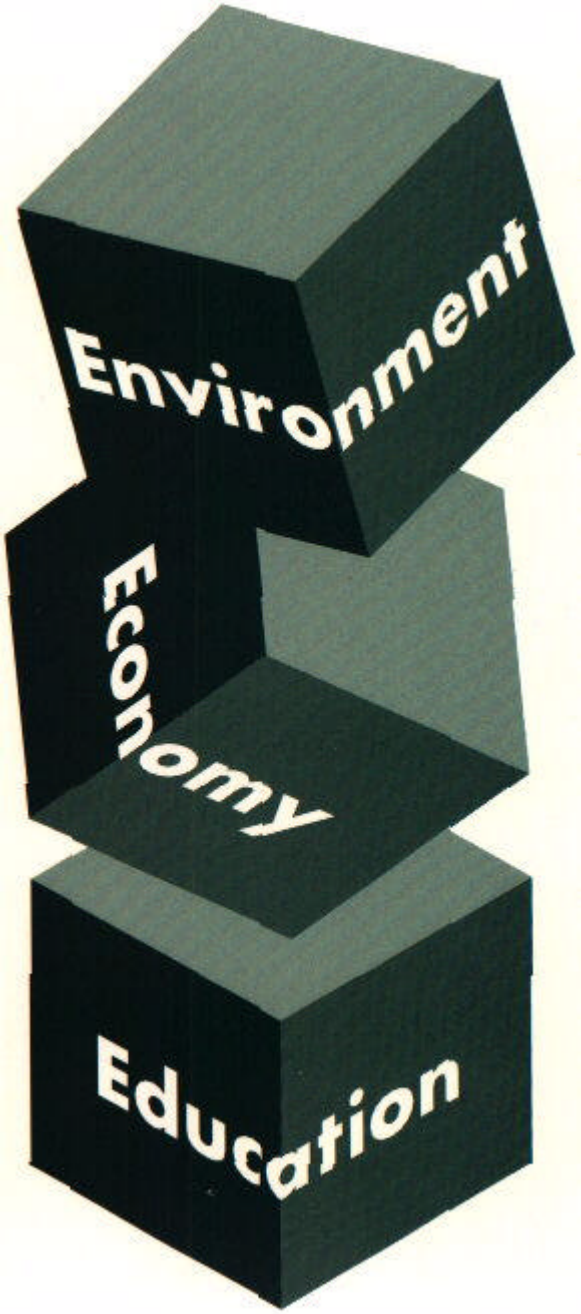
1996 Annual Report

The Environmental Institute of Houston
The University of Houston Clear Lake
The University of Houston

A Question of Balance



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University of Houston Clear Lake

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March 1997

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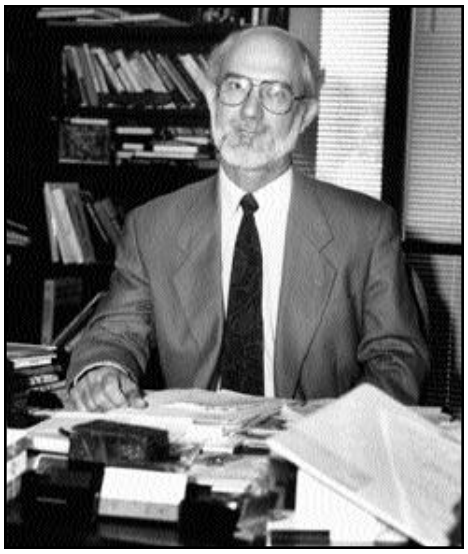
The Director's Message



Dr. Jim Lester, Director,
Environmental Institute of Houston

In March 1996, EIH celebrated its fifth anniversary at UH Clear Lake; UH joined when Special Item funding was received in 1993. The Institute always operates with the broadest array of partners and stakeholders possible. This is especially true of outreach projects and conferences, but also pertains to the spectrum of faculty involved in research and development projects.

It has become clear that the focus of EIH on each of the sister campuses has clarified. UH expends a very high proportion of the special item funding on research seed funding while UHCL uses a large proportion of state funding for outreach and education projects. The two campuses also leverage their state funding in different ways. At UH, leveraging is provided through external research grants. The EIH office at UHCL obtains most of its leveraging through donations and contracts for service to agencies.

At EIH, research and development can refer to anything from an environmental literature program for underprivileged children to a genetically engineered microorganism to detect pollutants. The 1996 Annual Report opens with decomposition of pesticides (S. Chen), pollution prevention studies on migration of soil contaminants (Capuano), catalysts for chemical reactions (Lee), and development of better controllers (Malki and Chen). Several projects focused on changes in climate and ecosystems from historical records in corals (Wellington) to current climate effects of hurricanes (Lawrence) and the impact of these changes on birds (Zeh) and mammals (Cameron and Bryant). The management and monitoring of environmental concerns was the subject of four grants. Management of compliance (Allison) and of conflicts (Heath and Weeks) were investigated in diverse arenas from the chemical industry to shrimping. In one case, the study was about how to manage the managers of environmental issues (Gossett). The monitoring process can occur remotely from a spaceship (Garcia) or *in situ* using a microbe (Willson). EIH has funded an array of educational projects. It supported a summer institute on environmental geography (Maier) and an air quality course (Clifford). The dissemination of knowledge through a publication project was also supported (Melosi). Finally, we partnered on a summer program for urban kids (Dixon). As you can see, EIH supported a real grab bag of projects, reflecting the diversity of the EIH affiliates, our universities and our community. All of them are excellent in their own way and contribute to the environmental health of our future.

In Fall 1996, EIH convened a group of faculty from UH, UHCL and UHD to discuss the greening of curricula across the Houston campuses. The Environmental Studies Working Group meets biweekly during the academic year and includes participants from humanities, social science, science, engineering, business, and law from all the UH sister campuses in Houston. We invite participation from persons of all disciplines on all campuses. The only requirement is an interest in teaching about environmental issues.

This is a new era in the Houston community for participatory planning and consensus decision-making. There are many opportunities to bring together industry, government, environmental organizations and university experts to forge consensus solutions. EