student Jason Jones conducting a photo-transect on a coral reef in the Veracruz Reef System (Mexico) for his thesis project assessing the condition of several reefs in the system.

Figure 15. One of the diamondback terrapins captured by graduate student Kim Halbrook during her thesis project on their population structure in the Nueces Estuary, Texas.

Their successes and projects define my research program. The next phase of my research on invertebrates (mostly) now includes laboratory studies on ecophysiology. I became interested in ecophysiology through the interests and work of my good friend and colleague Dr. David Hicks, now at the University of Texas-Brownsville, during his too-short tenure as a research scientist at the Center (Figure 16). He and I collaborated on a study of the influence of desiccation on the respiration rates of gastropods on Caribbean ironshores (Figure 17). But it wasn't until I embraced my most recent passion–bay scallops– that his influence opened a whole new world of research tools to me when I began conducting laboratory experiments to determine bay scallop salinity tolerances (Figure 18). My goal in this work is to unravel the mystery of their "boom-bust" population cycles.

The real answer to Dr. Slack's question was that I was a "student" of community ecology, and I remain a "student for life." One of the ways I maintain my student status is by mentoring graduate students and learning as they learn. My philosophy has always been that a graduate student's career should be the best time of his or her life and that the projects they undertake should reflect their own interests and passions. I owe a great debt to those that mentored me, and I work to repay that debt by trying to provide my graduate students with the best possible experience. My commitment to fostering graduate students is the basis for my diverse research interests and the variety that characterizes my research "program." My current projects include: studies of bay scallop autecology, description of tidal stream invertebrate communities, cross-barred venus autecology, land crab ecology (Figure 19), and revision of a key to Texas estuarine polychaetes. My current graduate students are working on an assessment of the prevalence of the blue crab parasite *Hematodinum* (Figure 20) and porcelain crab feeding ecology and interactions (Figure 21).

Figure 16. Dr. David Hicks filtering seawater on the porch at Rancho Pedro Paila in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico, in preparation for determining aquatic respiration rates on Caribbean iron shore gastropods.

Figure 17. Experimental apparatus for determining oxygen consumption rates of Caribbean iron shore gastropods in the field lab of Casa Rosa at Rancho Pedro Paila. The inset shows a beaded periwinkle in a respiration chamber.

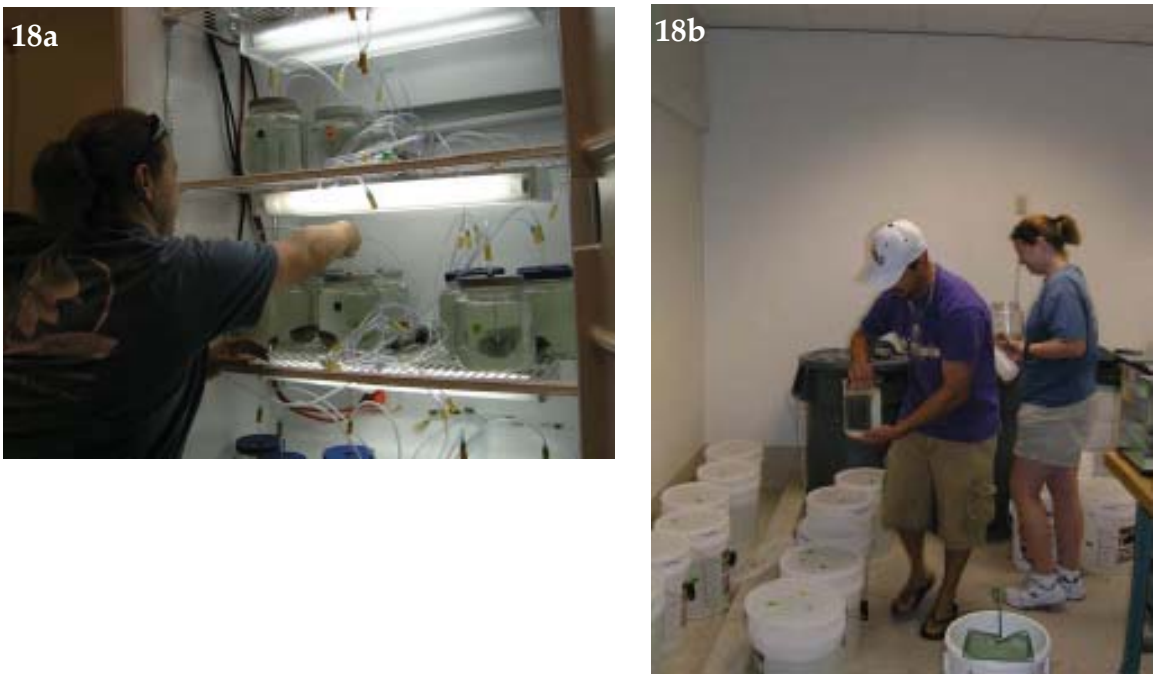


Figure 18. a) Research assistant Jackie Staggs preparing bay scallop experimental chambers for a water exchange during a salinity tolerance experiment. b) Jackie and graduate student Jon Gain exchanging water in bay scallop experimental chambers.

Figure 19. a) A giant land crab in the jungle adjacent to Rancho Pedro Paila in the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. b) Graduate student Ryan Fikes (left) and Kim Withers collecting leaf litter samples in the Sian Ka'an jungle for a preliminary assessment of the role of giant land crabs in leaf litter processing.

Figure 20. Graduate student Jon Gain extracting a sample of hemolymph from a blue crab to determine the presence of the dinoflagellate blue crab parasite *Hematodinum.*

Figure 21. a) Graduate student Kim Johnson introducing a porcelain crab into an experimental chamber at the beginning of an experiment to determine feeding rates. b) Close-up of a porcelain crab, a filter feeding crab, before it goes into the experimental chamber.

Biology graduate students advised or co-advised with graduation dates and thesis topics:

Jason Jones – 2008, "Spatial and Temporal Evaluation of Nearshore and Offshore Coral Reefs Within the Veracruz Reef System, Southwestern Gulf of Mexico"
Heather Butler – 2008, "Coral Monitoring at Sian Ka'an, 2006 and 2007" (non-thesis)
Mollie McIver – 2008, "Growth and Recruitment of Black Mangrove (*Avicennia germinans*) Along the South Texas Coast and the Composition of its Associated Plant Community"
Matt Schweitzer – 2008, "Distribution of Adult Blue Crabs, *Callinectes sapidus,* along a Salinity Gradient in a South Texas Estuary"
Heidi Cyr – 2007, "Wading bird (Ciconiiformes) Ecology at Indian Point and Sunset Lake Parks, Nueces County, Texas: Abundance, Habitat use, and Behavior"
Kristie Landaberde – 2007; "Reproductive Success of Black Skimmers (*Rynchops niger*) on a Dredge-Material Island in Nueces Bay, Texas"
Judy Metcalf – 2007, "Community Composition and Behavior of Shorebirds on South Texas Gulf Coast Beaches: A Comparison of Driving and Non-Driving Sites"
Matt Hubner – 2007, "Recruitment by Bay Scallops (*Argopecten irradians*) and Other Bysstate Bivalves in the Upper Laguna Madre, Texas"
Jeffrey Landgraf – 2005, "Relationship of Larval and Juvenile Fish Abundance, Community Structure, and Growth Rates in Laguna Madre, Texas to Distance From Gulf Passes"
Jason Zeplin – 2005, "Effects of Prop Scarring on the Distribution and Abundance of Juvenile Fish and Invertebrates in *Thalassia testudinum* Beds in Redfish Bay, Texas"

Maren Harding – 2004, "Effects of Hydrology and Prey Density on Shorebird Distribution in the Blind Oso, Oso Bay, Corpus Christi, Texas"
Shannon Rowell-Garvon – 2004, "An Assessment of Shorebird and Wading Bird Habitat Use in an Urban Coastal Mosaic, Indian Point and Sunset Lake Parks, Texas"
Amy Thurkill – 2004, "Effects of Nutrients on Seagrasses in Upper Laguna Madre, Texas"
Richard Gibbons – 2003, "Abundance and Habitat Preferences of Wintering Waterbirds in Redfish Bay" (non-thesis)
Jennifer Pearce – 2003, "Benthic Community Relationship to Seagrass Cover, Upper Laguna Madre and Baffin Bay, Texas"
Jennifer Davidson – 2002, "Effects of Propeller Scarring on Molluscan Community Structure in Seagrass Meadows of Redfish Bay, Texas"
Matt Campbell – 2001, "A Dry Season Analysis of Larval and Juvenile Assemblages of the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico"
Kathryn Harvey-Tunnell – 2001, "Epibiont Flora and Fauna Associated with Prop Roots of Two *Rhizophora mangle* Forests, Vera Cruz and Quintana Roo, Mexico"
Jace Tunnell – 2001, "Abundance and Community Structure of Juvenile Fish Using *Halodule beaudettei*, *Cymodocea filiformis* and Unvegetated Substrated in the Upper Laguna Madre"
Teresa Barrera-Carrillo – 2000, "Historic Vegetation Changes in the Blind Oso (Oso Bay), Texas : Avian Abundance and Habitat Use of the Resulting Wetland Mosaic"
Tammy White – 2000, "Snowy Plover Breeding at Sunset Lake" (non-thesis).
Amy Koltermann – 2000, "Ecological Characterization of Northwestern Caribbean Ironshores, Quintana Roo, Mexico"
Lucinda Sohn – 1999, "Predator and Prey Relationship Between *Perna perna* (Linnaeus, 1758) and *Stramonita* (=*Thais*) *haemastoma* (Linnaeus, 1767)"
Tannika Engelhard – 1998, "Biological Effects of Mechanical Beach Raking in the Upper Intertidal Zone of Padre Island National Seashore, Texas"

Environmental Science graduate students advised or co-advised with graduation dates and thesis topics:

Jackie Staggs – 2008, "Laguna Madre: A Characterization of Trophic Status and Community Structure"
Michelle Kolar – 2005, "Nesting Success and Ecology of the Snowy Plover (*Charadrius alexandrinus*) at Two Localities in the Texas Coastal Bend"
Alex Nuñez – 2004, "A Characterization of the Benthic Macroinvertebrate Communities in the Mission-Aransas and Nueces Estuaries"
Kim Halbrook – 2003, "Population estimate of Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) in Nueces Estuary and Assessment of Nesting Habitat Suitability"

4 Conservation Science and Communication

Elizabeth Smith

It wasn't difficult to begin my career as Research Scientist at the Center for Coastal Studies (CCS) in Fall 1994, as I intended to stay and work in the Texas Coastal Bend area. I earned my BS and MS at Corpus Christi State University now Texas A&M University-Corpus Christi (TAMUCC), and I believed that my professional and personal missions corresponded to those of the Center. Dr. Tunnell's recommendation to me and other CCS research scientists was to take your scientific expertise and passion and build a program. Wetland ecology was my formal field in which I had conducted my dissertation work in at Texas A&M University, Wildlife and Fisheries Sciences program. However, CCS graduate students were already working in this field through state and federal contracts when I arrived, so a Wetland Ecology Program was already being implemented. However, I was not the traditional estuarine ecologist (e.g., fish, benthos), as my interests were focused more on the landscape perspective and in evaluating restoration and conservation strategies.

My first students were just as willing to take on the multi-scale approaches even though three of them (Susan [Cox] Childs, Christina [Garcia] Conner, and Suzanne [Dilworth] Bates) already had fishery-based projects funded and underway through grants with Texas Parks and Wildlife Department (TPWD), U.S. Environmental Protection Agency (EPA), and U.S. Fish and Wildlife Services (USFWS), respectively. We expanded their projects to incorporate the landscape linkage with upland/aquatic influences on both function and management. My opportunity to expand to barrier island vegetation dynamics (Figure 1) was realized with a TPWD grant and graduate student (Kay Jenkins). My other research interest in using fauna as indicators of habitat use and health was achieved with three multiple funding sources (USFWS, U.S. Army Corps of Engineers, and Diamond Shamrock, Inc.) for a graduate student (Traci Darnell) to evaluate habitat created for whooping cranes (Figure 2) using other avifauna as ecological surrogates.

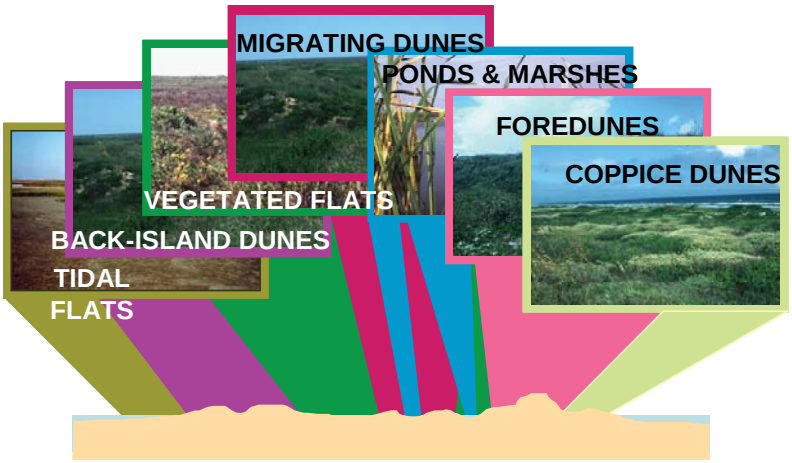


Figure 1. Barrier island habitats mapped in Mustang Island State Park, Texas. Created by K. Jenkins.

Figure 2. Pair of wintering whooping cranes moving between mainland and island habitats in Mesquite Bay, Texas.

It was quite a fast-paced start to my research involvement at CCS, as well as providing the foundation for what ultimately expanded into the Conservation Science/Geographic Information Science (GISc) Program. Research priorities within the program generally followed four subprograms: habitat assessment, ecological community assessment, conservation and management, and education and outreach. The program development necessarily followed funding priorities and availability from state, federal, and nongovernmental organizations. The overall goal for each project was to provide funding for graduate students in applied ecological research that resulted in tangible and useful results for the funding organization. Ultimately, these students graduated with a diverse set of skills and real-world experiences and ready to enter the professional workforce.

Coastal Habitat Restoration and Creation

Each funded project placed us in a perfect position to work with other biologists and environmental scientists, and provided the professional connections that would assist the students in finding their career niches. Susan worked with newly graduated Dr. Todd Merendino on the Mad Island Marsh management project (Figure 3) prior to placement of a series of water control structures within the marsh complex. Suzanne coordinated her study with Stewart Jacks on effects of weir placement and management in tidal impoundments at Brazoria National Wildlife Refuge. Traci's project targeted an innovative use of dredged material

Figure 3. Freshwater impoundments at Mad Island Wildlife Management Area, near Collegeport, Texas.

intended to increase whooping crane habitat, guided by the knowledge and sage intuition of Tom Stehn, National Coordinator for that endangered species. With Kay's previous experience in landscaping and MS degree in Forestry, she collaborated with several botanists and plant ecologists at TPWD.

With the restoration planning and implementation focused on Shamrock Island intended on protecting rookery habitat, two CCS students were able to be an integral part of each part of the process with several agencies (Texas General Land Office [GLO], TPWD, USFWS, The Nature Conservancy [TNC]). Carolyn Gorman reconstructed a GIS-based shoreline change model and developed the coordination and permitting plan for the *Spartina alterniflora* created marsh island. Roger Hayes followed with an experimental design project evaluating which spacing and types of planting material worked best at different elevations and wave activity.

Meris Sim's work on evaluating vegetation changes on other rookery islands (Figure 4) in the upper Laguna Madre linked us with Padre Island National Seashore biologists and managers. Claudia Dorn extended our geographic scope to San Antonio Bay, working with Audubon Warden Chester Smith and other avian naturalists. While her project was unfunded, her interest in the restoration and enhancement on the rookery provided her connections with the Texas Coastal Bend birding conservation community. Another unfunded project that focused on seagrass establishment was undertaken by Michael Mahala. This project followed up on two previous projects where the centers of dredged material islands were removed to the appropriate depth, and one lagoon was planted with seagrass. In all these projects, the interaction among agency personnel and graduate students as well as the utility of the thesis results exemplified the CCS mission.

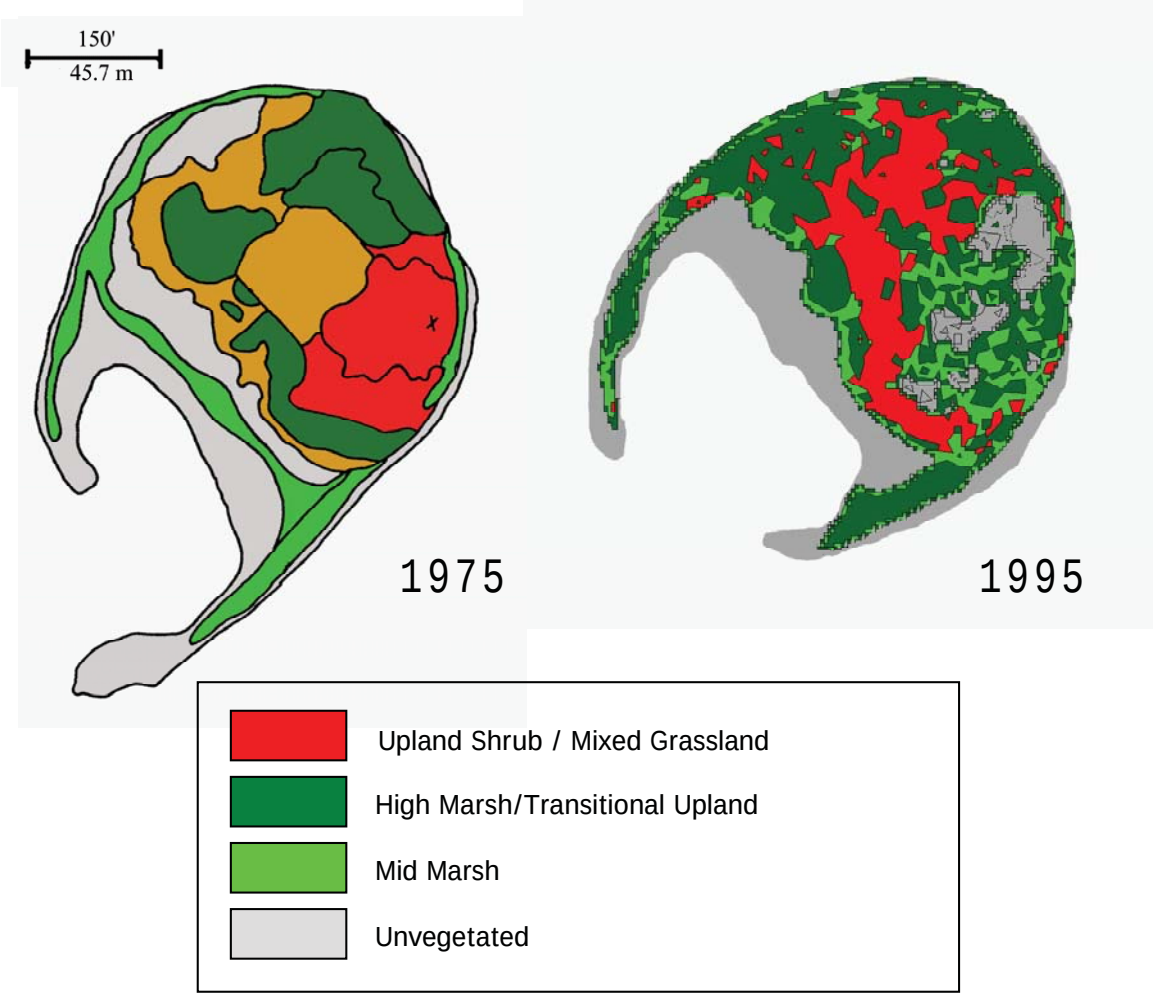


Figure 4. Quantifying habitat change on DMI 163 where the largest estuarine colony of American White Pelicans nest within Padre Island National Seashore, Texas. Created by M. Sims.

Our interest in linking all habitats within the watershed was further achieved, not by my ideas, but rather by students walking in my office with their own passions of interest. Kara Vick's research project incorporated the ranching landscape and using frogs as indicators of habitat quality in wetlands in rangeland. She was graciously allowed access to three ranches, Welder Wildlife Refuge, B+ Ranch, and the Fennessey Ranch. Daphne McCann was interested in using butterflies as environmental indicators along the lower Rio Grande Valley riparian corridor, investigating whether corridor fragmentation affected diversity. Tami Beyer, whose expertise encompassed geology, hydrology, and computer science, embarked on a modeling thesis reconstructing the Mission-Aransas and Nueces-Oso Pleistocene river valleys. In all of these and other theses, I learned as much, if not more than they – often just hours before our discussions! I still have a penchant for taking the path less traveled when we have identified an information gap and a student ready to embark on an adventure.

Conservation Science and GIS Connection

Beginning with one of the first projects (barrier island vegetation dynamics), we recognized that to incorporate a multi-scale landscape approach we needed to use Geographic Information Systems (GIS) as a tool. While GIS programs are fairly user intuitive today, such was not the case in mid 1990s! Since TAMUCC was educating undergraduate students in GIS/Geomatics, I recognized the need to hire GIS interns to work with my students and myself. The Conservation Science Program greatly benefited from a progression of GIS students, beginning with Emily Lundblad and John Wood. They assisted with the Oso Watershed project (Figure 5) which was presented at two ESRI International meetings.

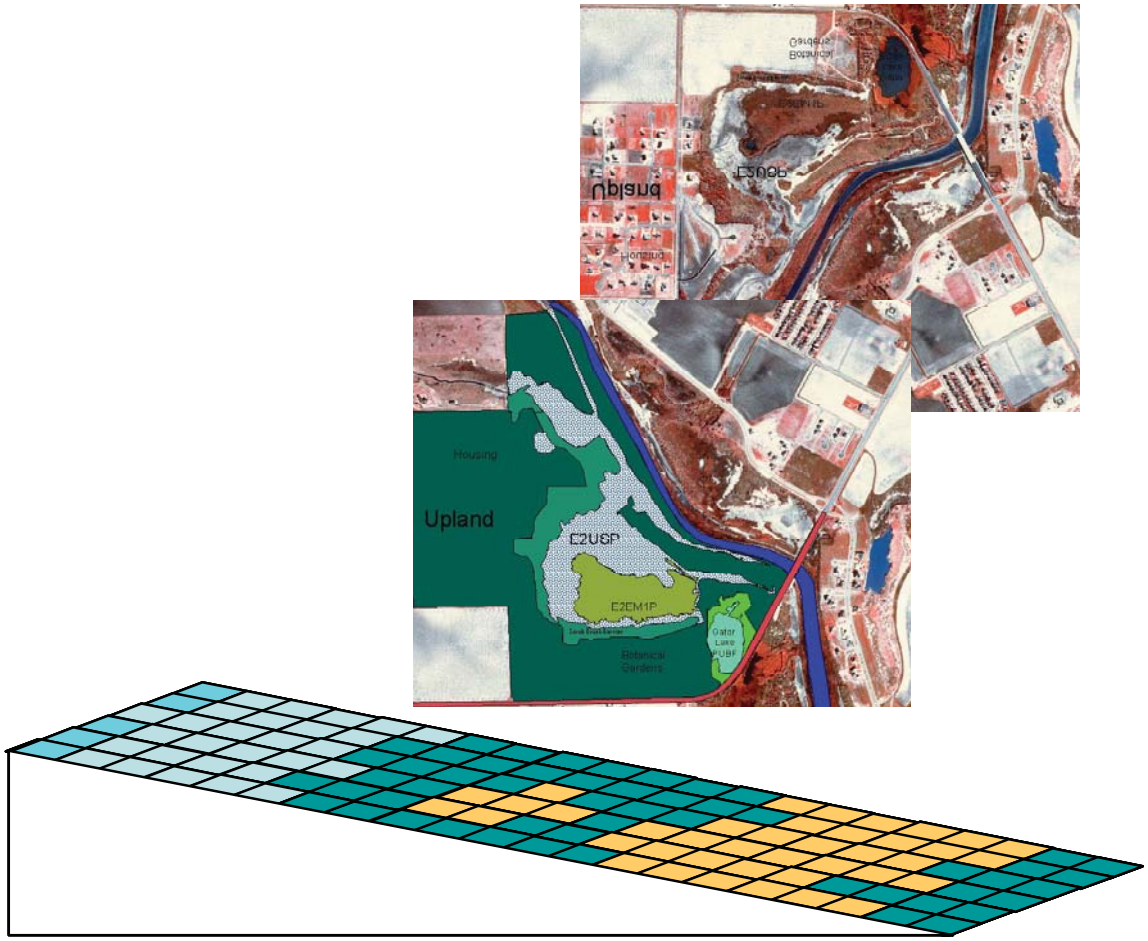


Figure 5. Translating wetland data from Corpus Christi, Texas, Botanical Gardens into GIS for use in ecological modeling.

John continued to provide GIS expertise and training to several projects resulting in several MS theses including riparian habitats (Amy [Longfield] Hanna), bay island habitats (Carolyn Gorman, Meris Sims, Claudia Dorn), Nueces Bay seagrass habitat (Leah McCullough), wind-tidal flats (Maren Harding, Shannon Rowell-Garvon, Leslie Smith, Rosalie Rossi) (Figure 6), and even beach/upland jungle habitat in Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico (Catherine Childs). During that period, John completed his BS, left for a year to earn his MS in GIS at Redlands University, and returned to enter the Coastal Marine Systems Science PhD program. He continues to serve as a GIS guru to the Conservation Science/GISc Program and still mentors current students in GIS studying riparian corridors (Nikki Morgan) and barrier island strand-plain peninsulas (Rosaleen Baluyot).

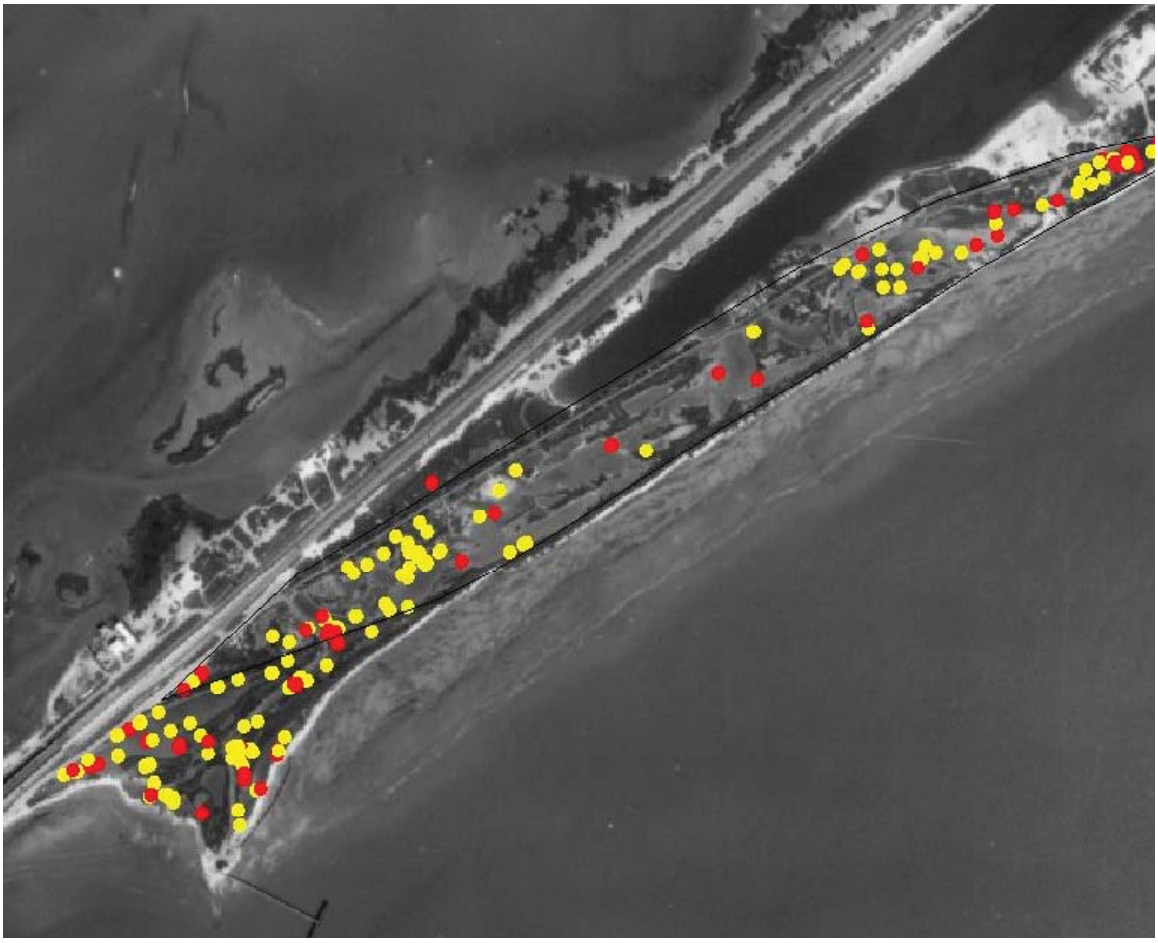


Figure 6. Using GIS methods to create data points for bird presence and activity on Indian Point, Portland, Texas (following field technique created by G. Blacklock).

We were also able to partner with the Coastal Bend Bays & Estuaries Program, Inc. (CBBEP) for several years and develop a comprehensive GIS database for the Texas Coastal Bend area. Many other organizations were working on the same endeavor and now data are fairly easy to obtain. At the turn of the 21st century, though, it was quite a task to download, organize, catalog and reproject GIS data for easy access and use. Our plan included setting up a computer large enough to house all the data, as well as include templates to provide maps suitable for presentations, proposals, and reports. The original computer setup and programming was facilitated by incoming GIS/Geomatics professor Dr. Stacey Lyle.

Several GIS interns that were funded by CBBEP, providing them with on-site working experience and expertise. They were all active students in various programs at TAMUCC, including the GIS/Geomatics undergraduate program (Stacey King, George Crandell, Olivia Gomez), as well as Computer Science (Ashwani Tomar) and Biology (Lauren Young) graduate programs. The CBBEP GIS Program was a prime example of the beneficial relationships between CCS and an environmental organization when a multi-year approach allowed time for the database to expand and also reduced the overall cost by funding each year.

Conservation Science encompasses many fields, and we are fortunate to have a complementary resource down the hall at the Center for Water Supply Studies. Understanding hydrologic processes is a complex task, and often we were entering "murky waters" by asking questions at watershed scale or looking at potential linkages among water bodies through groundwater. Rick Hay used to be the best kept secret on campus, and we went to him for GIS, statistics, and geohydrologic advice. His interest in our more biologically-oriented work provides great interaction and feedback, when answers are not immediately clear. His expertise was never more needed and appreciated than when we evaluated redhead duck (Figure 7) habitat on coastal ponds along the Laguna Madre for the U.S. Geological Survey. He created a rainfall model that would differentially fill these small depressions based on rainfall data from surrounding towns (Figure 8). His current work in Oso Bay is providing the much needed groundwater connections to water flow and water issues.

Figure 7. Target conservation species, the Redhead duck, using ecological models to assess freshwater wetland availability along the Laguna Madre, Texas.

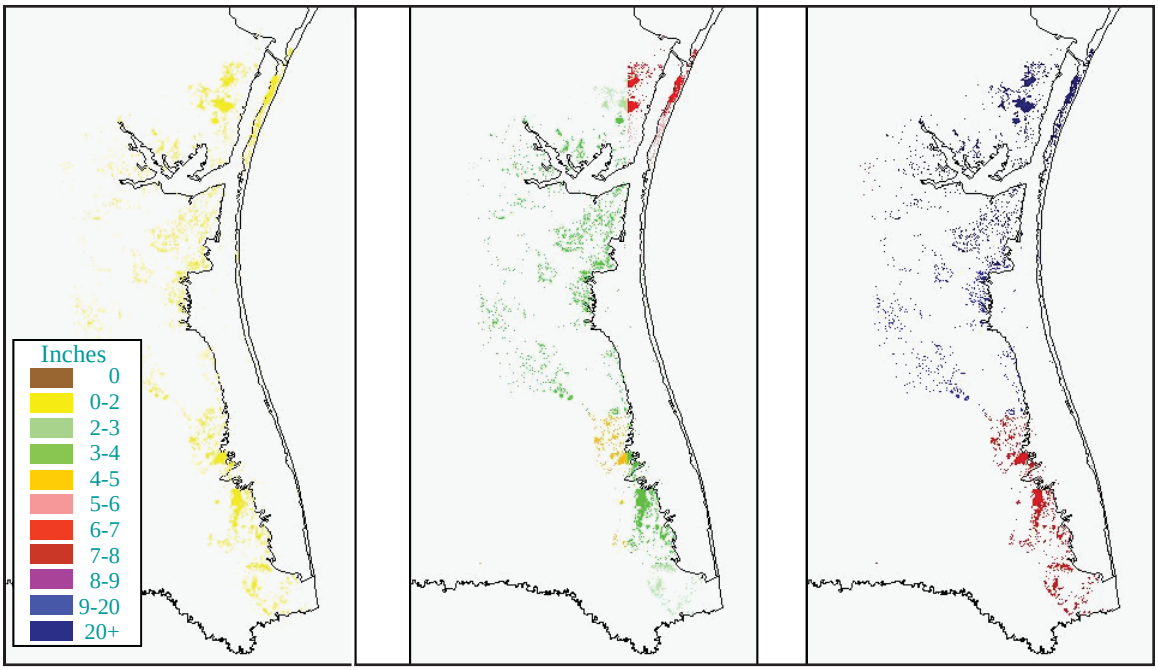


Figure 8. Precipitation range predictions from coastal pond availability model for a) August 1997, b) September 1997, and c) October 1997. Created by R. Hay, Center for Water Supply Studies.

Conservation Planning

Virtually all of the projects we have undertaken within the Conservation Science Program will hopefully further the larger mission of conserving natural resources. We also received funding to assist in developing GIS data layers for various projects that would result in conservation planning for several organizations, including CBBEP, TNC, USFWS, National Park Service, National Oceanic and Atmospheric Administration (NOAA) Environmental Cooperative Science Center program. In most projects, the end results actually were intended to be a "living" document or database, as it is more valuable when updated regularly. The challenge continues to be in the ability to provide time for updates when the projects have been completed.

Our first landscape-wide conservation planning project was funded by the GLO through an EPA grant. I was able to hire my newly graduated student Susan Childs, as my first Research Specialist, and we worked with Tom Calnan, coastal biologist, at GLO. I always felt that working with Tom was analogous to having a post-doc experience, as he mentored Susan and me through each phase of the project. Through much peer-review and revision, we accomplished the first site-based report for future restoration/enhancement, education/outreach, and conservation opportunities in the Nueces/Corpus Christi Bay system. This report was ultimately published by CBBEP and continues to be referenced for that area.

I used this approach as a template for another project funded by EPA in the Mission Aransas Watershed, focusing on developing a wetland conservation plan. My success on this project was achieved when I was introduced to the two Soil & Water Conservation District boards in the watershed. I learned a valuable lesson in community-based planning to enlist the assistance of those entities that are already promoting conservation in concert with economic sustainability. My next Research Specialist (and former student), Suzanne Bates, and I ultimately produced a document that has been used as reference material and guidance for federal program proposals by the three counties involved (Figure 9).

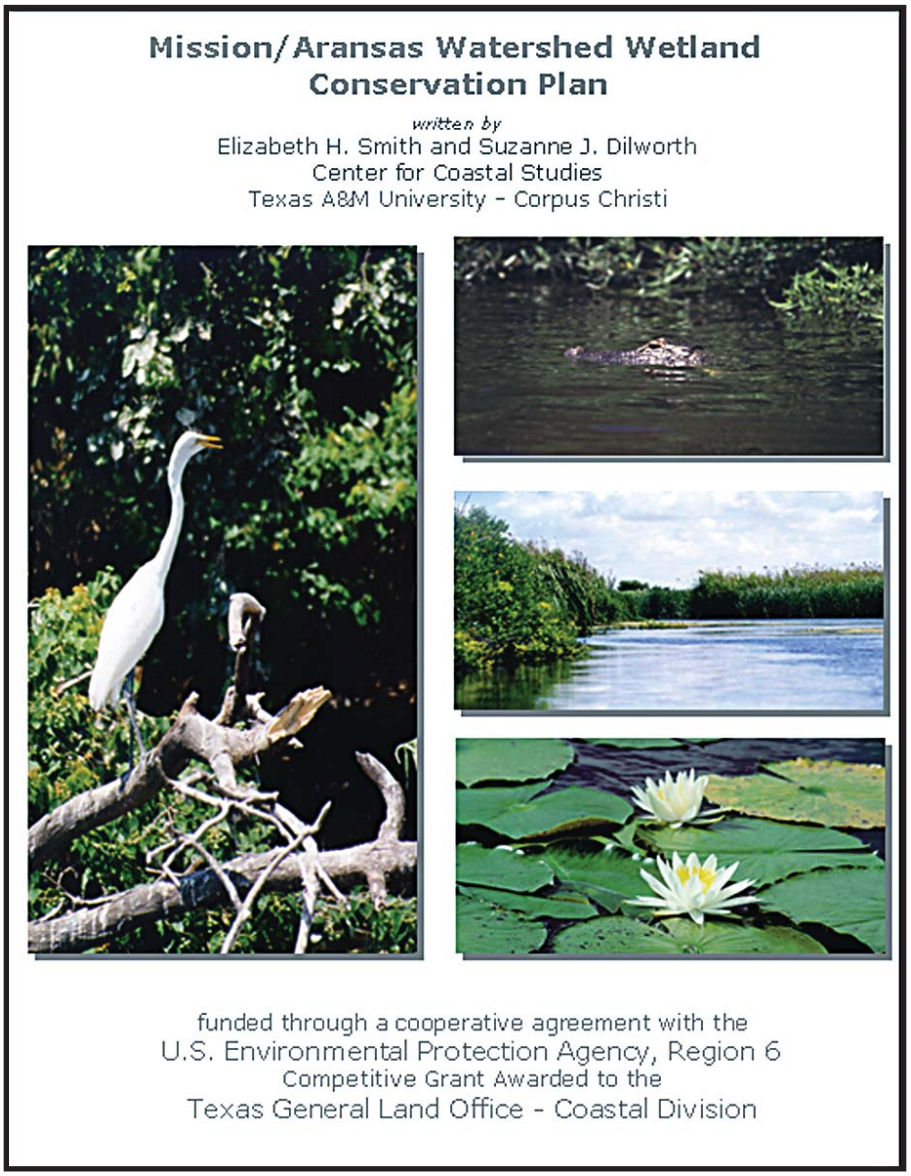


Figure 9. Development of first wetland conservation plan in Texas addressing the watershed level.

The first effort to subdivide coastal watersheds in the Texas Coastal Bend into sub and even sub-sub watersheds was achieved while characterizing riparian corridors and determining potential areas for restoration, enhancement, education/outreach, and conservation. While John Wood led the GIS effort (Figure 10), Suzanne and I collected the field data from 42 sites and developed the plans. This project was funded by CBBEP and also involved collaboration from TPWD (Drs. Dan Moulton and Warren Pulich, Jr.). The project also identified several research needs, including finer-scale remotely-sensed GIS data and understanding community dynamics in these semi-arid coastal systems.

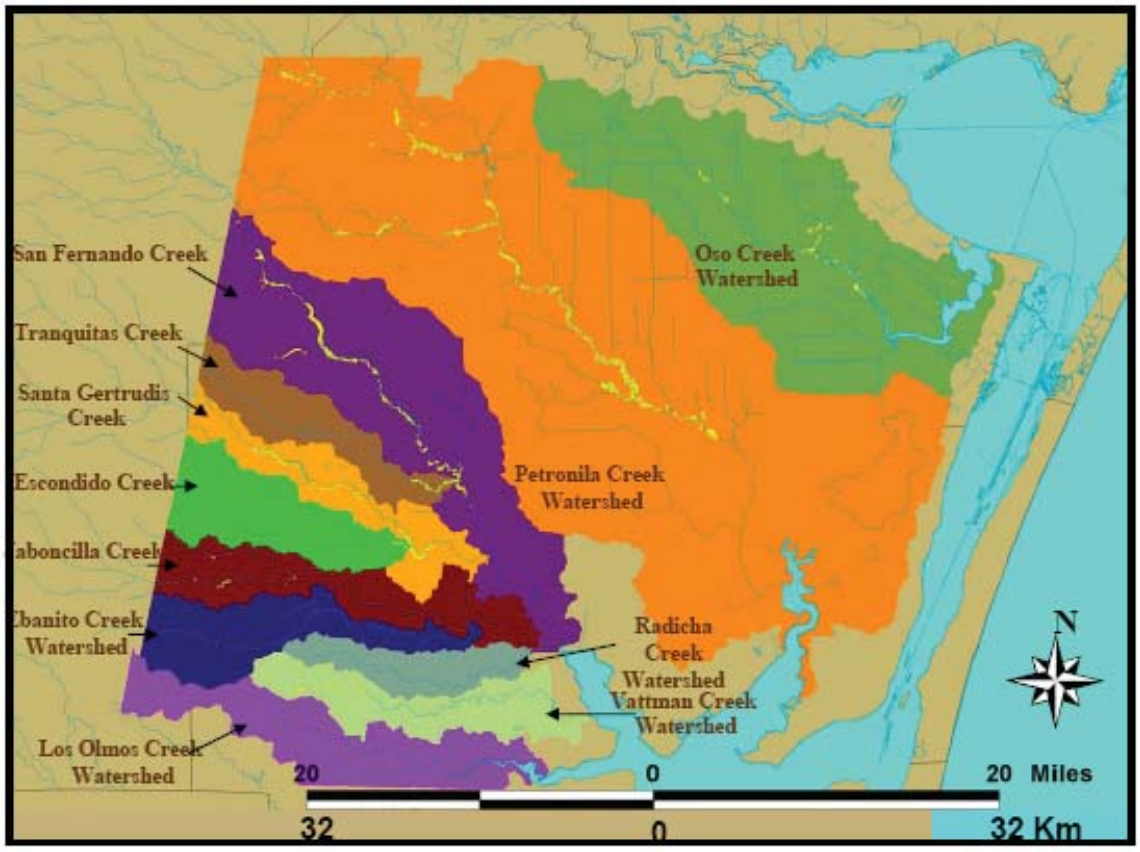


Figure 10. Subwatershed models and associated riparian habitats (in yellow) for creeks south of Corpus Christi to Baffin Bay, Texas. Created by J. Wood, CCS.

We were able to produce numerous conservation site plans using the CBBEP GIS interns and CCS students with the guidance by CBBEP project managers Terri Nicolau, Kendal Keyes, and Amy Hanna – all graduates of TAMUCC and of my wetland ecology classes! Through the establishment of the Coastal Bend Land Trust, we were able to engage several students in the conservation planning process, and they co-authored these CBBEP reports (John Wood, Olivia Gomez, Daphne McCann).

A unique collaboration with TNC and CCS evolved from these projects, including contracts to assist with developing GIS maps for the Laguna Madre of Texas Ecoregion Conservation Plan (John Wood co-author). Through a TNC connection, Susan Childs and I developed during a site evaluation at Rancho Anacahuitas along the Tamaulipan Laguna Madre, Jeff Weigert suggested a project that would cover the historic Rio Grande delta area, which we named the Atascosa-Anacahuitas Conservation Corridor to designate the upper and lower bounds. He arranged for us to collaborate with their Mexican conservation organization counterpart, Pronatura Noreste, through a TNC Migratory Bird Program grant directed by David Mehlman.

Upon the completion of this project, TNC was able to fund the next area to the south in Tamaulipas to complete the ecoregion mapping area. Since we were now familiar with the process, we were able to more fully integrate the project site recommendations from the Pronatura Noreste biologists (Alfonso Banda, Alberto Contreras-Arquieta, Joel Hernandez, and Hector Quintanilla). It was an awesome experience to create the binational land use/land cover (LULC) GIS database and see the commonalities of the ecoregion. This grant provided travel funds to Mexico, and true to the CCS mission, we invited several TAMUCC undergraduate and graduate students to participate in the ground-truthing portion in Tamaulipas. They experienced science and culture, the interaction of biologists in a bilingual setting, and pristine coastal habitats - no better way to start understanding conservation planning at the international level.

Our research focus extended across the Gulf of Mexico and Yucatan Peninsula onto another small coastal peninsula within the Sian Ka'an Biosphere Reserve. One of my Environmental Science graduate students (Catherine Childs) wanted to compare habitat diversity among various upland environments in natural vs developed areas. She established several transects across the peninsula from the Caribbean Sea to the lagoon (Figure 11) and, with the help of Dr. Kim Withers and others in the Coral Reef Ecology class, recorded vegetation every meter through the thick selva (forest). Once back to the lab, we had difficulty relating species zonation patterns even in the natural areas, and returned to the tropics with Suzanne and Amy (Koltermann) Nuñez as willing field assistants. In conversing with the locals, we discovered that little selva was untouched, but had either been repeatedly cleared for coconut palm plantings then abandoned or selectively cut for construction materials (chit palms) or onshore breeze corridors. We also conducted some vegetation mapping on TNC's Pez Maya conservation easement over a couple of Coral Reef Ecology field expeditions (Figure 12).

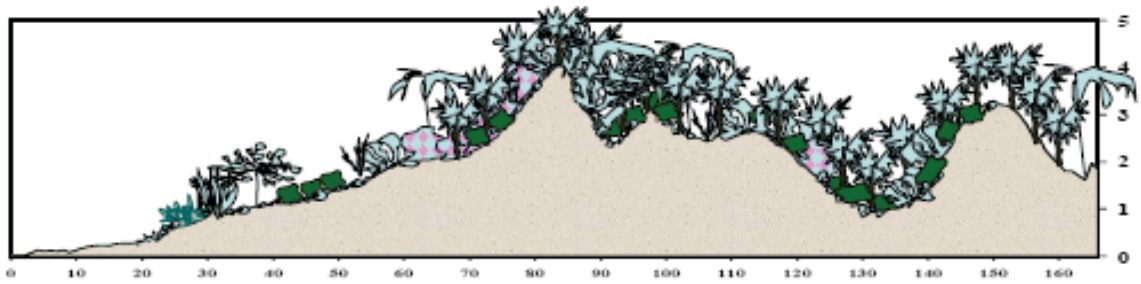


Figure 11. Vegetation profile from an undeveloped transect within Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. Constructed by C. Childs.

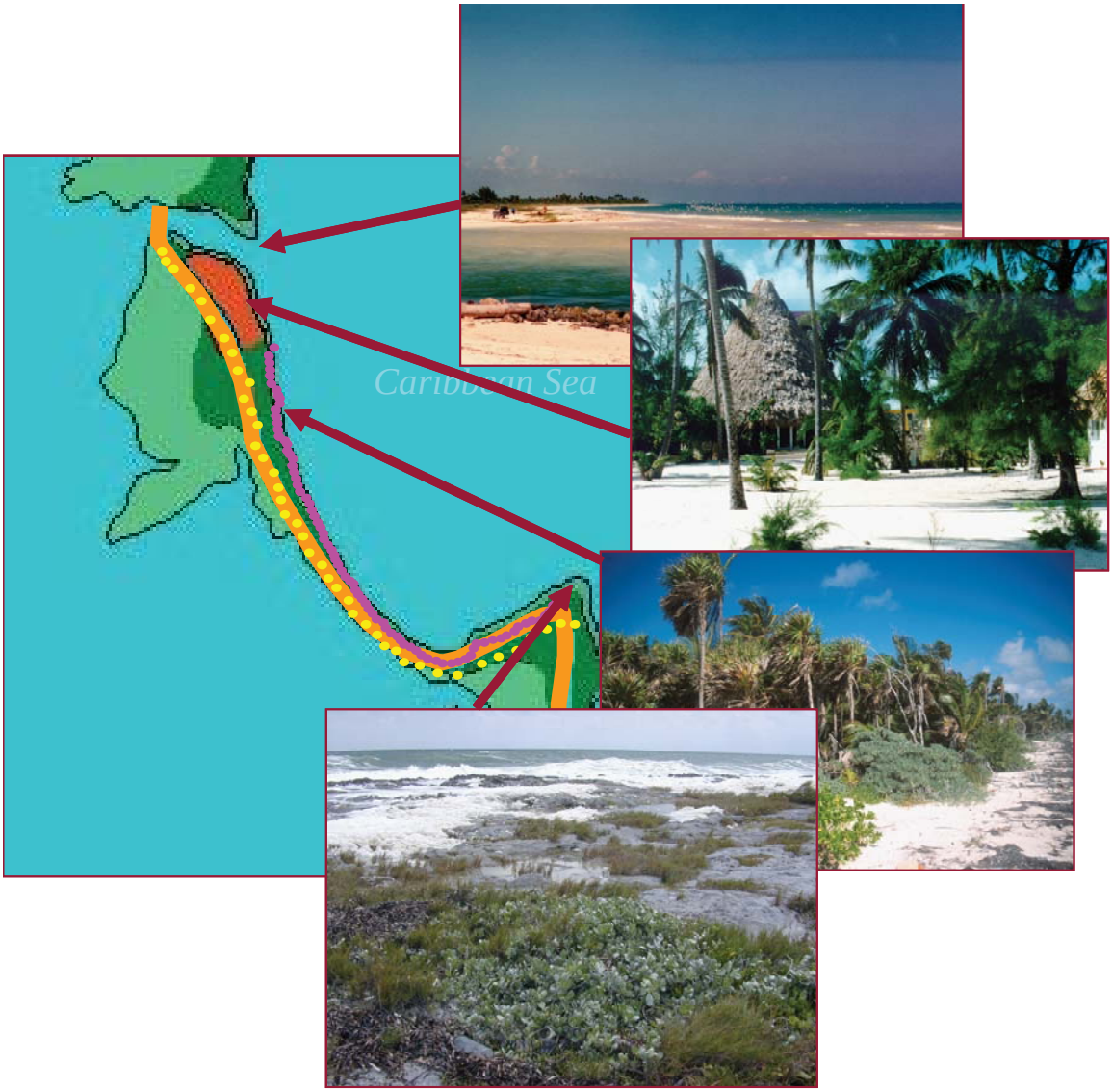


Figure 12. Habitat diversity within Pez Maya Conservation Easement in Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico.

One of my GIS Intern students, Ashwani Tomar (MS Computer Science), was interested in developing a computer program that would enable conservation planners the ability to use various information layers without using ArcGIS (ArcExplorer was not enabled at that time). He also wanted to work on a real-world issue, so we focused on land cover changes on Live Oak Peninsula. It was necessary to digitize changes in 2001 that were not present in 1994 to construct the program. Through a USFWS Texas Coastal Ecosystem Team grant, we were able to detect where changes had occurred to the most extent on the Peninsula, however, we realized the computer program would need to be housed in a server for public internet access (which was not feasible within the grant funding).

In an effort to provide the local government as well as environmental conservation organization with all available information for Live Oak Peninsula, several of my students (Kristi Landaberde, Lauren Young, Rosalie Rossi), research specialists (Linda Price-May, Leslie Smith), and I, produced an ecological characterization. The funding was provided by CBBEP, and we were able to synthesize and share GIS data among all the interested organizations. Our interest in conservation planning on Live Oak Peninsula continued through another student's (Desireé Edwards, MS Environmental Science) interest in wetland changes (Figure 13), environmental regulations, and policy. She extended the information base from amount of wetland conversion to relating why the conversion took place through extensive groundtruthing (funded by a CCS scholarship).

Figure 13. Freshwater wetland surrounded by live oak woodland on Blackjack Peninsula, Texas during a "wet" year.

With my first 5-yr funded project from NOAA Environmental Cooperative Science Center (ECSC) program, I am able to fund several students to assist in various aspects of land use/land cover change in the Mission-Aransas Watershed. Lauren Young completed a GIS-based lesson plan overviewing the watershed, hydrology, oysters, birds, and sharks. During the summer of 2008, we provided undergraduate fellowships to Krystal Alvarado, Mike Gregory, and Mitch Winters. They assisted in the preparation of a hyperspectral flyover mission on Fennessey Ranch (Figure 14). Currently, an MS Biology graduate student (Rosaleen Baluyot) is evaluating Live Oak Peninsula, as well as the other three barrier strandplain peninsulas in the Texas Coastal Bend for land use/land cover changes (Figure 15) as a result of natural (i.e., sea-level rise) and anthropogenic changes. Her funding is covered under a graduate fellowship. In addition, we are developing a historical land cover map based on elevation, soil type, and proximity to estuarine and freshwater wetlands to establish a baseline to compare all changes over time. All this information will be useful as providing a scientific basis to conservation and development planning that both Aransas County and the Mission-Aransas National Estuarine Research Reserve are actively pursuing.

Figure 14. NOAA ECSC graduate (Sandra Arismendez) and undergraduate (Krystal Alvarado) fellows prepare for water quality sampling at Fennessey Ranch Conservation Easement, near Refugio, Texas.

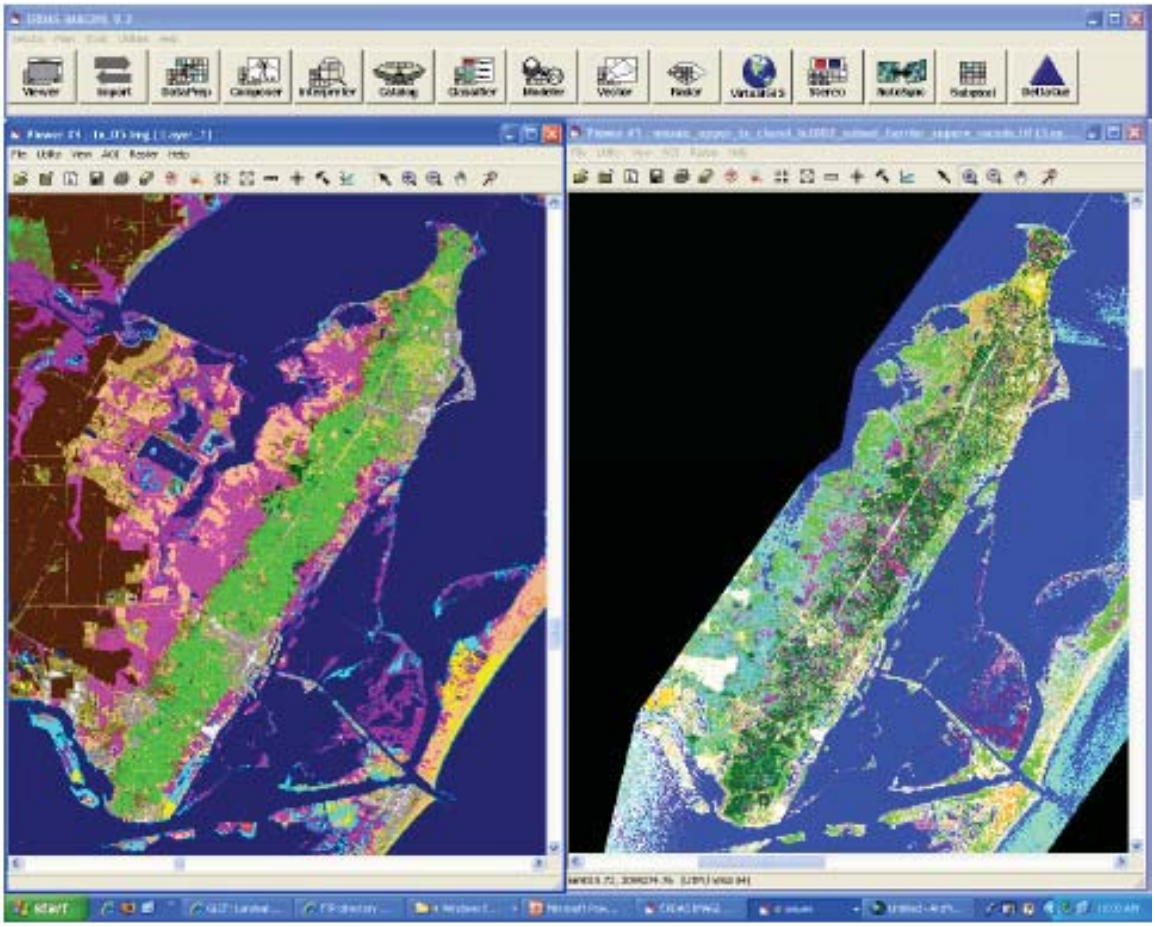


Figure 15. NOAA C-CAP Land Use/Land Cover (LULC) data for Live Oak Peninsula, Texas on left, and reclassified data for same location to differentiate deciduous and evergreen (live oak) woodlands.

Communicating Conservation

If I have been guilty of any offense (that I will admit to) over the past 15 years, it has been to try and cover all the bases toward my conservation mission. This admission begins with serving as an adjunct professor for most of those years, that would give me the interaction with biology and environmental science graduate students in the classroom and field. Over the years, I discovered that many of them (more than the administration may realize) are interested in research as well as education and outreach. I began incorporating an outreach component to their syllabi in both Wetland Ecology and Coastal Ecology, including developing species/habitat cards (Figure 16) to creating videos on coastal environments and issues. It appeared to be well received by most, and even something they could add to their career toolbox when applying for professional positions.

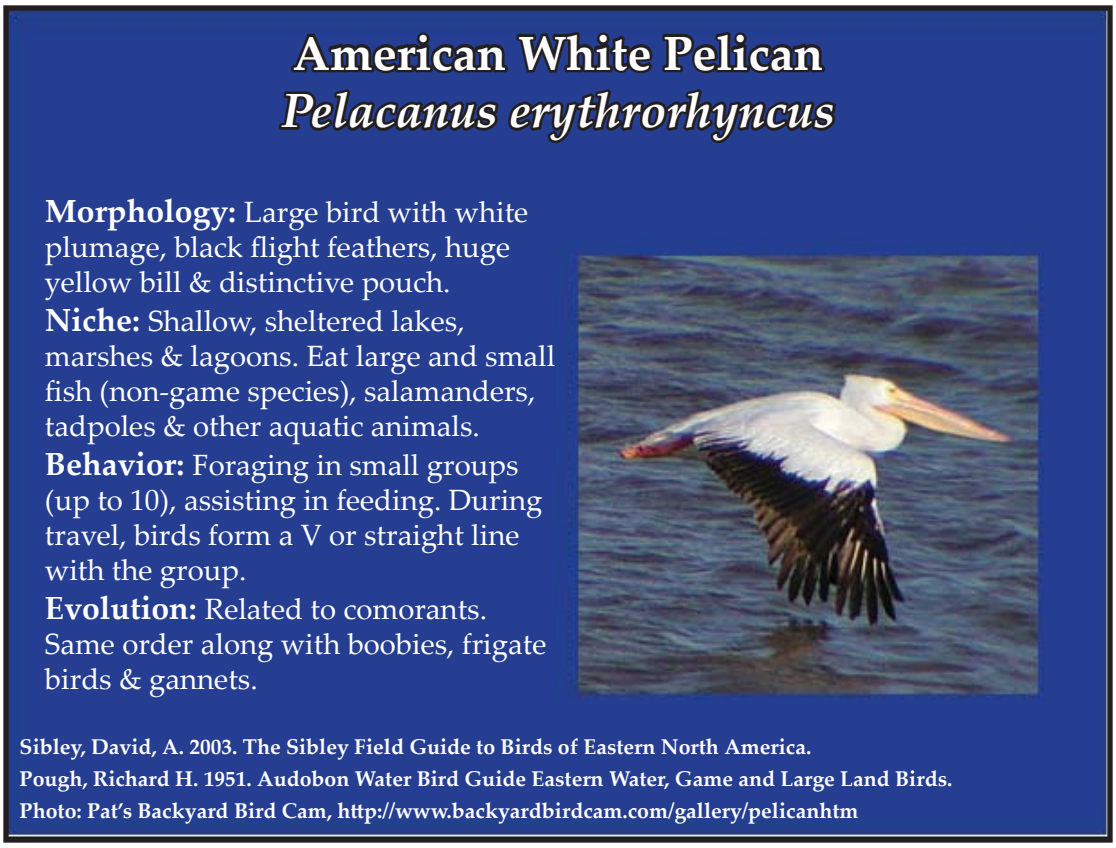


Figure 16. Species card example developed by coastal ecology students for education and outreach tools. Created by L. Young.

We also hired a good number of teaching assistant students in the summer months through funded projects – too many to mention here! We designed interpretive materials and constructed signage for many natural areas in the Texas Coastal Bend. Riparian habitats were highlighted in the interpretive signage and brochures for Lion/Shelly Park in Refugio,Texas funded by a grant from CBBEP to the Town of Refugio. Salt marsh restoration and value were discussed on signage at Aransas Nature Park in Aransas Pass, Texas (Coastal Management Plan [CMP] grant to the City of Aransas Pass). We added interpretive signage on a newly constructed boardwalk through the Corpus Christi Botanical Gardens (CMP grant). Coastal woodland flora and fauna signage guided the visitors through Memorial Park in Rockport, Texas (CMP grant, CBBEP grant to City of Rockport). With the designation of no motorized craft zones in Redfish Bay, we created large signage at each boat ramp (CBBEP grant). The restoration work and conservation value of both Shamrock Island and Francine Cohn Nature Preserve were highlighted in brochures (Figure 17) and signage, funded by TNC and other partners. One of our largest efforts was led by Suzanne in redeveloping the CBBEP Bay User Guides for three systems in the Texas Coastal Bend.

We expanded our outreach approaches when requested by the City of Refugio to design and construct the interpretive exhibits in the Wetland Connection Center funded by a Coastal Impact Assistance Program grant. This effort took a team of dedicated scientist/designers that included Suzanne Bates, Jay Tarkington, Gary Patrick, Dave Smith, Amy Thurlkill, and myself. Complete with a watershed diorama, taxidermied birds and alligators, images, and interactive watershed maps, we highlighted all the habitats and key species in the Mission-Aransas Watershed. More as an opportunity, than as a funded deliverable, I developed my first educational video "Mission-Aransas Watershed: Who Lives Here?" Jay gave me my next opportunity to incorporate video into the CCS Wetland on Wheels display, where we looped a stream of video for each habitat type in a coastal watershed.

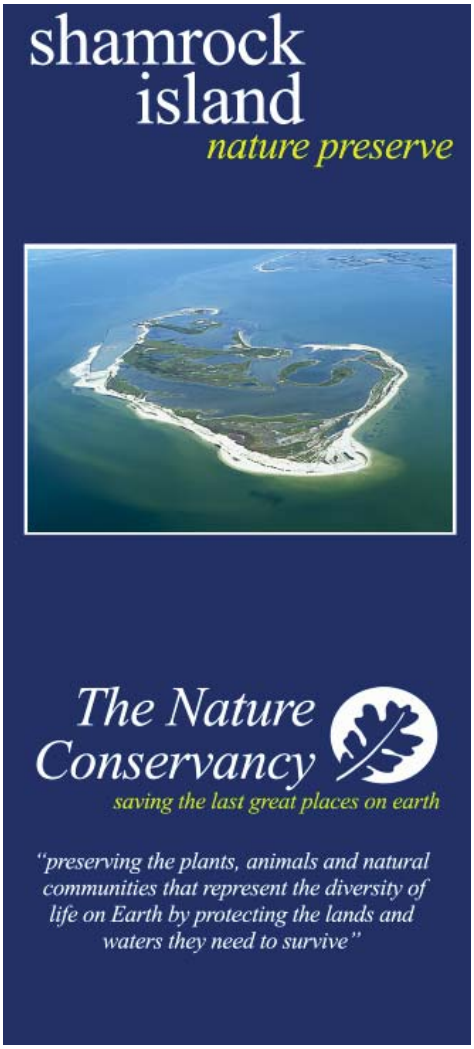


Figure 17. Educational brochure highlighting the conservation efforts to protect one of the largest colonial waterbird rookeries on the Texas Coast. Created by S. Bates.

Through the NOAA ECSC grant, I have had the pleasure of capturing the visions and career highlights of two fine conservationists in a CCS video series Conservation Conversations. Dr. Lynn Drawe, director (retired) of Welder Wildlife Foundation, and Brien O'Connor Dunn, owner of Fennessey Ranch, were each honored through dedication of Wildlife in Focus III and IV books, respectively. These ten-minute videos attempted to characterize their personal and professional missions to conservation and education. It was a true honor to discuss their motivation, innovative approaches to educate and motivate others to conserve our natural world.

We recently received funding to educate public school children about shorebirds and the Texas Coast. The USFWS, Coastal Ecosystems Program has recognized that conservation of public lands for the benefit of millions of shorebirds must take an educational approach. To date, we have collaborated with USFWS, Audubon Society, and CBBEP to update our video database to high definition.

We are hopeful that an interactive approach to learning about shorebirds (biology, ecology) where they live and migrate (geography), how far they must travel (math), and what potential actions impact their survival (social science), will resonate with our young people and effect change and stewardship (Figure 18).

Figure 18. Photo documentation of a banded piping plover during filming of the shorebird video (banded in Saskatchewan, Canada in 2004).

5 Marine Ecotoxicology

Marion Nipper

The Marine Ecotoxicology Program at the Center for Coastal Studies (CCS) is a prime example of a program developed as the result of cooperation with a federal agency (see Chapter 1). The program was born from a service agreement with the then U.S. Fish and Wildlife Service, later reorganized into the National Biological Survey, then National Biological Service, and finally incorporated into the Biological Resources Discipline of the U.S. Geological Survey (USGS). The federal Marine Ecotoxicology Research Station (MERS) is led by Dr. R. Scott Carr with the assistance of Jim Biedenbach. Several students were hired as research assistants to work in the lab over time, of which two remained "on board" for many years: Linda Price-May and Russell Hooten.

A strong involvement of CCS with this program began in 1997, when I was hired as an aquatic toxicologist with a job experience ranging from a government agency in Brazil, to the private sector in New Zealand, and work as an adjunct graduate professor at a Brazilian university. Although the Marine Ecotoxicology Program at CCS is very focused in its area of expertise, its geographical range has been very broad over the years, encompassing a large variety of locations, habitats, environmental variables and methodologies, including:

- Biological effects of ordnance compounds (Figure 1) and their biotic and abiotic transformation products in marine waters and sediments: Project funded by the U.S. Navy with focus on ordnance contamination in Puget Sound, Washington.

Figure 1. Marion Nipper preparing sediments for toxicological experiments. Photograph by R.S. Carr.

- Tropical ecotoxicology:

    o Environmental assessment of sediments contaminated as a result of copper mining activities on the island of Marinduque, Philippines (Figure 2): Project developed in collaboration with the USGS by invitation of the government of Marinduque.

    o Sediment toxicity assessments using porewater tests with samples collected in situ at the main Hawaiian Islands, including Hawaii, Kauai, Maui, Molokai (Figure 3) and Oahu: This included several different projects in collaboration with a variety of organizations including USGS, U.S. Environmental Protection Agency (EPA) and the University of Hawaii.

    o Analyses of the potential contribution of African dust to the decline of Caribbean coral reefs, by analyses of samples from the US Virgin Islands, as well as Cape Verde, off the coast of Africa: Project in collaboration with USGS and partially funded by the National Undersea Research Program under National Oceanic and Atmospheric Association (NOAA).

    o Development of sensitive sublethal toxicity tests with model Cnidarians to be used as surrogates for corals in laboratory toxicity tests.

Figure 2. Research vessel used during sampling trip in the Philippines.

Figure 3. Marion Nipper bringing syringes with porewater samples to the surface in Molokai, Hawaii, USA. Photograph by R.S. Carr.

- Chemistry and toxicology of hydrophobic organic chemicals (HOCs) in sediments using passive samplers (Figure 4):

  This includes several projects in collaboration with chemists from the Massachusetts Institute of Technology, with grants from the Massachussets Sea Grant Program for studies in Boston Harbor, and from the Cooperative Institute for Coastal and Estuarine Environmental Technology, under NOAA, for studies in Texas Bays.

Figure 4. Undergraduate student Gustavo Gobato, from Universidade Santa Cecilia, Brazil (center) working with USGS scientists R. Scott Carr (right) and James Biedenbach on the preparation of samples for studies with hydrophobic organic chemicals.

In addition to these larger projects, mostly in collaboration with the USGS-MERS, the CCS program also attracted a variety of graduate and undergraduate students (Figure 5), whose research projects broached several environmental interests and priorities related to environmental effects of contaminants, including:

- The influence of biomass on the toxicological effects of HOCs.
- Seasonal variation of sediment toxicity (Figure 6).
- Influence of parental nutrition on the sensitivity of early-life stages of echinoids to organic and inorganic contaminants (Figure 7).
- Effect of ocean acidification on embryological development of echinoderms and formation of larval calcium spicules.
- Effects of contaminants on the innate immune ability of Cnidarians.

Figure 5. Marion Nipper holding sediment core with graduate students (from left) Larissa Bright, Virginia Hallinan and April Anderson participating in field activities.

Figure 6. Graduate student, Thomas Wauhob, taking a salinity measurement in Corpus Christi Bay, Texas.

Figure 7. Graduate student Rachael Nelson (left) and James Biedenbach, from USGS, performing toxicity test with sea urchin embryos.

Since the inception of the Ronald E. McNair Post-Baccalaureate Achievement program at Texas A&M University-Corpus Christi (TAMUCC) in 2008 the Marine Ecotoxicology Program at CCS has played an integral role. The program provides first-generation, low-income minority college students with paid internships and mentoring to prepare for enrollment in graduate programs. I was responsible for mentoring a student in the first cohort of McNair scholars at TAMUCC in summer 2008 in a project related to effects of contaminants on coral reefs, following CCS tradition and interest in reef ecosystems. The McNair program is a win-win situation, where the students are paid to learn how to run a research project and present it at a conference of national and, oftentimes, international recognition, and the mentor receives the funds not only for the student's research supplies, but to accompany him or her to the conference where the data are presented. For students coming to get their research experience with the Marine Ecotoxicology Program, the conference of choice is the Meeting of the Society of Environmental Toxicology and Chemistry, which takes place at a different place in North America each year, with an attendance of approximately 3,000 scientists, environmental managers and students.

The Marine Ecotoxicology Program also has a strong international presence, having received several international visitors for scientific consultations or training. Overseas visitors spent periods ranging from a few days up to 6 months with the program, including scientists from Australia, Brazil, Korea, New Zealand and Spain, and students from Brazil, Italy and Spain. The Marine Ecotoxicology Program also contributed to the research, preparation of a graduate course booklet, and mentoring of PhD students from Universidad de Vigo, Galicia, Spain, as part of a USGS visit to the university and my activities as a Fulbright Senior Specialist Scholar.

With these main lines of research, activities with graduate and undergraduate students from TAMUCC, and visiting scientists and students from several countries, the Marine Ecotoxicology Program has touched a broad range of environmental concerns, including but not limited to:

- The remains of ordnance from past military activities ranging several decades.
- Bioavailability, and biotic and abiotic transformation of contaminants in marine environments.
- Mining impacts in remote parts of the globe.
- Environmental effects of organic and inorganic chemicals of anthropogenic origin in numerous bays and estuaries of the United States (Figures 8 and 9).

- Global climate change, as a contributor to:
    - o Increased erosion and enhanced transport of African dust, containing contaminants resulting from anthropogenic activities.
    - o Ocean acidification through increase in atmospheric CO_2.
    - o Seasonal changes in temperature and rain patterns which may affect the bioavailability of contaminants in coastal sediments.

Figure 8. James Biedenbach collecting sediment cores in Tabbs Bay, Texas.

Figure 9. Marion Nipper (left) with graduate students Anne Evans and Thomas Wauhob extracting pore water from field-collected sediments. Photograph by R.S. Carr.

6 Artificial and Natural Reefs

Quenton Dokken

Arriving at the Center for Coastal Studies (CCS) September 1991 was an interesting development in my personal history. I had just completed an eight year endeavor with the development of the Texas State Aquarium and my experience with academia had always been on the student side of the lectern. I was young, full of energy and ideas, opinionated, confident, maybe a little cocky, and fearless. I started out working half time with the Dean's office and half time with CCS. Fortunately, I was rescued from my duties in departmental administration when Dr. Tunnell offered the opportunity to work full time with the fledgling CCS. The truth - Dean Ruth Bakke was ready to fire me and Wes took pity on me! Maybe I was a little too cocky and opinionated?

Once Dr. Tunnell and I reached agreement that I was not going to answer the phone, sort mail, do filings, or type up his daily hand written volumes of notes and correspondence, I was given carte blanche to go forth and develop programs. Gloria Krause was recruited to handle the daily office operational duties and with a modest funding earmark from the State Legislature we instantly became a three person staff – the sum total of CCS. And, as they say, "the rest is history."

Although my doctoral studies focused on nutritional requirements and bioenergetics of aquatic species cultured in the aquaculture industry I soon realized that the same dynamics could be studied in naturally occurring populations as a component of habitat and ecosystem dynamics. From there it was just a short step back into the study of the dynamics of natural and artificial reefs. Over the years as needs and opportunities presented themselves, I was able to assemble teams of talented individuals to pursue applied investigations and studies of diverse issues such as socioeconomics of Texas fisheries and management of the Gulf of Mexico as a regional ecosystem. Although these topics presented interesting and challenging tasks, I view our success in terms of the people who joined me in these studies and adventures. They were and are very intelligent, talented, and capable individuals whose enthusiasm and passion for our mission and journey matched mine in every respect. Our accomplishments can be directly attributed to their efforts – we were a hell of a team!

My career with CCS got off to a great start when out of the blue Dr. Tom Bright, Director of Texas Sea Grant Program at the time, called and asked if I would be interested in taking over management of a Gulf wide project, the Gulf of Mexico Regional Marine Research Program (RMRP). I drove to Galveston to discuss this with him and returned to CCS with a grant and one of the most talented people I've ever worked with, Bonnie Ponwith. At the time, Bonnie was a MS graduate student whom Dr. Bright had hired to assist him with the RMRP. Today, befitting her

talent and drive, Dr. Ponwith is director of the National Oceanic and Atmospheric Administration (NOAA) Southeast Fisheries Science Center in Miami.

Together Dr. Ponwith and I took on the task of pulling together the resource management and research professionals from around the Gulf of Mexico to outline research needs and priorities for the Gulf of Mexico in the coming decades. Through the luck of the draw we found ourselves sitting at the head table in rooms filled with the most recognized and accomplished scientists representing decades of work in the Gulf of Mexico. The experience was both intimidating and intoxicating and we thrived. It proved to be an invaluable education in the internal politics of a major federal agency – NOAA. Through the process we managed to produce a two volume document that provided a road map for funding and implementing research to better understand the dynamics of the Gulf of Mexico. Just recently nearly 15 years after the original effort that process has been repeated. There is still much to learn about the Gulf of Mexico's dynamics, habitats, and living resources.

My move back into field science was a perfect example of being at the right place at the right time. Before arriving at CCS I casually, and with little forethought made the off the cuff comment to a Vice President of Mobil Oil and Gas, "When are you going to let us onto your platforms to conduct biological research?" The next week I was on a helicopter on my way to Mobil's HI-A389 over a hundred miles offshore (Figure 1)! At the time I was Executive Director of the Texas State Aquarium and not involved in research, but I recognized an opportunity when it landed on my head and I quickly assembled a team and jumped back into research.

Figure 1. Mobil's High Island A389 platform.

For the next decade, my team and I spent months each year on offshore oil/gas production platforms and marine vessels as researchers and environmental consultants. Our program was featured in numerous trade journals and documentaries and I was sent to Norway to explain the program to North Sea producers. This program not only expanded our knowledge of artificial reefs; we also advanced scientific diving in the Gulf of Mexico, built lasting partnerships with the oil/gas industry, and we earned experience that is influential across and beyond the Gulf of Mexico today.

As word got out my research team grew quickly, and it seemed that there was always a very talented student knocking on the door asking if they could come and play with me. Between ~1995 and 2005, scores of scientists and students from may different agencies and universities participated in our offshore research programs. Christi Adams, now Dr. Christi Savarese, was one of the first to join our team and launched a study of sponges on artificial reefs as her thesis. I had no experience or knowledge of working with sponges, so Christi had to find others who could provide the help that I could not. She was a self-starter and soon had the best invertebrate scientists in the country assisting her including Dr. Shirley Pomponi of Harbor Branch Oceanographic Institute. Christi went on to earn a doctorate working at the British Museum of Natural History in London and eventually worked in Australia on the Great Barrier Reef as a post-doc before returning to the United States.

Christi was soon followed by the late Dr. Carl Beaver (Figure 2). Carl arrived in Corpus Christi from Pennsylvania to work as an electrician at the ButterKrust Bakery. Soon after arriving he discovered Dr. Tunnell's Coral Reef classes and CCS and upon hearing of the diving involved in my artificial reef research, he too was knocking on my door. Carl found his calling – the ocean. And, he had a perfect blend of skills to work with the artificial reef studies program. He had the intellect and curiosity necessary to understand the studies, but he was also good with a wrench, could fix a boat motor, had a degree in electronics, and was a natural leader. He was truly a "jack of all trades."

I had learned long ago not to trust C-cards to define a person's true diving ability, but to rely only on what I saw in the field. Knowing that we would be doing a great deal of diving and much of it beyond traditional recreational diving depths, I invited Carl to join me on a dive trip so that I could personally asses his diving skills. On our first dive of the day we circled the shallow portion of a production platform off Port Aransas a couple of times and then headed for the bottom at ~150 feet salt water (fsw). At 130 fsw we entered the murky nephloid layer where visibility dropped to 3 feet and the imagined monsters of deep always lurked, but Carl stayed with me. It was the first of many deep dives he and I made together over the next decade (Figure 3). Carl went on to complete his doctoral dissertation on the bioenergetics of an artificial reef and to work with the Florida Marine Research Institute before his untimely and tragic death in 2006. During his time with me he was a cornerstone of our offshore research team (Figure 4.).

Figure 2. Christi Savarese and Carl Beaver checking Nitrox blends before a dive.

Figure 3. Quenton Dokken and Carl Beaver on deck.

Figure 4. Carl Beaver exploring the Flower Garden Banks coral reefs.

It was about 1993 when I organized our first expedition to HI A-389 with most of my crew made up of students from Texas A&M College Station. Among these students were Roy Lehman, Jeff Childs, and Derek Hagman. Roy was a doctoral student and later joined Texas A&M University-Corpus Christi as a faculty member where he still teaches today. Jeff and Derek became regular members of my deepwater offshore research team; and each was critical to the success of our program. Today, Jeff (Figure 5) is in Alaska pursuing a doctorate and Derek is now Dr. Hagman working in biotechnology in Oregon (Figure 6 and 7). That first expedition was a learning experience for all of us. We had to learn how to interact with the platform staff and how to conduct research and diving operations from 80 feet above the sea surface (Figure 8). Thankfully, the weather and sea conditions were perfect during this inaugural expedition, and we did not loose anyone!

Figure 5. Jeff Childs, John Reeves, and Hector Gutierrez checking out collections.

Figure 6. Derek Hagman on the deck of the M/V *Fling* at the Flower Garden Banks.

Figure 7. Derek Hagman (left) and Carl Beaver geared up for a deep dive on the personnel basket which delivered them to the water 80 feet below the upper deck of the platform.

Figure 8. Equipment set up on deck of HI A389.

Much of our success on this first and many subsequent expeditions can be attributed to Clyde Jones, John Reeves, and Hector Gutierrez of Mobil Oil and Gas. Clyde was in a management position working out of Lake Charles, Louisiana. John and Hector were the technicians manning HI A389 during our first week aboard (Figure 9). We arrived in Mobil's Lake Charles office not knowing what to expect and they greeted us just as perplexed. Clyde took us in hand and led us to the shore base in Cameron, Louisiana, where we boarded the offshore supply vessel M/V *Norman McCall*. This was the first of many trips that Captain Dwight Bebe would deliver us to HI A389. Little did we anticipate the accomplishments and friendships that first expedition would launch.

Figure 9. John Reeves and Hector Gutierrez helping sort the dive team's collections.

This was quite an eye opening experience for my fledgling offshore team with the big boats, big shore base equipment, helicopters, and men and women used to the rigors of the offshore oil and gas industry (Figure 10). The M/V *Norman McCall* was 170 feet long had six engines and stayed offshore continuously except for the one day a week it came to shore base to pick up supplies and change crews (Figure 11 and 12). It was always a thrill for me to board the vessel and sit up in the wheelhouse as Captain Bebe maneuvered his vessel out the channel into the open waters of the Gulf of Mexico. However, for those members of my team susceptible to seasickness it was not that big of a thrill. Stephen Meyers, an amazing underwater photographer, never turned down an invitation to travel with us although he knew that motion sickness would overtake him soon after leaving the dock. On one memorable trip, after 14 hours of running into 15 foot-plus seas more than one of our team had to be helped to the back deck and onto the Billy Pugh personnel transport basket for transport to the platform deck (Figure 13).

Figure 10. Team assembled for helicopter transport.

Figure 11. M/V *Norman McCall* under power.

Figure 12. Suzanne (Dilworth) Bates and other members of the team heading for a platform study site.

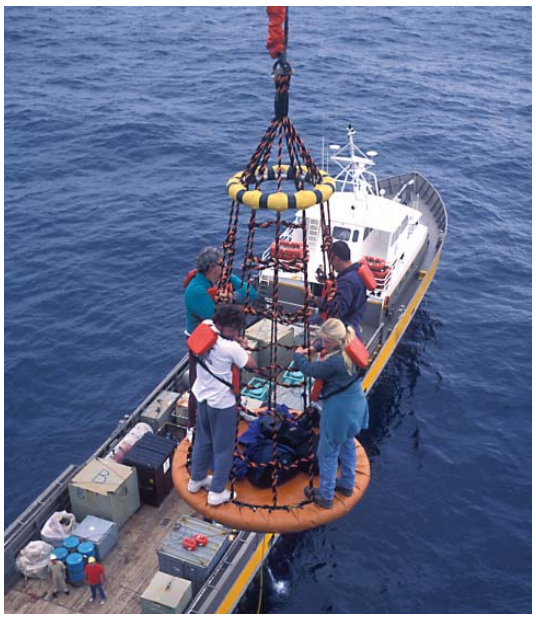


Figure 13. Team offloading from the M/V *Norman McCall* to the platform via a Billy Pugh personnel basket.

After transferring from the M/V *Norman McCall* to the upper deck of the platform we met our host, John Reeves and Hector Gonzales for the first time. Over the years John and Hector became part of our offshore team (Figure 14), and some of our students became fairly competent platform operators. Mobil once asked me to tell Derek, Carl, and Jeff that they could not live on the platform all summer – they had to come to shore at least every third week! Free room and board was an almost irresistible lure to starving graduate students. After helping us that first week both John and Hector earned their SCUBA certifications and took up diving on a regular basis. Today, Hector is a staff diver at NASA's zero gravity training center in Houston, Texas, and John is still doing seven days on - seven days off shifts in the far waters of the Gulf of Mexico.

Figure 14. John Reeves checking out the critters from beneath HI-A389.

As word of our first expedition spread more dreamers and adventurers began to show up at my office door, and my offshore team solidified into a core group. Susan (Cox) Childs (Environmental Director for Shell Oil/Gas Alaska) (Figure 15 and 16), Suzanne (Dilworth) Bates (consulting biologist for Geo-Marine, Inc.), Tom Bates (high school teacher and SCUBA instructor), Chris Rigaud (Diving Health and Safety Officer for University of Maine) (Figure 17), and Terry Riggs (marine electronics technician working offshore in the Gulf of Mexico for Fugro, Inc.) joined Carl, Derek, and Jeff (Figure 18) to form what I consider the most talented offshore diving research team in the nation at the time. Other notable participants included David Hicks (Dr. David Hicks, Professor University of Texas Brownsville) (Figure 19), Paul Chocair (works with CITGO), Larry Hyde (research technician Harte Research Institute for Gulf of Mexico Studies), Jay Rooker (Dr. Jay Rooker, Professor Texas A&M University Galveston), Stephen Meyers (professional photographer) and Jan Edwards Meyers (teacher/writer), Franklin and Kathy Viola (professional photography team), Gregg Stanton of Florida State University (then Diving Health and Safety Officer at Florida State University) (Figure 20), Bruce Bierman (videographer and documentary producer for Texas Parks and Wildlife Department), Dr. David Gray, MD, and Captain Ed "Hunyak" Andrews (U.S. Navy retired) (Figure 21).

As our program matured Susan and Suzanne really became the glue that tied it all together. They were tireless, enthusiastic, and capable of completing any task I asked of them. As well as their considerable talents as marine biologists, divers, and leaders they brought fun to the group. Who can ever forget the time Suzanne was left hanging upside down beneath a personnel transport basket fifteen feet above the water in full dive gear?! And when it came to dealing with hard nosed platform supervisors, all I had to do was put Susan on the phone – they never stood a chance. Ed Andrews, a friend of mine going back to our teen years and a retired Navy fighter pilot came knocking on my door soon after retiring asking, "What are we going to do for fun now?" Ed learned to dive and joined our team often saying, "I am just happy to be a part of the team!" When not offshore, Ed led us on several adventures; some would say "misadventures," at conferences in places such as Las Vegas and New Orleans. He, along with Susan and Suzanne, kept the entertainment volume on high.

Figure 15. Susan Childs handling photographic equipment.

Figure 16. Susan Childs on the decompression line after a long dive.

Figure 17. Chris Rigaud and Tom Bates.

Figure 18. Terry Riggs, Carl Beaver, and Jeff Childs in the well bay on a platform.

Figure 19. David Hicks beneath a platform reef.

Figure 20. Gregg Stanton manning a recompression chamber.

Figure 21. Webcast/documentary team on BP platform.

Chris Rigaud and Terry Riggs certainly brought new elements to our program. Chris, from Long Island, New York, arrived with his dry suit and an insatiable passion to dive. The warm waters of the Gulf were a new adventure for Chris, and I thought for sure we had him hooked. I envisioned that someday soon Chris would take over CCS Scientific Diving Program, but the lure of home and an offer from the University of Maine took him away. But, before leaving he completed an excellent thesis project and was a key player in our diving program and projects. Terry came to my door after fourteen years in the military's Special Forces having served in both in the Army Rangers and Navy Seals. A Native American from New Mexico, Terry joined our merry and usually irreverent team bringing impressive intellect and physical capabilities. Usually quiet, one only had to start a discussion on guns or motorcycles to get Terry fully engaged. My first challenge with Terry was to convince him that we were not storming enemy beaches and safety stops during ascent were good. He became and excellent scientist, scientific diver, and writer. Today he is still working offshore.

Dr. David Gray, a trauma specialist became our traveling "Doc on Deck." David was and is a great adventurer and taught us a lot about first aid response. Who can forget the day when he was teaching us to do neurological exams and he dropped his swim suit to show us how to observe the male genetalia to determine neurological condition. Most of us have tried to forget that demonstration. The challenge of having David as the "Doc on Deck" was that he was usually underwater helping with the science collections (Figure 22).

Mobil Oil and Gas opened the doors for this program and other offshore producers followed. British Petroleum (BP), Texaco, and Panaco made their offshore production facilities available to my research team. With this support we were able

Figure 22. Dr. David Gray, our "Doc on Deck" anywhere but on the deck.

to expand the geographic reach of our studies. BP America in particular joined us with great enthusiasm. Terry Rooney, Ann-Rene LaPlant, Deb Beaubien, Chris Summers, and Jan Farmer along with many others in BP joined and encouraged our efforts. When we teamed with Steve Amos' 4empowerment.com company to do the first ever live webcasts from underwater beneath a production platform, BP sponsored us and Chris and Jan were "on air talent" for these productions. We had over 30,000 kids join us on these webcasts!

Our projects and offshore team became so popular in the offshore "oil patch" that many times I would get calls from the platform crews requesting that we come to their platform next; in fact it became an open competition between the platforms to see who got to host us next! Once when John Reeves of Mobil asked if BP treated us as good as he and Hector, I informed him that BP had ribbon cane syrup on the breakfast table which reminded me of my Great Grandmother's breakfast table. The next time we off loaded at Mobil's HI 389 platform John met me on the deck with a gallon can of ribbon cane syrup. It was going to be a cold day in hell before he let another platform lure us away without a fight! It was a privilege and honor to have been accepted into their offshore families.

One of our biggest learning curves was how to integrate a team of academics into the daily work world of a production platform operations team. This learning curve started at headquarters and carried forward to the platform. One memorable event resulted in a written document on acceptable and unacceptable behavior on the platforms. I had assisted in getting BP to host a film crew from the National Geographic Society (NGS) who were completing a documentary on whales of the Gulf of Mexico. NGS had contracted a sail powered catamaran with a boat crew to assist. One of the catamaran crew members truly marched to his own drum and shook up the platform family when he joined the breakfast buffet line 0530 one morning completely nude!

Now, offshore crews are predominantly male and usually a little homophobic, so a naked man standing at the buffet counter was a real eye opener. Within an hour of

the event Terry Rooney of BP headquarters was on the phone explaining to me that they did not want to do anything to jeopardize our partnership, but they could not have naked men running around the platform! My advice to Terry – "throw him overboard!" I did not want to jeopardize our relationship either, and I certainly would not want a naked anything standing next to my breakfast buffet. Following this event we wrote up a booklet of guidelines and one section emphasized that clothes were not optional.

Dr. Bill Busch of NOAA took great interest in our efforts and sponsored a trip to Bergen, Norway, for me to tell of our program to oil and gas producers working in the North Sea. The Russians were very keen on having us come to their platform just inside the Artic Circle. They told me that there was about eight weeks of the year where the water was not frozen and for the rest of the year polar bears hung around feeding on table scraps thrown from the platform. They claimed to have a good store of vodka, and I was encouraged to bring women – several times. I don't know if it was my aversion to cold water, concern for swimming with polar bears, or my alarm at their insistence that I bring women, but for whatever reason, unfortunately, we never made it to the Artic to work with our Russian friends. Maybe in my next life we will make this trip.

Getting to Bergen was another misadventure for me. First I got off the plane in the wrong city and the airline actually stopped the plane as it taxied to the runway and brought it back to the gate to put me aboard! Once in Bergen and on the shuttle bus to the hotel I was not going to make the same mistake twice. When the bus got to the end of the line, and I was the only passenger left aboard, the driver pulled over, turned to me, and said in perfect English, "You're not from here are you"? I had to confess that despite my Norwegian heritage and name, I did not understand a word of Norwegian. He kindly took me back to my hotel, and in English, told me when to get off his bus.

Our artificial reef program focused on the study of the ecosystem and habitat dynamics of the reef system (Figure 23). With more than three thousand platform structures in the northern Gulf of Mexico, along with several liberty ships sunk as reef material, these artificial reefs influenced the ecology of the Gulf of Mexico. We studied energy flow, primary and secondary productivity, biodiversity, zoogeography, sponge ecology, vertical stratification, and more. These structures were excellent study subjects and still are today. Our work was instrumental in changing some policies related to these man made structures to the benefit of both the ecology and industry that owned them.

On other expeditions we assisted, the Texas Parks and Wildlife Department (TPWD) Artificial Reef Program scientist in evaluating the effectiveness of their artificial reef system. Hal Osburn and Jan Culbertson were advocates for this program, and today it is one of the most comprehensive programs in the Gulf of Mexico. Working with TPWD we were able to re-frame the age old question of artificial

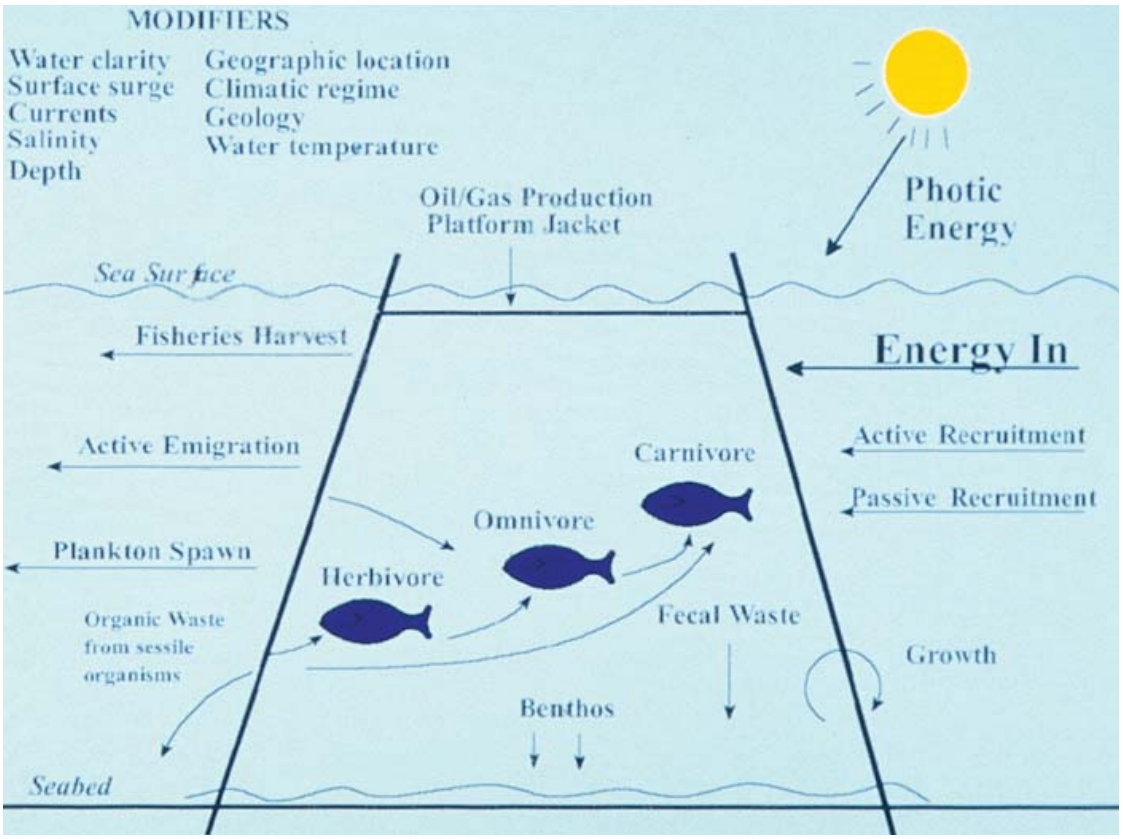


Figure 23. Simplified schematic of bioenergetics of artificial reef.

reefs – do they increase the number of fishery targeted fish or simply congregate those already existing – to more fully address the overall impact of these reefs from the sessile algae and invertebrates to the apex predators. We worked to asses the true ecological value of an artificial reef.

Our offshore diving research team was also a primary player in the study of natural reefs in the Gulf of Mexico. For six years this group led the monitoring studies of the Flower Garden Banks coral reefs and conducted studies on Stetson Bank east of Galveston, and Sebree Bank off the south Texas coast. Led by Susan, Suzanne, Carl, Terry, Tom, and Chris we would organize groups of twenty-five diving scientists, technicians, and students for five day expeditions on the Flower Garden Banks. We had divers in the water from sun up to well into the night collecting data (Figure 24). Our work attracted national attention and once the National Geographic Magazine featured pictures of our team working on Derek's dissertation project on the Flower Garden Banks. This team became known for its efficiency under all weather and sea conditions. They were good on the boat and good underwater.

On one expedition during a coral spawn, Dr. Tom Bright set up on HI 389 to record the fertilization and cell division of coral gametes (Figure 25). This was a first.

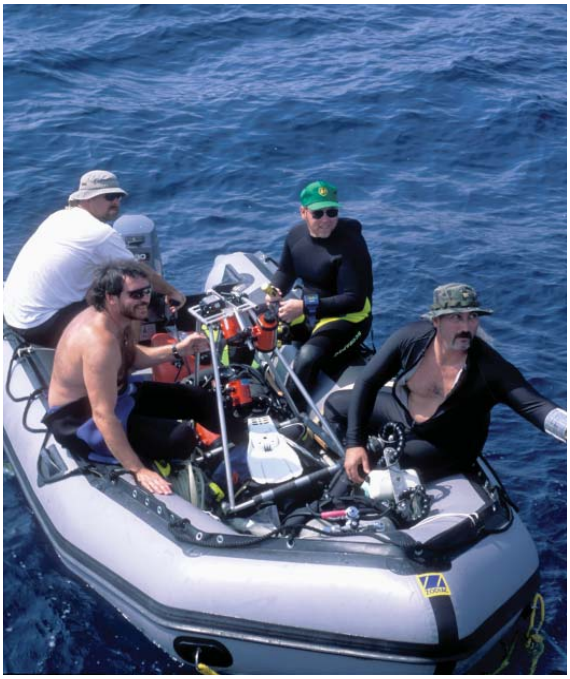


Figure 24. Part of dive team being transported to deeper areas of Flower Garden Banks.

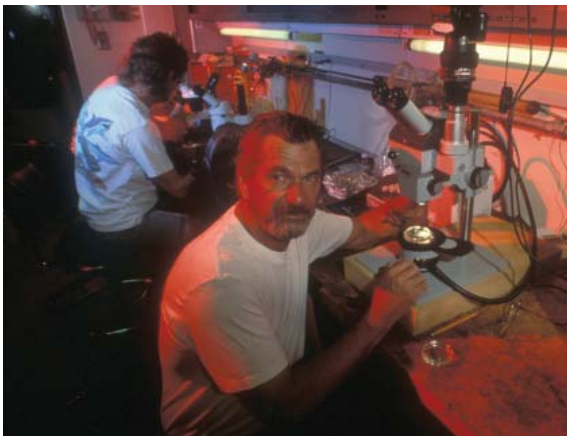


Figure 25. Dr. Tom Bright set up a platform lab to film coral gamete development.

The team also assisted Emma Hickerson in capturing 150 pound sea turtles in the middle of the night as they slept under coral ledges to complete her Master's thesis. The turtles were wrestled aboard the research vessel, tagged, and adorned with satellite transmitters for tracking before being released. All of this was done 110 miles offshore in the open ocean in the middle of the night! Sharks and other boogey creatures be damned – we were on a mission (Figure 26). And on numerous occasions professional camera crews joined us to document our work some of which still show on PBS across the nation. Bruce Bierman and Curtis Craven, film producers for TPWD were along on numerous expeditions to capture the action on film (Figure 27).

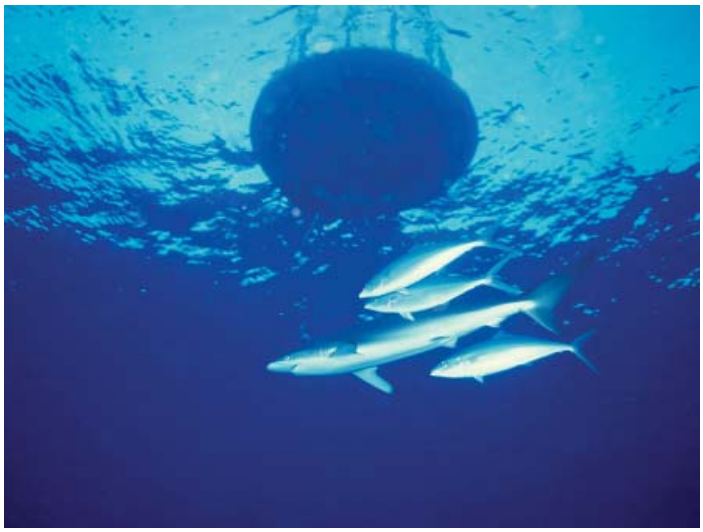


Figure 26. Sharks and other pelagic fish were constant companions – here investigating the Billy Pugh personnel basket that transported divers to and from the water.

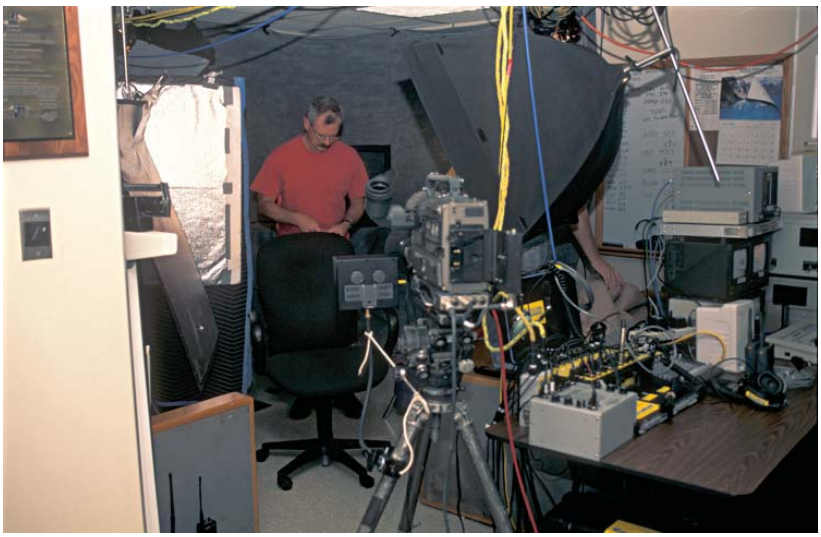


Figure 27. Setting up a broadcast studio on a BP platform.

Just as importantly as expanding our knowledge and understanding of the reef habitats of the Gulf of Mexico our research team began to set new standards for scientific diving. When we started we were doing more and deeper diving than any other academic based research group in the Gulf of Mexico. I still remember the time Derek and I dodged curious 5 foot long amberjacks coming at us like torpedoes in twilight waters at 250 fsw.

The success of our work and the safety record we sustained catalyzed others to follow suit. Gregg Stanton joined us to advance the diving technology we were able to utilize. We expanded the use of mixed gas and decompression diving and were exploring the use of advanced rebreathers to maximize bottom time and safety. Texas A&M University-Corpus Christi went from having no formal scientific diving program to having one of the most advanced in the nation. I was elected to the Board of Directors of the American Academy of Underwater Sciences (AAUS), and we influenced the advancement of the AAUS diving standards as well as NOAA's diving program. We helped to expand the bounds of scientific diving and, when all was said and done, we closed out our offshore research program with a perfect safety record over nearly a decade of scientific diving!

Unfortunately, my team began to graduate and move on to real world careers. Had I been able to keep them with me forever, we would likely still be exploring the amazing habitats and industries of the Gulf of Mexico. I tried to keep them, but they all knew better than I that in time they would move on to establish their own teams. The stories that are told and the friendships developed over this period of time are endless. For me our offshore diving research team will always hold a special place in my heart and be a source of pride. Sadly and tragically we lost Carl Beaver and Clyde Jones to senseless accidents on-shore. For other team members love and marriages happened. For all, our careers found direction and advanced on the experiences we shared.

Outside of our offshore projects, ever the opportunist, I grabbed onto an invitation by the Economic Development Administration to investigate the socioeconomics of the fisheries industries of Texas. For this project I once again recruited Bonnie Ponwith and a new team member, Heidi Lovett. Together we produced one of the most insightful studies of economics and social structure of Texas' commercial fisheries ever produced.

Bonnie and Heidi sifted through decades of data files and conducted hundreds of interviews which painted a colorful history and less than bright future of the commercial fisheries of Texas. As with much of society, young people were no longer focused on the interests of their parents, and questions of resource sustainability were undermining the future of the industry along with increasing operational costs, foreign competition, and stagnant product value. The conclusions of our report are evident today as commercial fisheries struggle to stay in existence and viable.

It was very flattering when the TPWD ordered boxes of this report to distribute to all of their offices. When we started this project they felt that they had adequately covered the subject and that the additional effort was not necessary, but when completed, they were the first to send us a congratulatory note for an excellent addition to our understanding of Texas fisheries.

During my years with CCS opportunities to consult cropped up. Being true to my opportunistic nature I rarely passed up an opportunity - a habit which benefited CCS students very favorably. Terry Riggs, Carl Beaver, Jeff Childs, Jace Tunnell, Brien A. Nicolau, Suzanne Bates, Erin (Albert) Hill, Jason Jones, Beau Hardegree and others were able to join me in consultant work to supplement their lean research assistant salaries. In some instances in six weeks time they were able to make as much or more consulting salary than they could in twelve months as a university research assistant. Through this work they gained valuable experience in the private sector and paid some bills so that they could continue their studies. It was a perfect example of taking science out of the classroom and applying it to real world challenges.

A habitual multi-tasker, and having learned early that diversification is good, I continued my work with the Gulf of Mexico Foundation (GMF) after joining CCS. The GMF was focused on education outreach and advocacy for management of the Gulf of Mexico to achieve sustainability of habitat quality, quantity, and productivity. Work of CCS in scientific investigation complemented the "shovel in the sand" programs and advocacy of the GMF. As usual, Susan, Suzanne, and Tom were with me, pitching to win. Today, we still use demographic studies of coastal areas of the Gulf of Mexico from Key West to Cancun produced by Tom Bates to explain our mission and its urgency. The GMF is active in seven Gulf States, two countries, and four U.S. territories in the Caribbean and has moved millions of dollars into habitat restoration, extended educational opportunities to

hundreds of students and teachers, and created an avenue for private industry to be involved in conservation programs. My CCS team played a significant role in getting the GMF to this level of activity and influence.

My time at CCS was a remarkable period in my life. My research team added to our knowledge of the Gulf of Mexico, helped raise my son John, and mourned with me the illness and passing of my wife, Kay, and taught me as much as I taught them. Taking this trip down memory lane dozens of names, faces, and memories have flashed across my vision. I wish I could have listed each and every one of the people who contributed to and helped shape my career at CCS. I will forever be grateful to you one and all. In closing, quoting the late great Paul Harvey, "And now you know the rest of the story." (Figures 28 and 29)

Figure 28. Quenton Dokken in gear and ready to go below for a live web-cast.

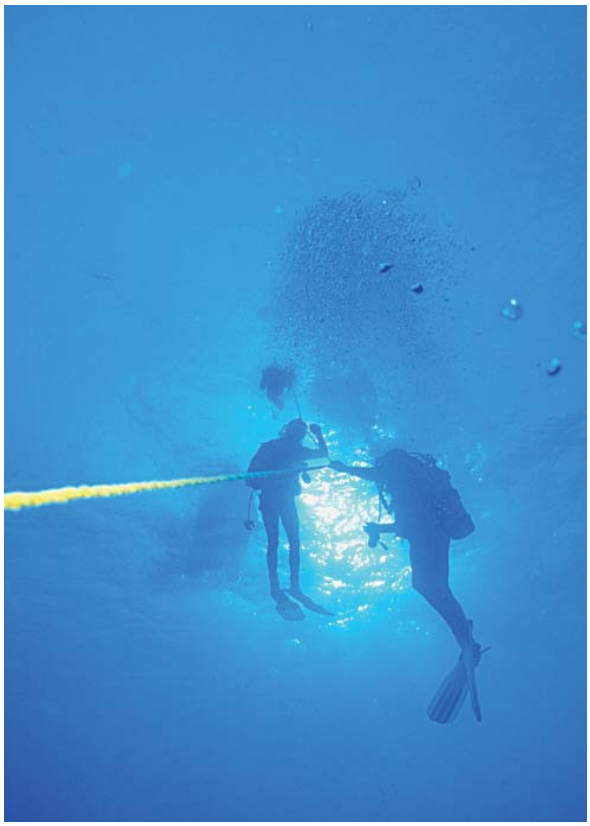


Figure 29. The end of the dive.

7 Nueces Delta/Water and Sediment Quality Monitoring

Brien A. Nicolau

When Dr. Tunnell first conceptualized this 25 year historical publication my first thought was, Wow, time has flown by! My thoughts that followed were: How did I arrive here? What have we accomplished? How have we all benefited from this unique experience we call the Center for Coastal Studies (CCS)? I wondered how to put this into words and decided that a personal narrative describing people, places, and events worked best. As opposed to most "jobs", I view my involvement as an important responsibility, and a personal experience. The history of CCS is in essence a large part of my history and exemplifies the opportunities that exist for students on this campus. Our program began evaluating biological and ecological productivity in the Nueces Delta before eventually evolving into the water and sediment quality arena. Our goal has always been to produce practical and useful information for local, state, and federal resource managers while remembering that at the core, it is all about the students' education and experience.

My long journey towards South Texas and subsequent arrival at CCS began many years ago upon the waters of Long Island Sound, in New Rochelle, New York. I grew up in a great neighborhood, where families interacted, and experienced life together. Growing up in Sutton Manor I learned many lessons at a young age that served me well in later life. Coming of age in this unique neighborhood allowed me the distinct privilege of being able to spend countless hours of my youth playing in the mud, sailing and swimming in the water, and generally being a "water rat". I had adventures that my parents would probably have shipped me off to the hinterlands for had they known. Like at the age of thirteen sailing a 12' "Sailfish" six and a half miles across the "Sound" to Glen Cove, Long Island, just for the fun of it. Who would have been able to predict that one day all those wild adventures would pay off, and that someone would actually consider paying me to do all the stuff I once did for free!

After taking a "leave of absence" from my college studies in 1974, I spent time sailing the French West Indies contemplating life, but generally living in the moment. Life went on and I lived, loved, and worked before eventually ending up in Texas in 1978. Fast forward 10 years spent working in Houston, living on my boat in Clear Lake and plying the waters of Galveston Bay and the Texas Coast, and I landed in Rockport, Texas. I was just in time for Hurricane Gilbert, which proved to be no problem for the Coastal Bend but I was wondering about my timing. At that point, I realized there was more to experience in life. So, taking my love of the water and the environment around me, I returned to school in 1989. As a late-in-life student, at the tender age of 35, I was going to get a degree in Biology and to tell the truth,

that was as far as the plan went as I enrolled for those first classes. After the fall 1989 semester at Del Mar College, in Corpus Christi, I transferred to Corpus Christi State University (CCSU) and started my junior year in the spring of 1990.

This is where the adventure began. Classes were fine and there was always something to learn each day, but the real excitement was in the field. I began to experience and benefit from the primary reason many students enrolled in biology at CCSU and that was for the field studies program. Field studies that provided you with soaking wet, down in the mud and water, hands on, real life practical experience. If you wanted to become a field biologist there was no better place to be (Figure 1). Here I met Drs. Brian Chapman, Bart Cook, David McKee, John "Wes" Tunnell, Jr., and luckily, the late Alan H. Chaney who stepped into teach the Vertebrate Biology class one semester. Those who "survived" this class will all probably agree that you learned more in that one semester than you ever thought possible. Oh, and as life went on, you realized that being called a "dunderhead" was not all bad (Figure 2).

Figure 1. Along the Mexican coast packing up for another day of exploration.

Figure 2. Dr. Alan H. Chaney and students identifying reptile specimens somewhere outside of Pandale, Texas.

During those first undergraduate studies was when I met what I like to call the "usual suspects". There was John Adams, Noe Barrera, Carl Beaver, Teresa (Barrera) Carrillo, Paul Choucair, Jeff Foster, Beau Hardegree, Al Oswalt, Linda Price-May, and Jim Tolan to name a few (Figure 3). Between all the individual chapters, you undoubtedly have seen many of the same names mentioned. If I leave someone out, it is not intentional I assure you. I hope that between all of us we included as many folks as possible that have participated in the long history of CCS.

So, how did I get to CCS? I actually owe thanks to fellow student and colleague John Adams, who in the late summer of 1991, encouraged me to take over the Nueces Delta Mitigation Project (NDMP) from him, just as he had done from

Figure 3. Vertebrate Biology field trip; a) Noe Barrera and Carl Beaver making lunch or preserving specimens, you always had to double check; and b) Jim Tolan takes it easy after a hard day in the field.

Barbara Ruth. He encouraged me to join the CCS family and made this simple statement; "Trust me, you'll have fun"! (Figure 4) Having just obtained my BS in Biology, and deciding a Masters degree was next, I knew gainful employment and a thesis project would be helpful. When I replied "sure, sounds great" I did not realize at that moment exactly what this would mean, but I felt there might be a long-term plan developing on the horizon.

Figure 4. John Adams pitching me on the idea of how much fun I would have playing in the mud.

Let me stop here to say a few words about the NDMP, as this project is a classic example of how CCS provides student opportunities through applied research. Developed as a cooperative agreement with the campus U.S. Fish and Wildlife Service (USFWS) office and the U.S. Army Corps of Engineers, CCS evaluated the biological response to a *Spartina alterniflora* marsh planted in mitigation for deepening of the Corpus Christi Inner Harbor Ship Channel (Figure 5). The project produced several Biology MS thesis projects, which looked at biological and ecological productivity through analysis of benthic infauna, epifaunal invertebrates, nekton, avian usage, and hydrological profiles. However, and I believe perhaps more importantly, the project also provided the opportunity for numerous undergraduate, and a few graduate students, to gain valuable experience in field trip planning, sample collection, and specimen identification. Many students who gained experience on this project took what they learned and upon graduating, and either obtained a position with a natural resource agency, environmental or commercial firm, or continued their education and sought higher degrees.

Figure 5. Nueces Delta Mitigation Project, February 1991. Photo by Lanmon Aerial Photography, Inc.

Having firmly put the cart in front of the horse, as I had a thesis project before taking my first graduate class, I began graduate studies in the fall 1991. I then began to meet many more friends, and future colleagues, that would become a part of my life and the CCS experience. Drs. Roy Lehman, Elizabeth Smith, and Kim Withers. Some fellow graduate students included Sandra (Alvarado) Arismendez, Susan (Cox) Childs, Suzanne (Dilworth) Bates, David Hicks, Larry Hyde, Kendal (Keyes) Kelly, Ron Smith, Chris Stahl and one special graduate student, Terri (Wood) Nicolau (Figure 6).

Figure 6. The early days in the NDMP: a) Susan Childs and Terri Nicolau setting up a periphyton experiment; b) Linda Price-May deciding then and there that marine mammals are more fun; c) Brien A. Nicolau sampling nekton samples; and d) morning in the Nueces Delta, Texas.

At the end of my first year, seeing as how I was playing catch-up with classes, I asked permission to do a two-year thesis project. As many of my friends had participated in slogging through the mud with me on my monthly sampling adventures, they were thrilled at the prospect of another year of sampling in the Nueces Delta. Truthfully, I do not recall a time that assistance was not available as this was the bond formed among us all. We always tried to look out for each other and help where we could. This spirit of cooperation is a fundamental aspect of CCS even today. Looking back, I also wonder if part of the reason I proposed a two-year thesis project was due to the exciting developments taking place on campus. The Texas Legislature had allocated funding in 1992 for the Natural Resources Center (NRC) and I saw potential for long-term involvement with the future expansion of CCS. I just needed to be here when that day came.

When the second year of my thesis research concluded in August 1993, the USFWS decided to continue the NDMP until successfully completing mitigation at this site, so I still had a job. Being opportunistic, and needing more than half-time graduate pay, in October 1993 I was offered a part-time job by James Dodson (Figure 7) who was then the Director of the Regional Water Office for the City of

Figure 7. James Dodson assisting with a fish census in the Nueces Delta, Texas.

Corpus Christi (City). Although this would delay my graduation, Dr. Tunnell saw this as an opportunity and encouraged me to take the position. I gained valuable experience with James as he planned future water acquisitions for the City and began the development and implementation of fresh water diversion projects for enhancement of the Nueces Delta. During my tenure with James, I also gained experience by working with David Pyle (Figure 8) of the City's Engineering and Surveying Office on various mitigation projects and assisting at the newly created Corpus Christi Bay National Estuary Program (CCBNEP) as one of the City's contributions to the programs development. Those early duties at the Program office with Richard Volk and Alice (Cowart) Sanchez involved everything from answering phones, assembling furniture, computer setup and repair, compiling and entering data for mailing lists databases, and whatever else needed doing. While not what I had gone to school for, this was a good life experience and, as Dr. Tunnell reminded me, the chance to develop future working relationships. Everyone's life was busy, work was good, and CCS personnel were scattered across campus working on various projects waiting for the NRC completion and moving day.

Figure 8. David Pyle and I discussing the City of Corpus Christi's Spur 3 Utility Project bringing new infrastructure across the Cayo del Oso to the Texas A&M University-Corpus Christi campus.

I had already decided that CCS was the place I wanted to be and that the timing of events had brought me to this juncture. So on a Sunday in May 1996, I sat down and put my thoughts into words of why CCS needed an Operations Manager and why I thought that person should be me. I delivered it to Dr. Tunnell's home that evening and discovered that he had been thinking much along the same lines as I had. The next day he said, "You're hired. One thing though, the hours are going to be long and the pay isn't that much, still interested"? We moved into the NRC in June 1996 and began the next evolution of the CCS.

So there we were, all under one roof, working on a multitude of projects, and operating under a simple mandate. Dr. Tunnell said, "Take what you know and like and develop a program that interests you. Be flexible and adaptable when needed, learning more at each step along the way, and most importantly, share the opportunities and experience with others". Having personally benefited from the CCS model, I knew I wanted to provide the same range of opportunities for future students. If I could secure applied research funding that delivered useful products to sponsors, provided funding for undergraduate and graduate students to obtain practical experience and develop their skills, and provide thesis opportunities, then I could pay forward what CCS had given to me.

This would entail continuing our work in the Nueces Delta, being in the right place at the right time with a great group of colleagues and students, and saying, "Sure, we can handle that for you" when funding opportunities arose. In fact, we said it until it hurt! Over the years, we would be involved with water, sediment, and habitat projects with the City, Coastal Bend Bays & Estuaries Program, Inc. (CBBEP), Nueces River Authority (NRA), Texas Commission on Environmental Quality (TCEQ), Texas General Land Office (GLO), Texas Parks and Wildlife Department (TPWD), and the U.S. Environmental Protection Agency (EPA).

The period of the late 1990's saw much activity and changes at CCS. Fellow graduate students who started the journey when I did, finished their studies and moved upward and onward, which would prove to be beneficial later on, while some continued their education to the next level. The opportunity now existed for a new cadre of students to enter the CCS arena. Three of these students produced what would become the core of the fledgling water and sediment quality monitoring program and enhance our continued studies in the Nueces Delta. Holly (Hardaway) Bellringer, Erin (Albert) Hill, and Alex Nuñez came knocking at the door after they heard CCS was a great place to gain practical experience and that opportunity existed for those willing to work for it. One by one, they showed up and asked, "I am looking to get some experience. Are there any opportunities for volunteers at the Center"? I thought, volunteers, what a novel concept. These three young people grasped the CCS concept, and I felt lucky to have them on the team. Their stories typify what CCS has meant for students and how students have made CCS and Texas A&M University-Corpus Christi (TAMUCC), a premier educational institution.

Holly and Erin arrived in December 1996 and began working as undergraduate research assistants on the NDMP and assisted Dr. Roy Lehman and Terri Nicolau on the San Jacinto River Oil Spill Bioremediation Project at Parkers Cove in Houston, Texas (Figure 9). Erin and Holly worked tirelessly in the classroom, field, and lab gaining as much experience as they could, and before long, actually received a paycheck. After they entered the graduate program in fall 1997, opportunity began knocking on the door and we answered it.

Figure 9. Dr. Roy Lehman and Terri Nicolau building walkways in Parkers Cove, San Jacinto, Texas.

In March of 1998, the NRA moved into the NRC and opened their Coastal Bend Division Office with James Dodson as the Regional Director. In an effort to involve local natural resource agencies in the TCEQ – Clean Rivers Program (CRP), the NRA contracted with CCS to coordinate their sampling in the Coastal Basins. This involved routine and targeted water quality monitoring as well as a receiving water assessment for San Fernando Creek at U.S. Naval Air Station-Kingsville.

Holly took this opportunity to apply for the graduate research position and put to use what she had learned during her tenure as an undergraduate at CCS. Through the NRA cooperative agreement, Holly obtained funding for her graduate studies and did her MS thesis on the *"Characterization of benthic macroinvertebrate communities in the Texas Coastal Bend in relation to salinity"*, and provided the NRA with the data necessary to meet their commitment to the CRP (Figure 10). Upon graduating, Holly married and moved to Spain with her husband Noah who is a naval aviator. As she had learned at CCS, always be on the lookout for opportunities. She met some scientists doing work aboard a Spanish research vessel cruising in the Mediterranean. They needed someone to do Chlorophyll *a* analysis, and she secured another life experience (volunteer) when she happened to mention that she knew her way around a fluorometer. Holly returned to Corpus Christi in 2004-

Figure 10. Holly (Hardaway) Bellringer and Chris Caudle (TCEQ) identifying aquatic organisms in San Fernando Creek, near Kingsville, Texas.

2005 and worked on various projects at CCS and with Dr. Jim Simons at TPWD before moving to San Diego, California, where she currently works at the Tijuana River National Estuarine Research Reserve.

After receiving his BS in Biology, Alex was not sure what was next in his life. He arrived at CCS in the spring of 1998 upon the urging of his fellow students. While here, he worked in the field collecting water quality data and in the laboratory, picking, sorting, and learning how to identify benthic organisms. Like many students, during that first year at CCS, his interactions with other students and the researchers focused his thoughts and energies, and he developed a clear sense of direction. With a strong desire to get an MS degree, he applied for entrance into the graduate program in 1999. The only problem; he was immediately hired away from me by Terri Nicolau, the new Environmental Program Manager for the NRA. Well, at least she knew what a great asset he would be to their program!

Terri's involvement in water and sediment quality issues prompted the development and submission of an NRA proposal to the CBBEP, and she and James Dodson asked if CCS would be interested in participating by doing the sampling work. In the course of project development, Terri would take a job at the CBBEP and become the Project Manager for the proposal she submitted while at the NRA. This prompted a new learning experience for us all when we rightfully asked the TCEQ and the EPA, the major funding agencies for the CBBEP, if this proposed any conflict of interest issues. Getting the green light, we proceeded forward with this wide-ranging project.

Developed in response to concerns over possible regulatory actions concerning elevated metal concentrations (copper), the CBBEP took a pro-active approach when funding this intensive water, sediment, and benthic monitoring program. True to many CCS projects, there was considerable interagency cooperation with project development, and additional funding assistance came through Blake Traudt with the GLO. Phase I included development, design, and initial implementation of the quarterly monitoring plan utilizing the EPA - Environmental Monitoring and Assessment Program (EMAP) probability-based sampling design to determine the status, extent, changes, and trends in water quality and the ecological community. Phase II continued the monitoring at 124 stations for field parameters, routine chemical parameters, dissolved and total metals in water, and metals in sediment for one year in the Northern and Central CBBEP area (Mission, Copano, St. Charles, Aransas, Redfish, Corpus Christi, Oso, and Nueces bays, Texas) (Figure 11).

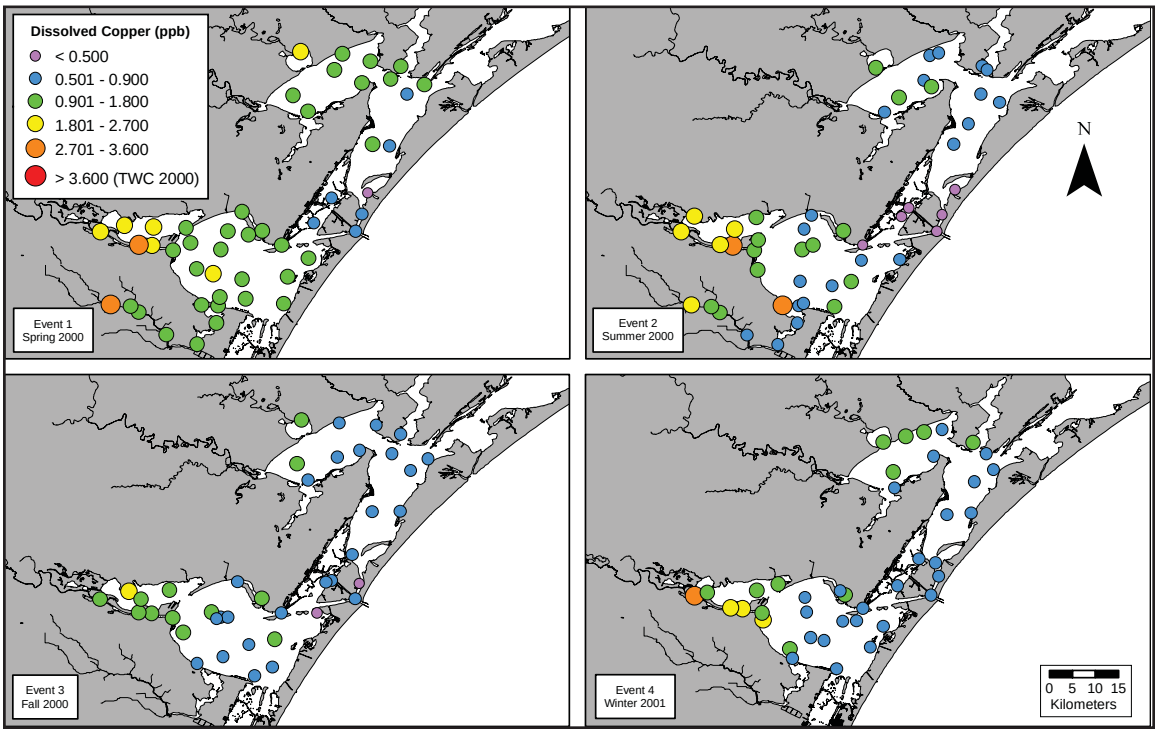


Figure 11. Sampling locations and dissolved copper concentrations (µg/l^{-1} or ppb) at both randomly selected EMAP and fixed TCEQ stations for RCAP 2000.

It was an ambitious project requiring an incredible amount of dedication and would provide the right student with a tremendous amount of experience and Alex wanted the job. This project would provide Alex with valuable experience, his MS thesis, *"Benthic condition in relation to trace metals and nutrient loads in the northern and central Coastal Bend Bays & Estuaries Program area, Texas"*, and gainful employment until he left CCS in 2006 to accept a job with the TPWD office located in the NRC. It also added a new member to the team when Jeff Childs, who was at CCS finishing his MS degree from Texas A&M University College Station at the time, came onboard to assist with sampling. In between diving with Dr. Quenton Dokken (Chapter 6), writing his thesis, and publishing a few papers, he managed to always make sure the sails were trimmed and that we ran a "tight ship"; starting each day with a rousing cry of "commence" sampling and we knew the day did not end until we heard the words "secure" sampling. Knowing Jeff's history as a submariner in a previous life, this was much better than hearing "dive, dive, dive". Although some days on the bays seemed like that might be an option! It was a great time for all involved (Figure 12).

Figure 12. RCAP sampling: a) Alex Nuñez with seagrass core sample; and b) Alex and Jeff Childs recording data.

Phase III of the project expanded into the southern portion of the CBBEP program area (upper Laguna Madre and Baffin Bay complex) with an additional 120 stations being sampled over the course of the year. Along with providing experience and employment for a vast number of students, Jennifer (Pearce) Pizzulli did the sampling for her MS thesis *"Benthic community relationship to sea grass cover, upper Laguna Madre and Baffin Bay, Texas"* during the course of assisting us with the project (Figure 13).

At the end of Phase III, Alex and I met with CBBEP and other resource agencies and developed the Regional Coastal Assessment Program (RCAP) to provide resource managers with an ongoing assessment of water quality and address special areas of concern (Figure 14). As this program coincided with the EPA National Coastal Assessment (NCA) program, led in Texas by Dr. Jim Simons with TPWD, a cooperative partnership was formed to maximize the national effort for the next

Figure 13. Dr. Kim Withers, Jennifer Pizzulli, and Amy Thurlkill taking core samples for RCAP sampling.

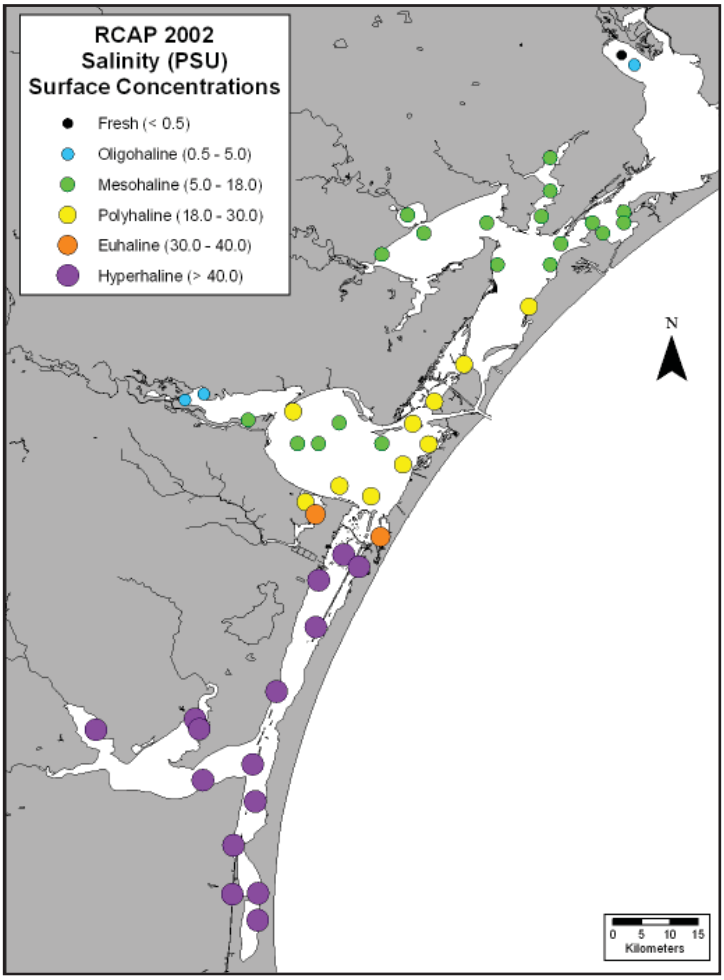


Figure 14. Sampling locations and surface salinity concentrations (PSU) at RCAP 2002 sampling sites.

three years (Figure 15). This cooperative effort allowed TPWD and EPA to increase the original 50 locations designated in the NCA sampling program for the State of Texas to 100 sampling locations. This assured better coverage of the extended Texas coastline and yielded a stronger dataset for assessing coastal conditions on a local and regional level as all stations were sampled for the exact same parameters and under an approved Quality Assurance Project Plan.

Figure 15. RCAP sampling: a) Dr. Jim Simons checking the nets for fish; b) Alex Nuñez taking water samples; c) Lee Lehman and Dr. Jim Simons sorting through the wrack; and d) at work in the Laguna Madre, Texas.

Additional work came our way when former CCS student Sandra (Alvarado) Arismendez, enlisted our aid in performing work on the Nueces Bay Zinc Total Maximum Daily Load (TMDL) project (Figure 16). This multi-phase project resulted from Nueces Bay being on the Texas Clean Water Act 303(d) list of impaired waters for not meeting the oyster water use due to elevated zinc levels in oyster tissue. Sampling involved the same Ultra-Clean sampling methods and analysis utilized in the RCAP program for the collection of zinc in water and sediment within Nueces Bay, the Nueces River, and the Corpus Christi Inner Harbor. This effort

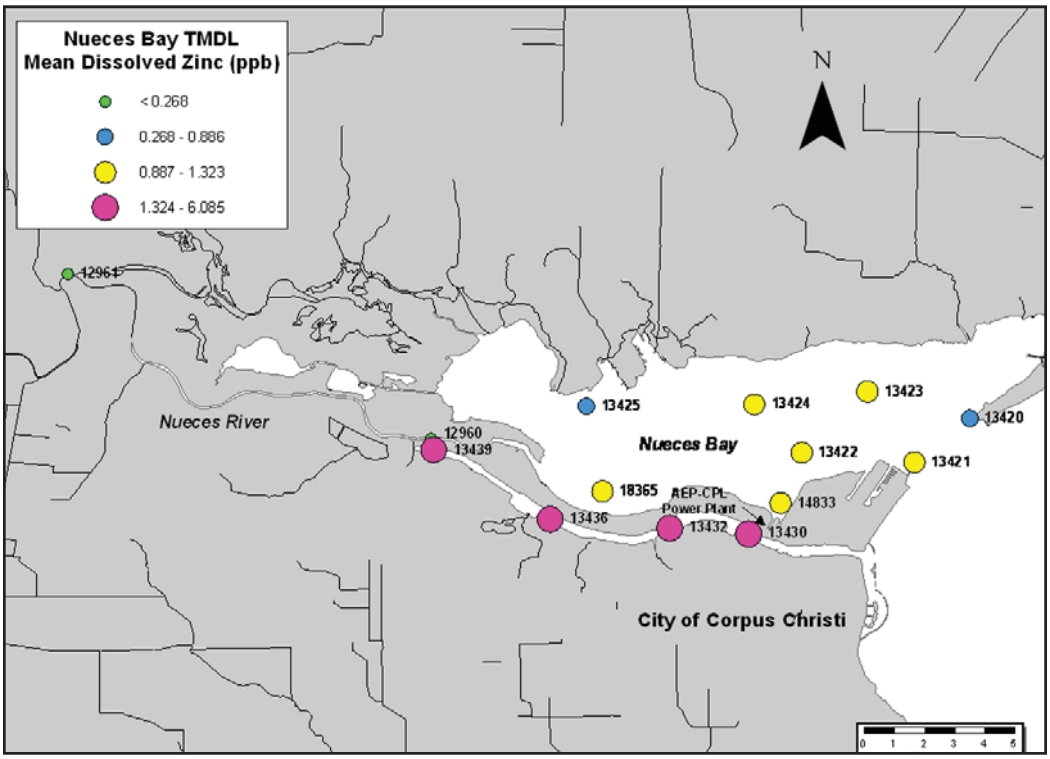


Figure 16. Sampling locations and mean dissolved zinc concentrations (μg/l^{-1} or ppb) for Phase I of the Nueces Bay Zinc TMDL Project.

continues to aid TCEQ in determining if the designated uses are being met and to track the effect reduced zinc loadings under the TMDL Implementation Plan have on water quality and ultimately in oyster tissue.

In particular, I owe the greatest debt of gratitude and praise to Erin Hill, who like me found a home here at the Center. Starting as a volunteer in 1996, Erin proved to be a valuable asset to CCS and in looking back at our accomplishments, I consider this program to be as a much hers as it is mine. Without her valuable assistance and expertise, her full-time support, and her extreme dedication, it would have been impossible for our success on so many projects. During her tenure at CCS, she has led, assisted, or has taken part in practically every project our program undertook. She had learned early on that the phrase, "Sure, we can handle that for you", meant never a dull moment!

During that first year in 1997, she graduated with her BS degree in Biology and not only assisted me but also traveled to Houston where she did her thesis, *"Benthic community response to bioremediation experiments on the San Jacinto River, Houston, Texas"*. As Dr. Tunnell had once encouraged me to take advantage of opportunities, in 1998 she went to work for John Adams at the Division of Nearshore Research of the Conrad Blucher Institute for Surveying and Science to gain more experience with water monitoring equipment and yet still found time for classes and to assist with the NDMP (Figure 17).

Figure 17. The NDMP: a) Erin Hill and Holly Bellringer cleaning samples; and b) Erin taking benthic core samples in the NDMP.

The success of our future endeavors ultimately began with the NDMP. This project became the basis for additional research opportunities by providing data on conditions within the Nueces Delta for the City's Allison Wastewater Treatment Plant Effluent Demonstration Diversion Project (EDDP), a collaborative project with the University of Texas Marine Science Institute (UTMSI) at Port Aransas that investigated the beneficial reuse of treated wastewater to surrounding biotic communities (Figure 18). In September 1998, while still a Graduate Research Assistant, Erin assumed primary responsibility for all field sampling and laboratory work. She became an integral of this six-year research program by leading students in the field (Figure 19) and taking an active role as Co-Principal Investigator in analyzing the data and in writing the annual reports.

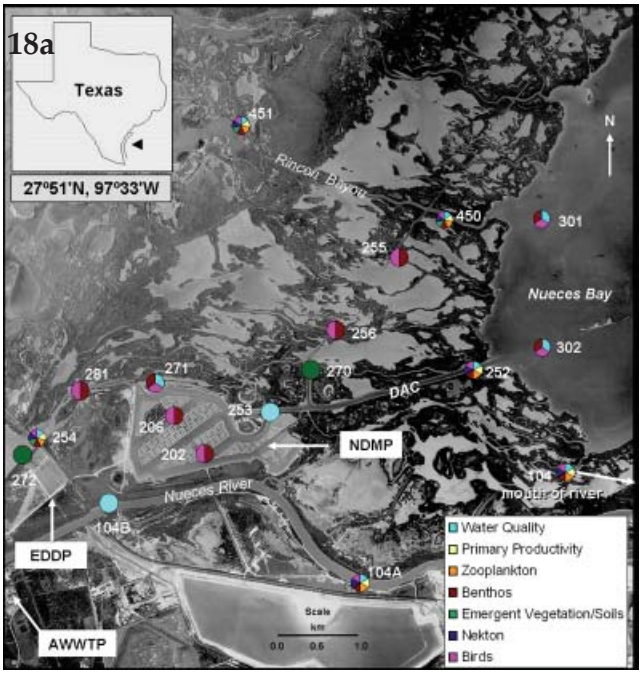


Figure 18. The EDDP: a) aerial photo depicting CCS and UTMSI sampling stations. Photo by Lanmon Aerial Photography, Inc.; and b) Cell I outfall at the EDDP.

Figure 19. TAMUCC students at the EDDP: a) Scott Hanson and Brian Holmes adjusting discharge flow at EDDP cells; b) Erin Hill and Scott Hanson monitoring water quality parameters at discharge outfall; c) view of EDDP Cell 1; d) Matt Schweitzer and Bobby Duke conducting bird surveys.

The following year was actually the first time Sandra Arismendez contacted us about work. After graduating and working at the CCBNEP, Sandra had taken a job with the TCEQ - TMDL team in Austin. They were interested in conducting a characterization and assessment of the water quality and biota of the Oso Creek/Oso Bay Watershed System in order to address concerns for various water quality standards or screening criteria. We put together a team consisting of John Adams and Dr. Joanna Mott to address the dissolved oxygen and microbiological monitoring, respectively. In October 1999, Erin assumed the responsibilities of Field and Laboratory Supervisor on the project, and we were off and running again. Like many of our other projects, numerous students gained valuable experience while helping us to fulfill our obligations to the sponsor.

Finding the time to graduate, Erin received her MS degree in 2001 and became a full-time Natural Resource Specialist at CCS. At this point, in addition to her other research duties she assumed the responsibility of supervising from five to ten Undergraduate Research Assistants who were working on major components

of these funded projects in our benthic research laboratory. Her duties on these projects ranged from assisting Alex in the field with sensitive Ultra-Clean Trace Metals sampling techniques, to performing duties as the Quality Assurance Officer on field and lab procedures, to analyzing data and report development necessary to satisfy our contractual obligations.

Our work with TCEQ eventually led to the Oso Bay/Laguna Madre Dissolved Oxygen TMDL Project, on which Erin served as Co-Principal Investigator. This project proved to be an excellent example of CCS teamwork and student opportunity. Sampling on this project ran from August 2003 through July 2005 and often resulted in long hours and days spent away from home in the Lower Laguna Madre. It provided the opportunity for two students to do their MS thesis work through their participation in the project. Jackie Staggs had arrived at CCS in April of 2002 and became another valuable asset to the team through her assistance with field and laboratory work. In the course of this project, she completed the sampling work for her thesis, *"Laguna Madre: a characterization of trophic status and community structure"*. In addition, Jeffery Landgraf, took advantage of the opportunity to assist on the project and was able to convince the team to hang out on the water a bit longer each day while doing his thesis, *"Relationship of larval and juvenile fish abundance, community structure, and growth rates in Laguna Madre, Texas to distance from Gulf passes"* (Figure 20).

Figure 20. Oso Bay/Laguna Madre, Texas TMDL: a) Jeffery Landgraf and Beth (Hester) Almarez cleaning samples; b) Jackie Staggs recording data; c) Jackie Staggs, Dr. Kim Withers, and Erin Hill after a fun day in the field.

While we continued to do additional work for TCEQ on the Nueces Bay Zinc TMDL project in 2007-2008 (Figure 21), our primary work has been in the Nueces Delta. When the EDDP ended in August 2003, the research from this and the original Rincon Bayou Demonstration Project conducted by the Bureau of Land Management and UTMSI, evolved into the ongoing Rincon Bayou Diversion Project. The current project is a joint effort with Dr. Paul Montagna of the Harte Research Institute for Gulf of Mexico Studies (HRI) and Dr. Ken Dunton of UTMSI where we currently look at how restoring freshwater inflows to the Nueces Delta effects the vegetative, benthic, nekton, and avian communities (Figure 22).

Figure 21. Bobby Duke and I taking sediment samples in Nueces Bay, Texas.

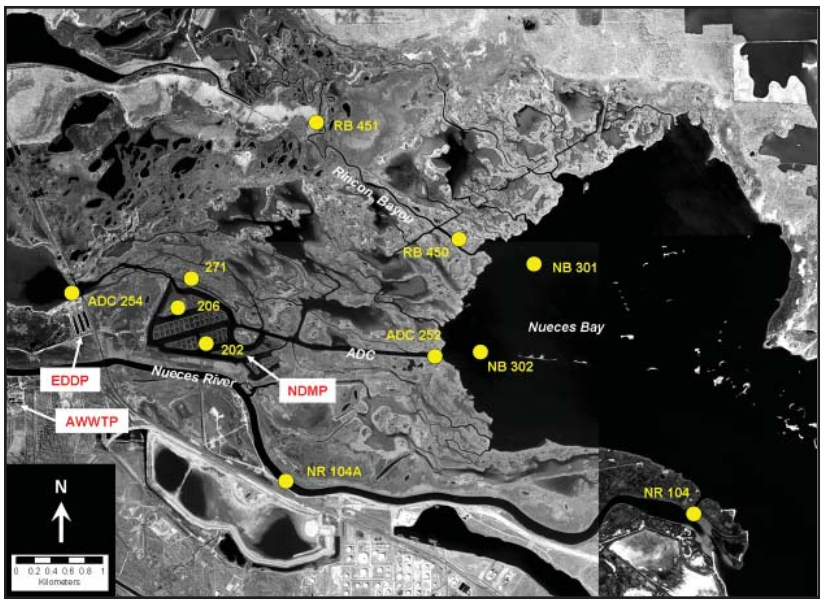


Figure 22. Photo aerial mosaic of the Rincon Bayou Diversion Project depicting location of CCS sampling stations. Aerial photos from Texas Natural Resources Information System. Courtesy of J. Wood.

Over the years, funding from the City and a multitude of other sponsors has allowed CCS to provide students with real-life experience opportunities that benefit the community as a whole, an often-overlooked project benefit (Figure 23). This is a perfect example of the CCS model, which coupled with cooperative agreements and other projects, led to the Center for Environmental Studies and Services, and eventually to the current NRC. It is also one example of the caliber of people produced by their involvement with CCS. Erin's dedication to CCS, and her projects, continues to provide opportunities for numerous students working at the Center. She is always willing to assist students with questions regarding their classes, their research projects, and life in general. She continues to assist Dr. David McKee as a reviewer of student papers for the Marine Ecology class and is an excellent mentor to all students lucky enough to meet her.

Figure 23. The Nueces Delta: a) Fred Ruiz and Amy Thurlkill taking benthic core samples; b) Scott Hanson and friend; c) Adam ("The Conqueror") Cochran striking the benthic sampling pose; and d) Erin Hill conducting bird surveys.

I would be remiss if I did not mention several other very important people who are as much a part of CCS as the students and researcher programs. Without them, our lives would not have operated smoothly, as they kept our sails full and the ship on an even keel.

Gail Sutton came to the Center in January 2001 to replace Dawn Bennett as Business Coordinator. I seem to recall saying the same thing John had said to me years ago, "trust me, you'll have fun", when the position became available. I knew Gail from two different walks of life, as a fellow student taking some graduate classes together, and as my loan officer where I banked. The amount of CCS research grant funding, number of projects, and students was at an all time high, and I knew she was just what the Center needed as she had the financial background and experience we would require. We also knew that when Dr. Tunnell became the Associate Director of HRI, that life at the Center was going to get a considerable bit busier. Gail stepped in and mastered the art of "herding cats" very quickly, not an easy task! I am not sure she bargained for the added responsibilities of HRI, but she took on those tasks with the same spirit and determination when HRI set up shop in the Center for the next four years. As she guided the Center through those years, she was also instrumental in the development, design, and financial planning aspects of HRI. To this day, I believe she knows every nut and bolt, wire, and piece of construction material and office furniture that went into that building. Having temporarily taken over her duties at the Center during this last transition, I can say that while we always knew what a great job she did, I had no idea of how demanding it can be. We all thank you, but I most especially!

The other mainstay of our CCS family is Blenda Bligh. She came to the Center in 2002 and chose to stay. That may seem an odd statement, but at the time, the Center was a whirlwind of activity and not for the faint of heart. She became instrumental in "herding" up the stray cats that got away from Gail. While her title says Business Support Specialist, she has been like our mother. She gets us what we need, tells us what is good for us, encourages us to always do our best, and believe you me, she scolds us when we get out of line! Without her support, we would be lost. I just wanted to take this opportunity to say that we greatly appreciate her and all she does for the CCS family.

Al Oswalt was another returning student from the early days who came back to the Center. Having worked for many years at the Texas State Aquarium, he retuned to CCS in 2004 to take on the position of Field Operations Coordinator. He spent many hours working on trucks, boats, and in the field providing us with valuable support before leaving in 2008 to take a job at the GLO Oil Spill Prevention & Response Group located in the NRC.

As Quenton said in the previous chapter, this trip down memory lane has confirmed what we feel about CCS and the people and experiences we have had over the years. Everyone who participated over the years had a great influence on our program here at CCS. They continue to do great work and accomplish a wide range of goals. In the process, they made themselves and CCS an outstanding Center. I am fortunate that they came here to seek experience, and I give them all the credit for our accomplishments. In addition, I would like to recognize and thank the students who provided laboratory and field assistance, and were able to benefit from our program. Without their dedication and strong work ethic, our accomplishments would not have been possible (Table 1).

I started my chapter with a description of the people and place where I grew up and realize that in so many ways the Center is an extension of that experience, the reason I have felt at home here. As a family, we have interacted with each other and experienced much of life together. Many of us were together in an EPA training class sponsored by the CBBEP on September 11, 2001 when the world came to an abrupt halt. As we watched and waited, everyone assured Terri and me that all of my family and friends in New York City would be all right. Over the years there have been many marriages, such as Susan and Jeff, Suzanne and Tom, Holly and Noah, Alex and Amy, Erin and Robert, Jace and Kathryn, and like Terri's and mine, when we made the wedding into the CCS Christmas party that year, there have been numerous celebrations (Figure 24). We have watched the "youngsters" grow up and bring us the next generation of wide-eyed and eager students, and sadly some friends left us much too soon when we lost Carl Beaver and Kay Dokken in 2006.

Figure 24. Carl Beaver and Dr. Tunnell feeding the troops!

"Trust me, you'll have fun", John had said. With those simple words, and Dr. Tunnell's guidance and encouragement, I began what has turned into an 18-year adventure. While the seas have not always been smooth, in the long view, John was right. I am still having fun as we embark on the next evolution of the Center for Coastal Studies (Figure 25).

Figure 25. Sunrise over Corpus Christi Bay, Texas.

Table 1. Additional CCS students not mentioned in this chapter, but who participated in the Nueces Delta/Water and Sediment Quality Monitoring Program.

Serena Ahrens
Mike Barton
Aaron Baxter
Rian Bienek
Jennifer Bronson
Amanda Canning
Ben Chen
Grant Coppin
Katie Crysup
Steve Dial
Frank Diaz
Brion Dolan
Bobby Duke
Nicole Eckstrom
Ryan Fikes
Kristi Fluker
Ken Gaines
Sara Heilman
Brian Holmes
Erica Howard
Michelle Kolar
Brent Koza
Casey Krause
Michael Marquez

8 Aquatic Education Program

Capt. Jay Tarkington

Growing up along the Texas Gulf Coast, I was blessed with many opportunities to fish, sail, and explore the unique habitats around the water. It was not until later in my life that I discovered that with hard work and determination I could turn this love of the environment into a career. Until I entered high school, I thought the ultimate job would be to drive a shrimp boat or, at best, captain a tow boat. Above all, my parents were finally relieved when I decided on biology as my career of choice.

After working at local boatyards to help pay my way through college, I received my BS in biology at Corpus Christi State University (CCSU), now Texas A&M University-Corpus Christi (TAMUCC). While at CCSU, I learned more about the coastal environment and with the university's emphasis on field work, I discovered that science is something that one can "do" not just read about. The university also gave me my first opportunities to work with my future mentors Dr. Wes Tunnell and Dr. David McKee. Along with being highly regarded scientists, I was impressed with their teaching style and their "hands-on" approach to science.

Adopt-A-Wetland Program

After graduating, I sought a professional job to move from the boatyards for a while, so I relocated to Houston and took a high school teaching assignment. For five years I cut my teeth in education and learned much about learning styles and teaching techniques. I attended numerous seminars on effective teaching and one day found myself in Freeport attending an Adopt-A-Wetland Program (AAWP), seminar co-hosted by Nivra Kelly. As part of her TAMUCC MS Thesis work, while working in the Center for Coastal Studies (CCS), Nivra developed the AAWP concept.

AAWP was designed to teach the importance of wetland conservation to the general public. Participants in the program include school children (K-12) and other youth groups such as scouts, 4-H, and Boys and Girls Clubs.

CCS hosted the AAWP, and other supporters and partners included the Texas Parks and Wildlife Department (TPWD), the U.S. Fish and Wildlife Service-Region 2, U.S. Environmental Protection Agency's Gulf of Mexico Program, Phillips Petroleum Foundation, the National Fish and Wildlife Foundation, and the Texas Natural Resource Conservation Commission (now the Texas Commission on Environmental Quality or TCEQ). The AAWP Program works in conjunction with other state programs such as the TCEQ's Texas Watch Program, and the TPWD's

Project Aquatic WILD Program, thus providing a network effect. In short, the program involves getting kids out of the classroom and into science.

The next year I utilized much of the material I learned from my first AAWP seminar with many students benefiting from this program. With the many changes taking place in education and with district restraints on field work, I decided it was time to go back to school. I was lucky enough to meet with Dr. Tunnell who agreed to be my advisor for my graduate studies at the new TAMUCC. Once again I dove into my studies; however, with my previous educational experience I not only learned more about the coast but because of my teaching background, I found that I had the ability to break down some of the complex processes taking place in the environment into a language that could be understood by non-scientist participants.

This skill was not overlooked by Dr. Tunnell, when in 1999 a position became available to direct the AAWP. Upon completion of my graduate degree, I took over the AAWP from Ron Smith, who had taken over from Nivra Kelly, but decided to continue his career with a job in the Inland Fisheries Division of TPWD. I also inherited Kim Keplar as an assistant. During the first few years we continued traveling all over Texas promoting wetland information through seminars and workshops. Kim's help was invaluable to the program. We spent many long hours preparing for workshops and hustling teachers around in the mud. During our downtime we were allowed to dream about how we could enhance the program and possibly reach more individuals with the "wetland word". Following funding and the need for more environmental education, we found ourselves presenting at local festivals with a giant "portable" wetland pond sponsored by the Coastal Bend Bays & Estuaries Program, Inc. This portable wetland contained over 600 gallons of water and up to 300 live plants and encouraged participants to "walk through the wetlands" while receiving an environmental message.

Aquatic Education Program

In 2003 because of the changing nature and expansion of the program, the AAWP program was renamed the Aquatic Education Program (AEP). This new designation opened the program to a more varied menu. One of the new programs offered by the new AEP was coastal kayaking and ecology. The kayak boom hit the Texas coast and many people were entering and exploring the water in the new small plastic boats. Being an avid kayaker myself, I realized what a great teaching platform kayaking could provide. I soon became acquainted with Dr. Jim Needham from TAMUCC University Outreach, and a great partnership was formed. Coastal kayaking and ecology is one of our most popular programs still today. Together we have introduced over 3,000 individuals of all ages to the wetland environment (Figure 1).

Figure 1. Coastal kayaking and ecology students in Redfish Bay, Texas.

R/V *Wetland Explorer*

Working with the kayaks soon gave me another idea involving on-the-water education. There are other opportunities for students to explore the deeper waters of the Texas coast but no way (besides via kayak) to explore the vast shallow waters of the Coastal Bend. I soon found myself looking into large shallow draft boats. The ideal boat would have to be able to effectively carry a classroom of students and still operate safely in less than two feet of water. I soon found a candidate for this mission in an old vessel that had been a small passenger ferry in a previous life on the Crystal River in Florida. Like all boats, it needed a tremendous amount of work. I am very thankful today that Dr. Tunnell did not just throw this idea in the trash when he saw the first pictures of the boat. Evidently he trusted me to continue, and with the help of Dr. Trent Hill's Office of Institutional Advancement, at TAMUCC, I soon had a partner in this project with the Ed Rachal Foundation. My previous years of boatyard work came into play during this portion of the project with days and months spent sanding, welding, grinding, and painting. Deep down I was overjoyed because I knew the impact this boat would make on my program and to coastal education. In June of 2004, the newly re-commissioned *Ed Rachal Wetland Explorer* was in the water. The R/V *Wetland Explorer* is a unique thirty-six foot aluminum shallow water research/education vessel. The vessel is able to float in ten inches of water, motor in less than two feet of water, and possesses a 1000 lb. winch and "A" frame assembly to pull trawls and various other scientific equipment. The *Explorer* has an eighty gallon tank and is powered by two 150 hp outboards. Fully loaded with twenty-five passengers, the vessel is able to cruise at twenty knots. The twelve foot beam of the *Explorer* provides ample room for scientific discovery. The roof of the vessel can also be utilized for kayaks that can provide additional opportunities for discovery. Based out of Rockport, Texas and transporting over 20,000 participants, this vessel has proven itself an effective tool for educating the public on our local bays and estuaries (Figure 2).

Figure 2. R/V *Wetland Explorer*: a) refurbishing; b) refurbished; c) in action; and d) helping with bay/island clean-up.

Wetlands on Wheels

With the *Explorer* now transporting middle school and high school students into our local marshes, I felt that our younger students were being left out. At one of my many talks, I met an older gentleman who said he was an amateur taxidermist and if I ever had any need for his skills to give him a call. My mind instantly began racing with potential ideas. I had been making classroom visits since I took over the job in 1999 and was always bringing in wetland "props" such as plants, mud, microscopes, small animals etc. I decided we needed to put all of these "props" together to tell a complete story on water as it makes its way down to the Gulf. Gary Patrick soon signed on as a slightly paid volunteer and began stuffing every bit of roadkill we could bring in (Figure 3). Students and friends were leaving specimens at my house and office for Gary to rebuild. In the meantime I presented my idea again to Dr. Tunnell and Dr. Trent Hill and soon I had a 20-foot enclosed trailer donated by Gus Cargile at Fabricators of Corpus Christi. Trent Hill also connected me with the Earl Samms Foundation, and they provided the money to outfit the trailer with an appropriate display, video monitors, and an accompanying generator.

Figure 3. Jay Tarkington (left) and Gary Patrick preparing a bird for the Wetlands on Wheels trailer exhibit.

In 2005 the concept for the Wetlands on Wheels became a reality. The trailer contains over 35 environment-specific preserved specimens to highlight the journey of the water. In addition, three video monitors provide live action to supplement the preserved specimens. Trained personnel are on hand to answer any questions that may arise. The Wetland on Wheels trailer has become a favorite at local festivals and helps raise awareness of the importance of water flow to the Gulf. Currently the trailer has seen over 15,000 individuals at festivals and over 7000 elementary students (Figure 4).

Figure 4. Wetlands on Wheels: a) Jay Tarkington with students at a local school and b) Jay with students inside trailer.

Estes Education and Research Station

During this time our *Wetland Explorer* boat program was going strong with support form the Saltwater Fisheries Enhancement program as well as the Coastal Bend Community Foundation. Our trips had been centered within the Estes Flats portion of Redfish Bay, Texas and included education on various birds, seagrass, benthic organisms, and coastal marshes. An island location for a permanent structure would certainly enhance the experience for the students as well as give us another platform for education (as well as get out of the rain, cold, or heat). I approached the Texas General Land Office about acquiring a lease to Talley Island for the purpose of my program. At the time there were two abandoned leases on the property that were in poor condition. For the lease I agreed to tear down and dispose of the older structures and build an environmentally friendly designed cabin in their place. Work began on this project in late 2005 and again the Ed Rachal Foundation assisted with funding for the building of a new cabin on the island. With many redesigns and extensive hard work, the new Estes Education and Research Station began to take form. All 2005-06 boat participants were "pressed" into volunteering to haul lumber up to the cabin site and along with a few volunteers and my family's help, the station was completed in late 2006. If the Texas General Land Office and the wild hogs on the island permit us, we are planning to expand the Estes Station and make it more handicapped accessible in the future. Building in a remote location is quite interesting and caused me many sleepless nights, but the experience of seeing kids chasing after fiddler crabs and collecting shells from the shore has been very rewarding (Figures 5 and 6).

Summary

Along with the kayak, boat, and wetland trailer programs, the Aquatic Education Program never passes up an opportunity to educate. We still offer several teacher training workshops, special topic seminars, and winter Texan/Elderhostel programs for the community. My Eco-Historic program is my favorite presentation to deliver and offers the venue through which I have the opportunity to delve into my other passion which is coastal history. These popular winter programs show the relationship between the area's colorful history and unique ecology.

I have truly found a home for myself at the Center for Coastal Studies where my passion for education and the outdoors is also my job (Figure 7). The Aquatic Education Program continues to evolve and upon completion of my Doctorate in Education in 2009, the program will certainly benefit with many new and diverse projects. I am very thankful to have the opportunity to work with all of the other dedicated individuals at the Center and will continue to strive to educate our coastal community on the unique ecology, history, and lifestyle of the Coastal Bend.

Figure 5. Estes Education and Research Station: a) Jay Tarkington hauling building supplies to Talley Island in Redfish Bay, Texas; b) erecting piers; c) hauling and building; d) walls going up; e) finished product; and f) in use.

Figure 6. Studying and collecting near the Estes Station: a) on Talley Island; b) in Redfish Bay, Texas; and, c) using a seine.

Figure 7. Jay Tarkington: a) building the Estes Education Station; and, b) trawling on the R/V *Wetland Explorer* in Redfish Bay, Texas.

9 Graduate Education

Wes Tunnell and Kim Withers

Graduate education has always been a cornerstone of Center for Coastal Studies (CCS) research. Researchers obtain extramural funding and MS students in Biology and Environmental Science are hired to do the research with the Principal Investigator (PI). The CCS provided the first Research Assistantships at Texas A&M University-Corpus Christi in the mid 1980's, and CCS PIs provided real-world research experiences for graduate students, primarily in the Texas Coastal Bend and often with state and federal agencies located on campus.

During the first 25 years of CCS research 99 graduate students have conducted research within CCS facilities or have been advised or co-advised by CCS researchers. These students and their thesis titles are listed with their advisor or co-advisor in Appendix II. Figure 1 shows the number of undergraduate and graduate students funded by CCS research grants and contracts.

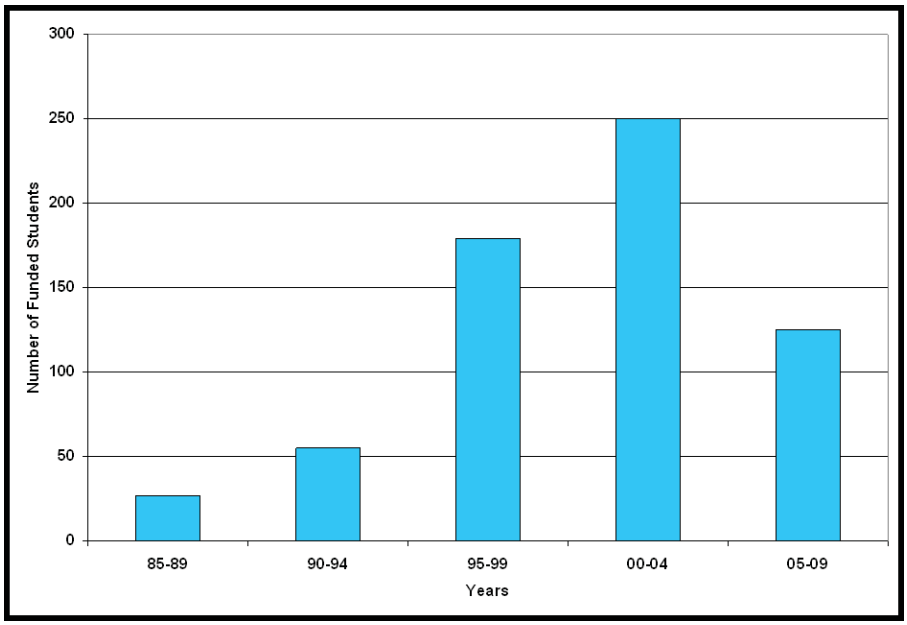


Figure 1. Graph of both undergraduate and graduate students funded via CCS during the past 25 years in 5-year increments.

10 Scholarships

Wes Tunnell and Kim Withers

The Center for Coastal Studies (CCS) has established seven scholarships for Texas A&M University-Corpus Christi students. Five of these are memorial scholarships, honoring former colleagues, students, or family members: David May Memorial Scholarship (1984), Dr. Millicent Quammen Memorial Scholarship (1993), Dr. Henry Hildebrand Memorial Scholarship (2003), Karen Koester Dodson Memorial Scholarship (2004), and Dr. Carl Beaver Memorial Scholarship (2008). Another one is set up in honor of the Suter family as the Hans and Patricia Suter Endowment (2002), and still another is established specifically to assist with the annual Coral Reef Ecology (CRE) class field experience, the Caribbean Connection (1997).

Generous contributions from families, friends, and colleagues have established these scholarships, and each is awarded on a competitive basis. Scholarship awards are based on high academic achievement, interest, and ability, as well as financial need.

Five of these scholarships are endowed (Quammen, Dodson, Hildebrand, Beaver, and Suter) and two of them expend funds contributed specifically for their purpose (May and Caribbean Connection). A CCS Scholarship Committee, chaired by Dr. Kim Withers, receives applicants and distributes funds annually. Full information and applications are found on the CCS website at http://ccs.tamucc.edu.

Below, each of these scholarships is listed in chronological order of establishment and characterized, and student recipients are listed with dates.

David May Marine Memorial Scholarship

The family of David May established this scholarship in 1984 in his memory with the express interest in promoting coral reef preservation. David learned to dive in Okinawa while serving in the Special Forces (the Rangers) in Viet Nam. He immediately became intrigued with reef systems, which evolved into his passion to preserve these fragile environments. Instead of creating an underwater warrior for battle they created a warrior for environmental protection. The Scholarship was created to provide financial assistance to students conducting coral reef education and research in the Gulf of Mexico and Caribbean Sea. It is the focus of this scholarship to provide resources that will assist in preventing destruction and degradation of reef systems. Several $100-$200 scholarships are given each spring to graduate or undergraduate students enrolled in BIOL 5632 CRE.

1987 Jerry Lawley
1987 Terri Nelson
1988 Bill Beau Hardegree
1988 Gary LaFleur
1990 Robin Greene Ford
1991 Paul Choucair
1991 Mike Thomas
1991 Carl Beaver
1991 Jim Tolan
1993 Christi Adams
1996 Merrilee Thorensen
1996 Tannika Engelhard
1998 Carolyn Gorman
1998 Devin Hayes
1998 Nancy Hilbun
1998 Scott Milroy
1999 Gloria Gonzales
1999 Dolly Dobson
2000 Jason Zeplin
2000 John Nuckols
2000 Catherine Childs
2003 Dana Burfeind
2003 Chanda Jones
2003 Kyle Klootwyk
2005 Ed Gorecki
2005 Brenda Catlin
2005 Ryan Fikes
2005 Jennifer Jenkins
2005 Anne Evans
2005 Georgia Stanford
2007 Heather Butler
2007 Ilaria Spiga
2007 Keith Johnson
2007 Misti Grohmann

Millicent Quammen Memorial Scholarship

The Millicent Quammen Memorial Scholarship Fund is an endowed scholarship fund established in 1993 in honor of Dr. Millicent L. Quammen by her family and friends. Dr. Quammen approached her scientific research with the highest professional standards, conducting ecological studies on the Pacific and Gulf coasts on shorebird utilization of intertidal mudflats, estuarine ecology, and wetlands mitigation. Her research in the Laguna Madre system focused on the roles of contaminants and nutrients in seagrass distribution. Dr. Quammen served as station Leader for the U.S. Geological Survey (USGS), Corpus Christi Field Research Sta-

tion, as well as contributed to the education community by establishing a Cooperative Agreement between USGS and Center for Coastal Studies and as an active member of the Strategic Planning Project for the Corpus Christi Independent School District. Her involvement in scientific professional societies, her community, her family, and all who worked for and with her exemplified her thorough and involved approach to life. The scholarship was established to assist graduate students studying in the field of marine, coastal, and environmental science. The funding is provided to assist students in attending scientific meetings, underwriting field trips, purchasing research equipment, or funding other opportunities that benefit the professional development of the student. One $500-$1,000 scholarship is given annually.

1994 Sandra Alvarado
1995 Terri Wood
1996 Carl Beaver
1997 Nicholas Ricono
1998 Kathryn Harvey
1999 Amy Koltermann
1999 Nancy Hilbun
2000 Matthew Campbell
2000 Sara Heilman
2000 Kathryn Harvey
2001 Katie Crysup
2001 Omar Guerra
2001 Erin Albert
2002 Jennifer Davidson
2002 Meris Sims
2003 Jennifer Pearce
2003 Amy Thurlkill
2004 Surida Nanez-James
2004 Katherine Miller
2004 Erin McCarthy
2005 Thomas Wauhob
2005 Anne Evans
2006 Matt Huebner
2006 Brooke Stanford
2007 Jenny Wrast
2008 Desiree Edwards
2008 Emily Williamson

Caribbean Connection

The Caribbean Connection, established in 1997 by Drs. Harley Moody and Wes Tunnell, is a scholarship that helps fund student study coral reef systems of the Gulf of Mexico and Caribbean Sea. The private and corporate sponsors that contribute to the Caribbean Connection understand the importance of field experienc-

es in Latin American countries that broaden scientific and cultural understanding. The Caribbean Connection fellowship provides funding to graduate and undergraduate students enrolled in BIOL 5632 CRE. Funds are raised annually from local and regional donors, distributed equally to the Coral Reef Ecology class and do not require an application. Photograph of Harley Moody by J.W. Tunnell Jr.

Class of 1997
Class of 1998
Class of 1999
Class of 2000
Class of 2001
Class of 2002
Class of 2003
Class of 2004
Class of 2005
Class of 2006
Class of 2007
Research Trip of 2008
Research Trip of 2009

Hans and Patricia Suter Endowment

The "Suter" name is synonymous with environmental advocacy and protection in the Texas Coastal Bend. The Suter family established this endowed scholarship in 2002 to honor the life and works of Dr. Hans Suter and his wife Patricia. Dr. Suter was a scientist, teacher, environmentalist, communicator, and leader. His book, *A Voice of Reason, Environmental Insights*, was a compilation of his articles for the Corpus Christi Caller-Times published over a 20-year period. Pat Suter, professor, scientist, environmental activist, and community leader has carried on Dr. Suter's successful role in environmental advocacy. Recipients of these scholarships receive funding for environmental research activities focused within the coastal zone of Texas. Several $500-$1,000 scholarships are given annually.

2004 Anne Evans
2004 Amanda Bushon
2004 Megan Reese
2005 Matt Huebner
2005 Crystal Ibanez
2005 Brooke Stanford
2005 Gabriel Ramirez
2006 Ryan Fikes
2006 Judy Metcalf
2006 Mollie McIver
2007 Matt Schweitzer
2008 Isis Dominguez
2008 Jason Slocum

Henry Hildebrand Endowed Scholarship

This scholarship was established in 2003 in honor of this famous marine scientist. Dr. Hildebrand pioneered scientific research along the Texas and Mexico coast, establishing baseline information that has been used as conservation and long-term monitoring benchmarks. In addition, Dr. Hildebrand was the founder of the marine science program at TAMUCC (then the University of Corpus Christi in 1957). The scholarship is used to underwrite graduate research in marine, coastal, and estuarine sciences. One $500-$1,000 scholarship is given annually.

2004 Amanda Bushon
2004 Megan Reese
2005 Ryan Fikes
2005 Brenda Catlin
2006 Matthew Schweitzer
2006 Brooke Stanford

Karen Koester Dodson Memorial Scholarship

The Karen Koester Dodson Memorial Scholarship was established in 2004 to honor Karen Dodson. Karen's love of life, family, friends, and the sea will be remembered annually through the distribution of this scholarship. The scholarship, established by her family and friends, will benefit graduate and undergraduate students on educational adventures to the coral reefs of Mexico. One $500-$1,000 scholarship is given annually to an undergraduate or graduate student enrolled in BIOL 5632, Coral Reef Ecology or to a graduate student doing thesis research on coral reefs.

2007 Jenny Wrast
2007 John Froeschke
2008 Misti Grohmann

Carl Beaver Memorial Scholarship

The Carl Beaver Memorial Scholarship is an endowed scholarship, established in 2008 in honor of Dr. Carl R. Beaver by his family, colleagues, and friends. Dr. Beaver received his BS and MS degrees at TAMUCC and his PhD at Texas A&M University. He worked as a research assistant in the Center for Coastal Studies during both his MS and PhD degrees. After graduation he worked as a research scientist in the coral reef monitoring program at the Florida Marine Research Institute. Carl's greatest love was teaching and researching on coral reefs, and he was a passionate advocate for conserving their future. One $500-1,000 scholarship is given annually for coral reef research.

None to date (will start in 2010)

11 Financial History

Wes Tunnell and Gail Sutton

The Center for Coastal Studies (CCS) was established with a $4000 grant from then University President B. Alan Sugg in 1984 and a vision to establish a coastal studies research center. During the first eight years (1984-92), CCS operated solely on soft money from grants and contacts. In 1992 the Texas Legislature, thanks to Representative Todd Hunter working with then University President Robert Furgason, awarded Special Item Funding to CCS. In 2000 and again in 2002 more funds were added to CCS operating budget as Special Item Funding.

Jeff Foster was hired in 1992 to be the first Business Coordinator or financial manager of CCS. In 1995 Jeff accepted a fulltime job with the new Corpus Christi Bay National Estuary Program, and Dawn Bennett was hired as the first full time Business Coordinator for CCS. When Dawn moved to Rockport, Texas in (2000) Gail Sutton became the next Business Coordinator in 2001. Because of Gail's broad experience in the private sector in administration, she later became CCS Assistant Director of Financial Operations. Subsequently, she began assisting (half-time) with the new Harte Research Institute (HRI) financial and administrative duties, until 2008 when she went fulltime with HRI. Brien A. Nicolau temporarily took over financial operations during 2008-09, until the new CCS director arrived in August 2009.

Extramural funding sources for CCS include state and federal agencies, private and non-profit entities, and local government (Figures 1 and Figure 2).

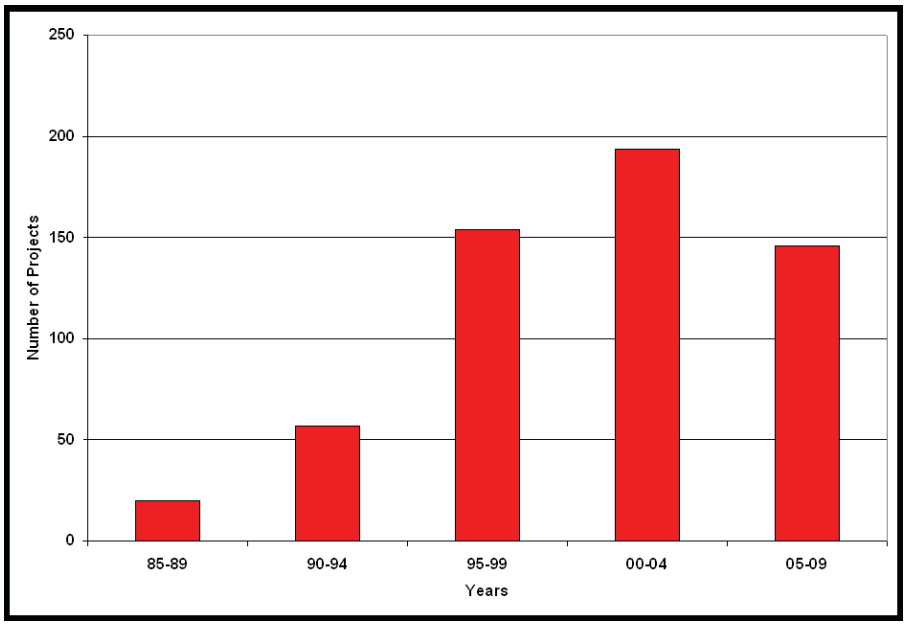


Figure 1. Number of Center for Coastal Studies grant and contract projects in five-year increments for the first 25 years (1984-2009).

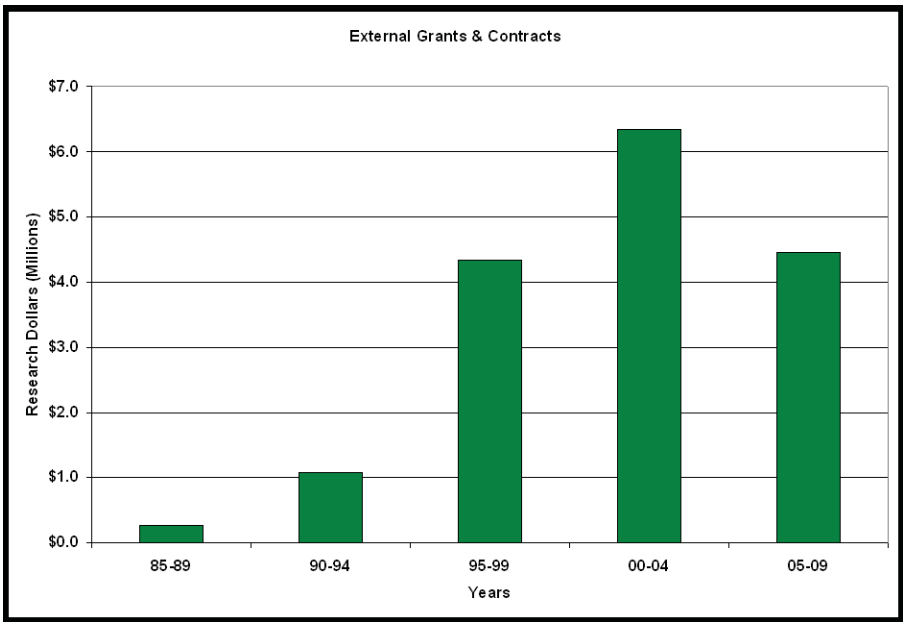


Figure 2. Extramural research grant and contract funding for the Center for Coastal Studies in five-year increments during the first 25 years (1984-2009).

12 Publications

Wes Tunnell and Kim Withers

The Center for Coastal Studies (CCS) has always maintained a list of Publications and Technical Reports. Since publication and dissemination of information is the final step in research, it is critically important as a public institution that we make our results and new knowledge or findings available. Appendix III is the Publications List of CSS from 1988 to the present, and it represents publications in peer-reviewed journals, proceedings, and books (Figure 1). Appendix IV is the Technical Reports list of CCS from 1987 to the present, and it represents all CCS technical reports that are the final product of selected grant or contract projects (Figure 2). All CCS Publications and Technical Reports were maintained at CCS for distribution upon request. Publications, or reprints of articles, were available for free and Technical Reports were available for a nominal fee, generally the cost of printing and binding. In the early 2000s CCS began providing Technical Reports as PDFs, and in 2009 we began converting all Technical Reports to PDFs upon request.

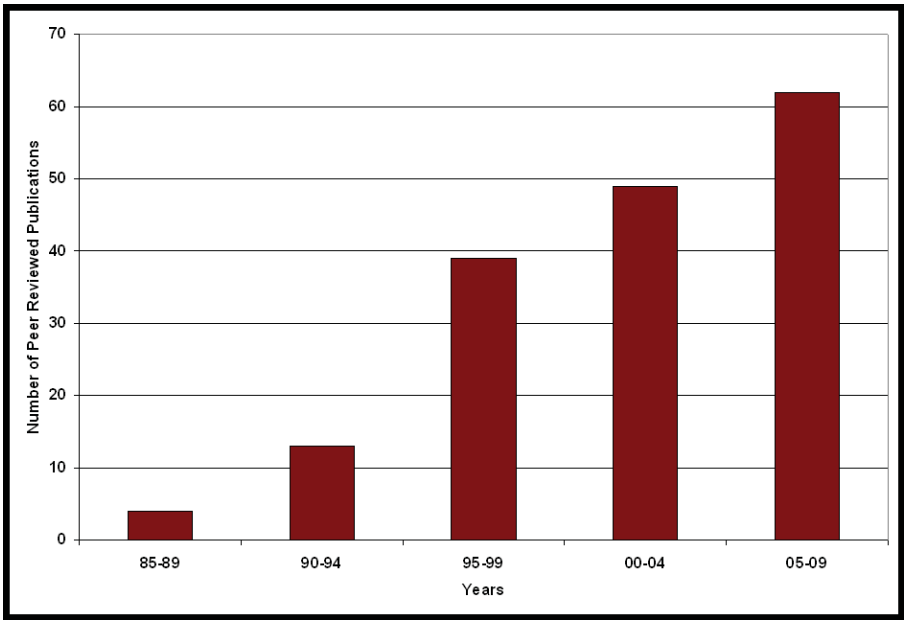


Figure 1. Number of peer reviewed publications from the Center for Coastal Studies in five-year increments during the first 25 years (1984-2009).

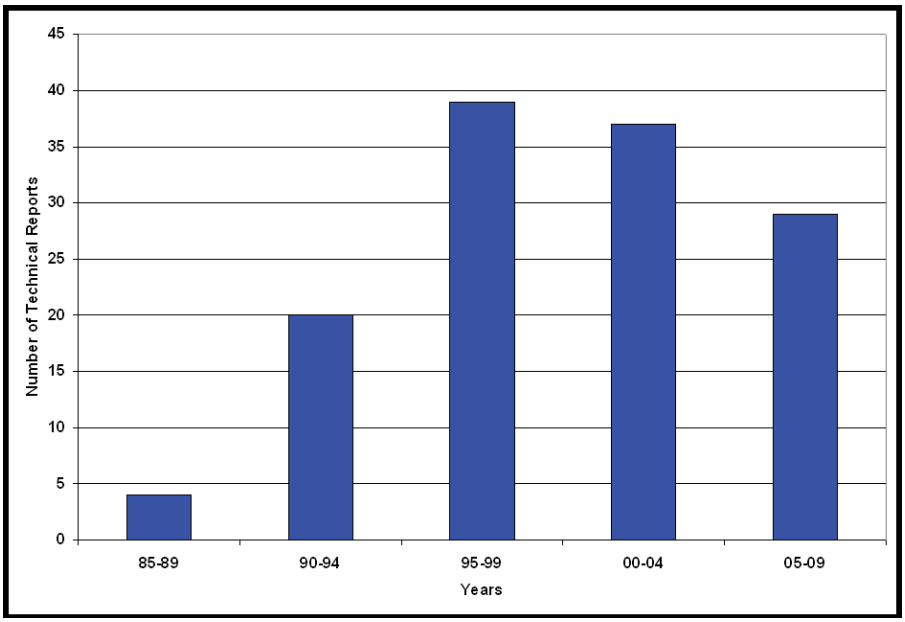


Figure 2. Number of research project technical reports from the Center for Coastal Studies in five-year increments during the first 25 years (1984-2009).

Epilogue

Wes Tunnell

As a young "bucket biologist" (name given to marine biologists who study the shoreline with few resources, other than a bucket), I never envisioned the opportunities, experiences, and developments that would occur at our island university when I started my career here in 1974. The creation of the Center for Coastal Studies (CCS) in 1984 without funding simply provided a mechanism or entity for several faculty to conduct research. In 1992 when the Texas Legislature awarded State funding for CCS and a new facility, the Natural Resources Center, a second phase of highly productive and successful research ensued, primarily with state and federal agencies on campus, using research to answer their management questions or issues.

The endowment of the Harte Research Institute (HRI) for Gulf of Mexico Studies, funding for a state-of-the-art HRI facility, and development of one, and then two, PhD programs ushered in a third phase of CCS history. This third phase began with my involvement in 2001 assisting in developing HRI and the focus on Gulfwide science and PhD level education, which required more publication effort in peer-reviewed journals. A comparison of Figures 1 and 2 in Chapter 12 indicates the success of CCS staff in rising to this new challenge, an increase in publications over the past five years, and a decrease in technical reports respectively.

The challenge for the new CCS Director and staff will be to seek and find a balance of these three phases: 1) hands-on, field oriented coastal science with graduate students; 2) practical, applied coastal science for state and federal agencies; and, 3) excellent research engaging PhD students and publishing in national and international journals.

Being Director of CCS for its first 25 years, and, in particular, working with its amazing and dedicated staff and students, has been one of the most rewarding components and highlights of my career. Thanks to all and best wishes for continued success!

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Hicks, D.W. and J.W. Tunnell, Jr. 1995. Ecological notes and patterns of dispersal in the recently introduced mussel, *Perna perna* (Linne, 1758), in the Gulf of Mexico. *American Malacological Bulletin* 11(2): 203-206.

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Hicks, D.W. and R.F. McMahon. 2003. Temperature and relative humidity effects on water loss and emersion tolerance of *Perna perna* (L.) (Bilvalvia: Mytilidae) from the Gulf of Mexico. *Bulletin of Marine Science*. 72: 135-150.

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Kelley, N. 1991. Wetland enhancement restoration and creation under the North American Waterfowl Management Plan: mid to lower Texas Gulf Coast 1991 status report. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-9101-CCS. Corpus Christi, Texas, USA. 40 pp.

Kelley, N. 1992. Adopt-A-Wetland Program and associated projects 1992 status report under the North American Waterfowl Management Plan. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-9202-CCS. Corpus Christi, Texas, USA. 30 pp.

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Lang, J., P. Alcolado, J.P. Carricart-Ganivet, M. Chiappone, A. Curran, P. Dustan, G. Gaudian, F. Geraldes, S. Gittings, R. Smith, J.W. Tunnell, Jr., and J. Wiener. 1998. Status of coral reefs in the northern areas of the wider Caribbean, pp. 123-134. *In* Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Townsville, Australia.

Lee, M.C. and L.L. Price-May. 1993. Historical trends in fish-eating waterbirds in a mercury-contaminated bay, Calhoun County, Texas. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-9201-CCS. Corpus Christi, Texas, USA. 48 pp.

Nicolau, B.A. and J.S. Adams. 1993. Estuarine faunal use in a mitigation project, Nueces River Delta, Texas: years two and three. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-9203-CCS. Corpus Christi, Texas, USA. 114 pp.

Ruth, B.F. 1990. Establishment of estuarine faunal use in a salt marsh creation project, Nueces River Delta, Texas. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-9001-CCS. Corpus Christi, Texas, USA. 52 pp.

Tunnell, J.W., Jr. and B.R. Chapman. 1988. First record of Red-footed Boobies nesting in the Gulf of Mexico. *American Birds* 42(3): 380-381.

Tunnell, J.W., Jr. 1988. Regional comparison of southwestern Gulf of Mexico to Caribbean Sea coral reefs, pp. 303-308. *In* J.H. Choat et al. (eds.), Proceedings of the 6th International Coral Reef Symposium. Vol. 3, Townsville, Australia.

Tunnell, J.W., Jr. 1992. Natural versus human impacts to southern Gulf of Mexico coral reef resources, pp. 300-305. *In* R. H. Richmond (ed.), Proceedings of the 7th International Coral Reef Symposium. Vol. 1. Guam.

Tunnell, J.W., Jr., A. Rodriguez, R. Lehman, and C. Beaver. 1993. An ecological characterization of the southern Quintana Roo coral reef system. Texas A&M University-Corpus Christi, Center for Coastal Studies Technical Report No. TAMUCC-9307-CCS. Corpus Christi, Texas, USA. 161 pp.

Tunnell, J.W., Jr., D.W. Hicks, and B. Hardegree. 1994. Environmental impact and recovery of the Exxon Pipeline oil spill and burn site, upper Copano Bay, Texas: year one. Texas A&M University-Corpus Christi, Center for Coastal Studies Technical Report No. TAMUCC-9402-CCS. Corpus Christi, Texas, USA. 75 pp.

Tunnell, J.W., Jr., B. Hardegree, and D.W. Hicks. 1995. Environmental impact and recovery of a high marsh pipeline oil spill and burn site, upper Copano Bay, Texas, pp. 133-138. *In* J.D. Ludwigson (ed.), Proceedings of the 1995 International Oil Spill Conference. 27 Feb.-2 Mar., 1995. Long Beach, California, USA.

Tunnell, J.W., Jr., B. Hardegree, K. Withers, and D.W. Hicks. 1995. Environmental impact and recovery of the Exxon Pipeline oil spill and burn site, upper Copano Bay, Texas: year two. Texas A&M University-Corpus Christi, Center for Coastal Studies Technical Report No. TAMUCC-9501-CCS. Corpus Christi, Texas, USA. 42 pp.

Tunnell, J.W., Jr. 1996. The Gulf of Mexico: Gulf resources, pp. 59-67. *In* Proceedings of the Annual Meeting of the Philosophy Society of Texas. Corpus Christi, Texas, USA.

Tunnell, J.W., Jr., Q.R. Dokken, E.H. Smith, and K. Withers (eds.). 1996. Current Status and Historical Trends of the Estuarine Living Resources within the Corpus Christi Bay National Estuary Program Study Area. Texas Natural Resource Conservation Commission Corpus Christi Bay National Estuary Program No. CCBNEP-06A, B, C, & D (4 vols.). Austin, Texas, USA. 1436 pp.

Tunnell, J.W., Jr., K. Withers, and B. Hardegree. 1997. Environmental impact and recovery of the Exxon Pipeline oil spill and burn site, upper Copano Bay Texas: final Report. Texas A&M University-Corpus Christi, Center for Coastal Studies Technical Report No. TAMUCC-9703-CCS. Corpus Christi, Texas, USA. 81 pp.

Tunnell, J.W., Jr. and B.R. Chapman. 2001. Seabirds of the Campeche Bank Islands, Southeastern Gulf of Mexico. *Atoll Research Bulletin* 482: 1-50.

Tunnell, J.W., Jr. and F. Judd. 2002. *The Laguna Madre of Texas and Tamaulipas.* Texas A&M University Press. College Station, Texas, USA. 346 pp.

Tunnell, J.W. Jr., E.A. Chávez, and K. Withers. 2007. *Coral Reefs of the Southern Gulf of Mexico.* Texas A&M University Press. College Station, Texas, USA. 256 pp.

Vega, M.E. 1989. Point source discharges in south Texas. Corpus Christi State University, Center for Coastal Studies Technical Report No. CCSU-0689-CCS. Corpus Christi, Texas, USA. 26 pp.

Appendix I

Original Tenants in Natural Resource Center at Move-in Date, June 1996

State of Texas

Corpus Christi Bay National Estuary Program
General Services Commission
Texas Department of Health, Seafood Safety, Division
Texas General Land Office, Oil Spill Prevention and Response
Texas General Land Office, Field Operations
Texas National Resource Conservation Commission
Texas Parks and Wildlife, Coastal Fisheries Division
Texas Parks and Wildlife, Resource Protection

Texas A&M University-Corpus Christi

Center for Coastal Studies
Center for Water Supply Studies
Conrad Blucher Institute GSI, Geomatics and Mapping
Conrad Blucher Institute Texas Coastal Oceanic Observation Network
National Spill Control School
University Outreach Program

Texas A&M University System

South Texas Regional Service Center
System Internal Audit Department
Sea Grant College Program
Texas Engineering Experiment Station (TEES)
Texas Engineering Extension Service (TEEX)

Appendix II

Chronological List of Center for Coastal Studies Graduate Students, Thesis Projects, and Advisors (1985-2009)

Biology MS Degree Program

1985

Mitchell, Christine, A. Effects of atrazine on *Halodule wrightii* Ascherson in the laboratory. (John W. Tunnell, Jr., PhD)

Vega, Robert A. The seasonal abundance, zonation, and migratory behavior of *Donax* (Donacidae: Bivalvia) on Mustang and Padre Island, Texas. (John W. Tunnell, Jr., PhD)

1987

Ordner, Michael T. The importance of the benthic infaunal community as secondary producers in South Texas shrimp ponds. (John W. Tunnell, Jr., PhD)

1988

Cobb, Robyn A. Species composition and distribution patterns of South Texas kangaroo rat ectoparasites. (Brian R. Chapman, PhD)

Vega, Mary E. The seasonal abundance and zonation of intertidal and subtidal infaunal macroinvertebrates on two Texas barrier island sandy beaches. (John W. Tunnell, Jr., PhD)

1989

Drumright, Albert O. Seasonal variation in diversity of faunal associates of two oyster reefs within a South Texas estuarine complex. (John W. Tunnell, Jr., PhD)

Gourley, John E. Mid-day and diurnal habitat discrimination by neckton between adjacent *Thalassia testudinum* and *Halodule wrightii* seagrass meadows. (Connie R. Arnold, PhD & John W. Tunnell, Jr., PhD)

1990

Ruth, Barbara F. Establishment of estuarine faunal use in a salt marsh creation project, Nueces River Delta, Texas. (John W. Tunnell, Jr., PhD)

1991

Nelson, Teri J. A quantative comparison of the community structure of two forereefs in the southwestern Gulf of Mexico. (John W. Tunnell, Jr., PhD)

1992

Choucair, Paul C. A quantative survey of the ichthyofauna of Arrecife de Enmedio, Veracruz, Mexico. (David A. McKee, PhD & John W. Tunnell, Jr., PhD)

Porter, Catherine W. Comparison of predation effects and benthic prey availability in Lavaca River delta marsh and a Lavaca Bay salt marsh. (John W. Tunnell, Jr., PhD & Roger J. Zimmerman, PhD)

1993

Adams, John S. A mitigation project in the Nueces River Delta, Texas: Second year comparison of mitigation and natural sites. (John W. Tunnell, Jr., PhD)

Beaver, Carl R. Quantitative survey of stony corals (Cnidaria: Scleractinia) of a Mexican coral reef system: Southern Quintana Roo, Yucatan Peninsula, Mexico. (John W. Tunnell, Jr., PhD)

Hicks, David W. Effects of the December 1989 freeze on seagrasses and associated bivalve Mollusca in Laguna Madre. (Christopher P. Onuf, PhD & John W. Tunnell, Jr., PhD)

1994

Adams, Christi L. Vertical zonation and abundance of sponges on an outer continental shelf gas production platform, northwestern Gulf of Mexico. (John W. Tunnell, Jr., PhD)

Martin, Christopher. Corpus Christi Bay and Quinta channel: a comparison of benthic diversity. (Paul A. Montagna PhD & John W. Tunnell, Jr. PhD.)

1995

Lee, M. Clare. Interhabitat movements of shorebirds on Mustang Island, Texas. (Allan H. Chaney, PhD & John W. Tunnell, Jr., PhD)

Rocha, Dennis D. The seasonal distribution and zonation of sandy beach infaunal macroinvertebrates at Padre Island National Seashore, Texas. (John W. Tunnell, Jr., PhD)

1996

Alvarado, Sandra A. Mollusca of southwestern Gulf of Mexico rocky shores, Veracruz, Mexico. (John W. Tunnell, Jr., PhD)

Hooten, Russell L. The development and application of a marine sediment porewater toxicity test using *Ulva fasciata* and *U. lactuca* zoospores. (Duane C. Chapman & John W. Tunnell, Jr., PhD)

Smith, Ronald. Temporal variation in intertidal macro-invertebrate assemblages associated with the invasive Mussel, *Perna perna* (Linnaeus, 1758), on a South Texas jetty. (John W. Tunnell, Jr., PhD)

1997

Cox, Susan A. Quantitative assessment of macrobenthic and macronektonic populations in a coastal marsh: Mad Island Wildlife Management area, Matagorda County, Texas. (Elizabeth H. Smith, PhD & John W. Tunnell, Jr., PhD)

Dilworth, Suzanne J. Ecological evaluation of an open and semi-impounded marsh system in the Brazoria National Wildlife Refuge, Texas. (Elizabeth H. Smith, PhD & Quenton R. Dokken, PhD)

1998

Engelhard, Tannika. Biological effects of mechanical beach raking in the upper intertidal zone on Padre Island National Seashore, Texas. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Vitale, Lisa D. Fish community associated with a partial removal of an offshore platform. Non-thesis Professional Paper. (Quenton R. Dokken, PhD & John W. Tunnell, Jr., PhD)

Wood, Terri. Ecological characterization and bioremediation experiments in Parker's Cove following the San Jacinto River oil spill. (Roy L. Lehman, PhD)

1999

Keeney, Talitha S. Coral reef macroalgae in northern Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (Roy L. Lehman, PhD)

Milroy, Scott P. Effects of light availability on reef community structure of hermatypic corals within Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (John W. Tunnell, Jr., PhD)

Ricono, Nicholas. Seasonal water quality study of riverine and coastal waters effecting the coral reefs of Veracruz, Mexico. (John W. Tunnell, Jr., PhD)

Sohn, Lucinda N. Predator and prey relationship between *Perna perna* (Linnaeus, 1758) and *Stramonita* (=*Thais*) *haemastoma* (Linnaeus, 1867). (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

2000

Carrillo, Teresa Barrera. Historic vegetation changes in the Blind Oso (Oso Bay), Texas: avian abundance and habitat use of the resulting wetland mosaic. (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

Gorman, Carolyn. Evaluation of long-term habitat and colonial waterbird dynamics to develop future management strategies for Shamrock Island, Nueces County, Texas. (David A. McKee, PhD & Elizabeth Smith, PhD)

Hilbun, Nancy L. Distribution and abundance of echinoderms from Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (John W. Tunnell, Jr., PhD)

Hyde, Larry J. The systematics, distribution, and ecology of the mollusks of Stetson Bank, northwestern Gulf of Mexico. (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

Koltermann, Amy E. Ecological characterization of northwestern Caribbean Ironshores, Quintana Roo, Mexico. (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

2001

Barrera, Noe C. Micromolluscan assemblages on the Flower Garden Banks, northwestern Gulf of Mexico. (John W. Tunnell, Jr., PhD & David A. McKee, PhD)

Campbell, Matthew D. A dry season analysis of larval and juvenile fish assemblages of the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

Tunnell, Kathryn. Epibiont flora and fauna associated with proproots of two *Rhizophora mangle* forests, Veracruz and Quintana Roo, Mexico. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Tunnell, Jace W. Abundance and community structure of juvenile fish using *Halodule beaudettei*, *Cymodocea filiformis* and unvegetated substrates in the upper Laguna Madre. (Kim Withers, PhD & David A. McKee, PhD)

2002

Davidson, Jennifer. Effects of propeller scarring on molluscan community structure in seagrass meadows. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Keplar, Kimberly. Non-thesis, Professional Paper. (John W. Tunnell, Jr., PhD)

Rigaud, Christopher. Effects of sea urchin exclusion experiments on the fouling community of an offshore petroleum platform, northwestern Gulf of Mexico. (Quenton R. Dokken, PhD & John W. Tunnell, Jr., PhD)

Tarkington, Wilson J. Shallow water discoveries: A kayaking guide to Aransas County. Non-thesis, Professional Paper. (John W. Tunnell, Jr., PhD)

2003

Bates, Thomas W. Locomotor behavior and habitat selection in intertidal gastropods from varying shore heights. (David W. Hicks, PhD & John W. Tunnell, Jr., PhD)

Dobson, Dolly R. Geographic variation in the song repertoires of the white eyed vireo (*Vireo griseus*). (Robert H. Benson, PhD & John W. Tunnell, Jr., PhD)

Gibbons, Richard. Abundance and habitat preferences of wintering waterbirds in Redfish Bay. Non-thesis, Professional Paper. (Kim Withers, PhD)

Ledford, Christopher, E. Comparison of coral species diversity and abundance between patch reefs and shallow reefs of the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (John W. Tunnell, Jr., PhD)

Newstead, David J. Larval fish recruitment to isolated nursery grounds in Nueces Bay, Texas. (David A. McKee, PhD & James M. Tolan, PhD)

Pearce, Jennifer J. Benthic community relationship to seagrass cover, Upper Laguna Madre and Baffin Bay, Texas. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Simms, Elizabeth "Meris". A geomorphic survey and ecological assessment of selected rookery islands, Laguna Madre, Texas. (Elizabeth H. Smith, PhD & John W. Tunnell, Jr., PhD)

Van Sant, Scott B. Community structure, abundance and biomass of fishes on a Caribbean coral reef, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico: An analysis by depth zone and habitat. (John W. Tunnell, Jr., PhD)

2004

Brayfield, Maria. Temperature and salinity effects on byssogenesis in two non-indigenous marine of the genus *Perna* from the Gulf of Mexico. (David W. Hicks, PhD & John W. Tunnell, Jr., PhD)

Harding, Maren. Effects of hydrology and prey density on shore bird distribution in the Blind Oso, Oso Bay, Corpus Christi, Texas. (Kim Withers, PhD & David A. Mckee, PhD)

Hayes, Roger B. Evaluation of a created *Spartina alterniflora* marsh at Shamrock Island, Corpus Christi Bay, Texas. (Elizabeth H. Smith, PhD & John W. Tunnell, Jr., PhD)

Reed, Addie L. Implementation of a long-term coral reef monitoring plan, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Rowell-Garvon, Shannon. An assessment of shorebird and wading bird habitat use in an urban coastal mosaic, Indian Point and Sunset Lake parks, Texas. (Kim Withers, PhD)

Thurlkill, Amy. Effects of nutrients on seagrasses in Upper Laguna Madre, Texas. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

2005

Landgraf, Jeffrey. Relationship of larval and juvenile fish abundance, community structure, and growth rates in Laguna Madre, Texas to distance from Gulf passes. (Kim Withers, PhD)

Smith, Leslie. Effects of hydrology and urbanization on shorebirds of the Ella Barnes Wetland, Oso Bay, Corpus Christi, Texas. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

Zeplin, Jason. Effects of prop scarring on the distribution and abundance of juvenile fish and invertebrates in *Thalassia testudinum* beds in Redfish Bay, Texas. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

2007

Cyr, Heidi. Wading bird (Ciconiiformes) ecology at Indian Point and Sunset Lake parks, Nueces County, Texas: Abundance, habitat use, and behavior. (Kim Withers, PhD & David A. McKee, PhD)

Hubner, Matt. Recruitment by bay scallops (*Argopecten irradians*) and other byssate bivalves in the upper Laguna Madre, Texas. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Landaberde, Kristie. Reproductive success of Black Skimmers (*Rynchops niger*) on a dredge-material island in Nueces Bay, Texas. (Kim Withers, PhD)

Metcalf, Judy. Community composition and behavior of shorebirds on South Texas Gulf coast beaches: A comparison of driving and non-driving sites. (Kim Withers, PhD)

Rossi, Rosalie R. Hydrological effects on abundance and distribution of shorebirds and wading birds on the south Ward Island intertidal flat, Oso Bay, Texas. (Elizabeth Smith, PhD & Graham Hickman, PhD)

Young, Lauren P. Applications of GIS methods for environmental learning in South Texas. Non-thesis, Professional Paper. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

2008

Butler, Heather. Coral monitoring at Sian Ka'an, 2006 and 2007. Non-thesis Professional Paper. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

Jones, Jason. Spatial and temporal evaluation of near-shore and offshore coral reefs within the Veracruz Reef System, southwestern Gulf of Mexico. (John W. Tunnell, Jr., PhD & Kim Withers, PhD)

McIver, Mollie. Growth and recruitment of black mangrove (*Avicennia germinans*) along the South Texas coast and the composition of its associated plant community. (Kim Withers, PhD)

Schweitzer, D. Matthew. Distribution of adult blue crabs *Callinectes sapidus* along a salinity gradient in a South Texas estuary. (Kim Withers, PhD)

Environmental Science MS Degree Program

1997

Darnell, Tracy M. 1997. The influence of landscape features on bird use of marsh habitat created for whooping cranes (*Grus americana*) through beneficial use of dredged material. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

Hubner, Charles M. Evaluation of nitrogen isotopes in ground water on padre island. Non-thesis, Professional Paper. (John W. Tunnell, Jr., PhD)

1999

Nicolau, Brien A. Estuarine faunal use in a mitigation project, Nueces River Delta, Texas: Years three and four. (John W. Tunnell, Jr., PhD)

2000

Childs, Catherine. Development of a natural resource conservation for Punta Allen Peninsula, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

Heilman, Sara. Fecal coliforms, enterococci, *E.Coli,* and total coliforms As indicators of water quality in Oso Bay, Corpus Christi, Texas. (Joanna Mott, PhD)

Jenkins, Kay V. Spatial and temporal dynamics of the natural vegetation communities of Mustang Island, Texas. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

Sahadi, Chemaine. Evaluation of mitigation projects from 1986-1999 along the Texas Coastal Bend. Non-thesis Professional Paper. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

2001

Albert, Erin M. Benthic community response to bioremediation experiments on the San Jacinto River, Houston, Texas. (Roy L. Lehman, PhD)

Hardaway, Holly. Characterization of benthic macrovertabrate communities in the Texas coastal bend in relation to salinity. (Roy L. Lehman, PhD)

Longfield, Amy J. Spatial and temporal evaluation of riparian habitat dynamics along a coastal river in Texas. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

McCullough, Leah C. Distribution of seagrass meadows and wintering redheads in eastern Nueces Bay, Texas. (Graham Hickman, PhD & Marc Woodin, PhD)

White, Tammy. Snowy Plover breeding at Sunset Lake. Non-thesis, Professional Paper. (Kim Withers, PhD & Janice Freeman, PhD)

2002

Childs, Catherine. Development of a Natural Resource Conservation Plan for Punta Allen Peninsula, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico. (Elizabeth Smith, PhD & John W. Tunnell, Jr., PhD)

Dorn, Mary. A historical assessment and inventory of habitat and avifauna dynamics on Sundown Island, Matagorda County, Texas. (Elizabeth Smith, PhD & Kit Price-Blount, PhD)

2003

Halbrook, Kimberly A. Population estimate of Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) in Nueces estuary and assessment of nesting habitat suitability. (Kim Withers, PhD & John W. Tunnell, Jr., PhD)

2004

Mahala, Michael. Composition and habitat use of natural and mitigated seagrass beds in the Upper Laguna Madre, Texas. (Greg Stunz, PhD & Elizabeth Smith, PhD)

Moore, Stephen. Avian density as an indicator of avian habitat preference for Egery Flats, Aransas, County, Texas. (Elizabeth Smith, PhD & Jennifer Smith-Engle, PhD)

Nuñez, Alex. A characterization of the benthic macroinvertebrate communities in the Mission-Aransas and Nueces Estuaries.(John W. Tunnell, Jr., PhD & Kim Withers, PhD)

2005

Kolar, Michelle. Nesting success and ecology of the Snowy Plover (*Charadrius alexandrinus*) at two localities in the Texas Coastal Bend. (Kim Withers, PhD)

McCann, Daphne M. Comparison of butterfly communities within a riparian corridor isolation gradient along the Lower Rio Grande, USA. (Elizabeth Smith, PhD & Robert Benson, PhD)

2006

Evans, Anne. Toxicity assessment of hydrophobic organic conaminants to marine organisms. (Marion Nipper, PhD & John W. Tunnell Jr., PhD)

Haralson, Gary. Random vs repetitive photo quadrat comparison at a long-term coral reef monitoring site, Sian Ka'an Biosphere Reserve, Quintana Roo, Mexcico. (John W. Tunnell, Jr., PhD)

Nelson, Rachael W. Parental dietary effect on embryological development response to toxicants with the sea urchin *Arbacia punctulata.* Non-thesis, Professional Paper. (Marion Nipper, PhD & David Jensen)

Vick, Kara D. An ecological assessment of modified wetlands within a ranch landscape using the breeding ecology of anurans in the Texas Coastal Bend. (Elizabeth Smith, PhD & Robert Benson, PhD)

Wauhob, Thomas. Seasonal variation inm the toxicity of sediment-associated contaminants in Corpus Christi Bay, Texas. (Marion Nipper, PhD & Eugene Billiot, PhD)

2007

Beyer-Shannon, Tami. Digital surface models of the South Texas Pleistocene shoreline. (Elizabeth Smith, PhD & Jennifer Smith-Engle, PhD)

2008

Staggs, Jacqueline. Laguna Madre: A characterization of trophic status and community structure. (Kim Withers, PhD)

2009

Edwards, Desireé K. Palustrine wetland change accountability on Live Oak Peninsula, a barrier strandplain in the Texas Coastal Bend. Non-thesis, Professional Paper. (Elizabeth Smith, PhD)

Computer Science MS Degree Program

2005

Tomar, Ashwani. Mapping and monitoring of Live Oak Peninsula area. Non-thesis, Professional Paper. (Dulal Kar, PhD)

Appendix III

Center for Coastal Studies Publications (published works in journals, proceedings, and books, from 1988–2009)

1. Nelson, T.J., T.L. Stinnett, and J.W. Tunnell, Jr. 1988. Quantitative assessment of an unusually dense octocoral community in the southwestern Gulf of Mexico, pp. 791–796. *In* J.H. Choat et al. (eds.), Proceedings of the 6th International Coral Reef Symposium. Vol. 2, Townsville, Australia.

2. Tunnell, J.W., Jr. and B.R. Chapman. 1988. First record of Red-footed Boobies nesting in the Gulf of Mexico. *American Birds* 42(3): 380–381.

3. Tunnell, J.W., Jr. 1988. Regional comparison of southwestern Gulf of Mexico to Caribbean Sea coral reefs, pp. 303–308. *In* J.H. Choat et al. (eds.), Proceedings of the 6th International Coral Reef Symposium. Vol. 3, Townsville, Australia.

4. Tunnell, J.W., Jr. and T.J. Nelson. 1989. A high density-low diversity octocoral community in the southwestern Gulf of Mexico, pp. 325–335. *In* M.A. Lang and W.C. Jaap (eds.), Proceedings "Diving for Science", American Association of Underwater Scientists. Woods Hole, Massachusetts, USA.

5. Ordner, M.T., A.L. Lawrence, and J.W. Tunnell, Jr. 1990. Macrobenthos in earthen shrimp ponds in southern Texas. *Texas Journal of Science.* 42(3): 273–282.

6. Barrera, T.A., D. Waechter, G. Jeffress, and J.W. Tunnell, Jr. 1992. A temporal salt marsh vegetation study: implementation of a GIS, pp. 251–260. *In* D.M. Freund (ed.), Proceedings of the Urban and Regional Information Systems Association 1992. Washington D.C., USA.

7. Lehman, R.L. and J.W. Tunnell, Jr. 1992. Species composition and ecology of the macroalgae of Enmedio Reef, Veracruz, Mexico. *Texas Journal of Science* 44(4): 445–457.

8. Tunnell, J.W., Jr. 1992. Natural versus human impacts to southern Gulf of Mexico coral reef resources, pp. 300–305. *In* R. H. Richmond (ed.), Proceedings of the 7th International Coral Reef Symposium. Vol. 1. Guam.

9. Chávez, E.A. and J.W. Tunnell, Jr. 1993. Needs for management and conservation of the southern Gulf of Mexico, pp. 2040–2053. *In* O.T. Magoon et al. (eds.), Proceedings Coastal Zone '93. Vol. 2, New Orleans, Louisiana, USA.

10. Dokken, Q. 1993. Flower Gardens Ocean Research Project: using offshore platforms as research stations. *Marine Technology Society Journal* 27(2): 45–50.

11. Hicks, D.W. and J.W. Tunnell, Jr. 1993. Invasion of the South Texas coast by the edible brown mussel *Perna perna* (Linnaeus, 1758). *The Veliger* 36(1): 92–94.

12. Ruth, B.F., J.W. Tunnell, Jr., and T.E. Grahl. 1993. Salt marsh creation in the Nueces River Delta, Texas: establishment of estuarine faunal use, pp. 853–866. *In* W.M. Wise (ed.), Proceedings of the 12th International Conference of the Coastal Society. 21–24 October, 1990. San Antonio, Texas, USA.

13. Vasquez, F.G., L.G. Aguilera, and V.K. Sharma. 1993. Trace and heavy metals in San Andres Lagoon, Tamaulipas, Mexico. *Environment International* 19: 71–77.

14. Vasquez, F.G., G.M. Sanchez, and V.K. Sharma. 1993. Trace metals in the oyster *Crassostrea virginica* of the Terminos Lagoon, Campeche, Mexico. *Marine Pollution Bulletin* 26(7): 398–399.

15. Watson, R.L., J.W. Tunnell, Jr., W.N. Lothrop, and S.H. Ratliff. 1993. Shoreline determination along gently sloping shores: A multidisciplinary approach, pp. 755–764. *In* W.M. Wise (ed.), Proceedings of the 12th International Conference of The Coastal Society. 21–24 October, 1990. San Antonio, Texas, USA.

16. Withers, K. and B.R. Chapman. 1993. Seasonal abundance and habitat use of shorebirds on an Oso Bay mudflat, Corpus Christi, Texas. *Journal of Field Ornithology* 64(3): 382–392.

17. Vasquez, F.G., L.G. Aguilera, and V.K. Sharma. 1994. Metals in sediments of San Andres Lagoon, Tamaulipas, Mexico. *Bulletin of Environmental Contamination and Toxicology* 52: 382–387.

18. Dokken, Q.R. 1995. Public-private partnerships for the future of marine science and technology. *Marine Technology Society Journal* 29(1): 67–68.

19. Dokken, Q.R., C. Beaver, S. Cox, C. Adams, J. Rooker, and J. Childs. 1995. Characterization of biofouling communities on oil and gas production platforms: impact on finfish assemblage, pp. 1–16. *In* Proceedings of the Minerals Management Service 1995 Information Transfer Meeting. New Orleans, Louisiana, USA.

20. Hicks, D.W. and J.W. Tunnell, Jr. 1995. Ecological notes and patterns of dispersal in the recently introduced mussel, *Perna perna* (Linne, 1758), in the Gulf of Mexico. *American Malacological Bulletin* 11(2): 203–206.

21. Hollyfield, S. and V.K. Sharma. 1995. Organic contaminants and characteristics of sediments from Oso Bay, south Texas, USA. *Environmental Geology* 25: 137–140.

22. Tunnell, J.W., Jr., B. Hardegree, and D.W. Hicks. 1995. Environmental impact and recovery of a high marsh pipeline oil spill and burn site, upper Copano Bay, Texas, pp. 133–138. *In* J.D. Ludwigson (ed.), Proceedings of the 1995 International Oil Spill Conference. 27 Feb.-2 Mar., 1995. Long Beach, California, USA.

23. Vasquez, F.G., V.K. Sharma, V.H. Alexander, and C.A. Frausto. 1995. Metals in some lagoons of Mexico. *Environmental Health Perspectives* 103: 33–34.

24. Beaver, C. and Q.R. Dokken. 1996. Operational and procedural guidelines for use of offshore oil and gas platforms Flower Gardens Ocean Research Project. *Marine Technology Society Journal* 30(2): 26–32.

25. Cox, S.A., C.R. Beaver, Q.R. Dokken, and J.R. Rooker. 1996. Diver-based underwater survey techniques used to assess fish populations and fouling community development on offshore oil and gas platform structures, pp. 101–105. *In* Proceedings of the American Academy of Underwater Sciences 1996 Scientific Diving Symposium, Smithsonian Institute. Washington, D.C., USA.

26. Dokken, Q.R. 1996. Platform reef ecological and biological productivity: fact or fiction? pp. 12–19. *In* Proceedings of the Minerals Management Service 1996 Information Transfer Meeting. New Orleans, Louisiana, USA.

27. Hardegree, B., D.W. Hicks, and J.W. Tunnell, Jr. 1996. Evaluation of burning as an oil spill cleanup technique in a high marsh community along the south Texas coast, pp. 195–212. *In* Proffitt, C.E. and P.F. Roscigno (eds.), Symposium Proceedings: Gulf of Mexico and Caribbean Oil Spills in Coastal Ecosystems. New Orleans, Louisiana, USA.

28. Tunnell, J.W., Jr. 1996. The Gulf of Mexico: Gulf resources, pp. 59–67. *In* Proceedings of the Annual Meeting of the Philosophy Society of Texas. Corpus Christi, Texas, USA.

29. Tunnell, J.W., Jr. and K.J.P. Deslarzes. 1996. Drilling for history. *Coral Reefs* 15: 176.

30. Tunnell, J.W., Jr., Q.R. Dokken, E.H. Smith, and K. Withers (eds.). 1996. Current Status and Historical Trends of the Estuarine Living Resources within the Corpus Christi Bay National Estuary Program Study Area. Texas Natural Resource Conservation Commission Corpus Christi Bay National Estuary Program No. CCBNEP-06A, B, C, & D (4 vols.). Austin, Texas, USA. 1436 pp.

31. Vasquez, G.F., D.M. Elias, J.E.C. Aguayo, B. Alijando, and V.K. Sharma. 1996. Trace metal species in aquatic samples of the Tabasco lagoons, Mexico. *Environmental International* 22(3): 377–382.

32. Vasquez, F.G. and V.K. Sharma. 1996. Trace metals in the oyster *Crassostrea rhizophora*, from the Laguna de Terminos of Campeche, Mexico. *Texas Journal of Science* 48(4): 261–266.

33. Beaver, C.R., Q.R. Dokken, and T.E. Riggs. 1997. Utilization of fouling community elements by reef fishes at a platform artificial reef in the northwestern Gulf of Mexico, pp. 388–394. *In* Proceedings of the Minerals Management Service 17th Annual Gulf of Mexico Information Transfer Meeting. New Orleans, Louisiana, USA.

34. Cox, S. and Q.R. Dokken. 1997. Project summary: monitoring health of Gulf of Mexico living aquatic resources, pp. 597–604. *In* Proceedings of the Minerals Management Service 17th Annual Gulf of Mexico Information Transfer Meeting. New Orleans, Louisiana, USA.

35. Lehman, R.L. and J.R. Manhart. 1997. A preliminary comparison of restriction fragment patterns in the genus *Caulerpa* (Chlorophyta) and the unique structure of the chloroplast genome of *Caulerpa sertularioides*. *Journal of Phycology* 33(6):1055–1062.

36. Nipper, M.G. and E.K. Williams. 1997. Culturing and toxicity testing with the New Zealand mysid *Tenagomysis novae-zealandiae,* with a summary of toxicological research in this group. *Australasian Journal of Ecotoxicology* 3(2): 117–129.

37. Nipper, M.G., M.L. Martin, and E.K. Williams. 1997. The optimization and validation of a marine toxicity test using the New Zealand echinoid, *Fellaster zelandiae*. *Australasian Journal of Ecotoxicology* 3(2): 109–115.

38. Rooker, J.R., Q.R. Dokken, C.V. Pattengill, and G.J. Holt. 1997. Fish assemblages on artificial and natural reefs in the Flower Garden Banks National Marine Sanctuary, USA. *Coral Reefs* 16: 83–92.

39. Schleman, T.A. and J.W. Tunnell, Jr. 1997. Seagrass distribution, pp. 74–118. *In* Brown, C.A. and N.C. Kraus (eds.). Environmental monitoring of dredging and processes in lower Laguna Madre, Texas. Final Report, Year 1. Conrad Blucher Institute for Surveying and Sciences, Texas A&M University-Corpus Christi. Tech. Rpt. No. TAMUCC-CBI-96-01. 118 pp.

40. Sharma, V., K. Rhudy, R. Brooks, S. Hollyfield, and F. Vazquez. 1997. Petroleum hydrocarbons in sediments of upper Laguna Madre. *Marine Pollution Bulletin* 4: 229–234.

41. Smith, E.H., T.R. Calnan, and S.A. Cox. 1997. Potential Sites for Wetland Restoration, Enhancement, and Creation: Corpus Christi/Nueces Bay area. Texas Natural Resource Conservation Commission Corpus Christi Bay National Estuary Program No. CCBNEP-15. Austin, Texas, USA. 165 pp.

42. Vasquez, F.G., M.C. Reyes, G. Fernandez, J.E.C. Aguayo, and V.K. Sharma. 1997. Contamination in marine turtle (*Dermochelys coriacea*) eggshells of Playon de Mexiquillo, Michoacan, Mexico. *Bulletin of Environmental Contamination and Toxicology* 58: 326–333.

43. Wood, T.M., R.L. Lehman, and J. Bonner. 1997. Ecological impacts of bioremediation field study experiments, pp. 119–124. *In* Proceedings of the Fourth International Symposium on In Situ and On-site Bioremediation. Vol. 4. New Orleans, Louisiana, USA.

44. Wood, T.M., R.L. Lehman, and J. Bonner. 1997. Ecological impacts of a wetland oil spill and bioremediation experiments, pp. 415–412. *In* Proceedings of the 1997 International Oil Spill Conference. Fort Lauderdale, Florida, USA.

45. Carr, R.S., P.M. Montagna, and M.C. Kennicutt. 1998. Sediment quality assessment of stormwater outfalls and other selected sites in the Corpus Christi Bay National Estuary Program study area. Texas Natural Resource Conservation Commission Corpus Christi Bay National Estuary Program No. CCBNEP-32. Austin, Texas, USA. 129 pp.

46. Childs, J. 1998. Avian diversity and habitat use within the Flower Garden Banks National Marine Sanctuary. *Gulf of Mexico Science* 2: 208–225.

47. Childs, J. 1998. Nocturnal mooring and parking behavior of three monacanthids (filefishes) at an offshore production platform in the northwestern Gulf of Mexico. *Gulf of Mexico Science* 2: 228–232.

48. DeWitt, T.H, C.W. Hickey, D.J. Morrisey, M.G. Nipper, D.S. Roper, R.B. Williamson, L.F. Van Dam, and E.K. Williams. 1998. Do amphipods have the same concentration-response to contaminated sediment in situ as in vitro? *Environmental Toxicology and Chemistry* 18(5): 1026–1037.

49. Hicks, D.W., C.P. Onuf, and J.W. Tunnell, Jr. 1998. Response of shoal grass, *Halodule wrightii,* to extreme winter conditions in the Lower Laguna Madre, Texas. *Aquatic Botany* 62: 107–114.

50. Lang, J., P. Alcolado, J.P. Carricart-Ganivet, M. Chiappone, A. Curran, P. Dustan, G. Gaudian, F. Geraldes, S. Gittings, R. Smith, J.W. Tunnell, Jr., and J. Wiener. 1998. Status of coral reefs in the northern areas of the wider Caribbean, pp. 123–134. *In* Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Townsville, Australia.

51. Nicolau, B.A., J.W. Tunnell, Jr., J.S. Adams, and B.F. Ruth. 1998. Long-term monitoring of estuarine faunal use in the Nueces Delta mitigation project, Corpus Christi, Texas: 1989 through 1995, pp. 67–86. *In* Proceedings of the 23rd Annual Conference on Ecosystems Restoration and Creation. May 1996. Tampa, Florida, USA.

52. Nipper, M.G. 1998. The development and application of sediment toxicity tests for regulatory purposes, pp. 631-643. *In* Wells, P.G., K. Lee, and C. Blaise (eds.). *Microscale Testing in Aquatic Toxicology – Advances, Techniques and Practice.* CRC Lewis Publishers, Boca Raton, Florida, USA.

53. Nipper, M.G., D.S. Roper, E.K. Williams, M.L. Martin, L.F. Van Dam, and G.N. Mills. 1998. Sediment toxicity and benthic communities in mildly contaminated mudflats. *Environmental Toxicology and Chemistry* 17(3): 502–510.

54. Hyde, L.J., K. Withers, and J.W. Tunnell, Jr. 1999. Coastal high marsh oil spill clean-up by burning: five year evaluation, pp. 1257–1260. *In* Proceedings of the 1999 International Oil Spill Conference. March, 1999. Seattle, Washington, USA.

55. Lehman, R.L. 1999. A checklist of benthic marine macroalgae from the Corpus Christi Bay area. *Texas Journal of Science* 51(3): 241–252.

56. Rhudy, K.B., V.K. Sharma, R.L. Lehman and D.A. McKee. 1999. Seasonal variability of the Texas "Brown Tide" (*Aureoumbra lagunensis*) in relation to environmental parameters. *Estuarine Coastal and Shelf Science* 48: 565–574.

57. Dokken, Q.R. 2000. Fixed offshore platforms for conducting scientific diver training and marine environment research. *Marine Technology Society Journal* 3(4): 47–49.

58. Nipper, M. 2000. Current approaches and future directions for contaminant-related impact assessments in coastal environments: Brazilian perspective. *Aquatic Ecosystem Health & Management* 3(4): 433–447.

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61. Hicks, D.W., J.W. Tunnell, Jr., and R.F. McMahon. 2001. Population dynamics of the nonindeginous brown mussel *Perna perna* in the Gulf of Mexico compared to other world-wide populations. *Marine Ecology Progress Series* 211: 181–192.

62. Ingrao, D.A., P.M. Mikkelsen, and D.W. Hicks. 2001. Another introduced marine mollusk in the Gulf of Mexico: The Indo-Pacific green mussel, *Perna viridis,* in Tampa Bay, Florida. *Journal of Shellfish Research* 20(1): 13–19.

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65. Tunnell, J.W., Jr. and B.R. Chapman. 2001. Seabirds of the Campeche Bank Islands, Southeastern Gulf of Mexico. *Atoll Research Bulletin* 482: 1–50.

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69. Hilbun, N. and A. Koltermann. Ranching heritage, pp. 59–69. *In* J.W. Tunnell, Jr. and F.W. Judd (eds.), *The Laguna Madre of Texas and Tamaulipas.* Texas A&M University Press. College Station, Texas, USA.

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Appendix IV

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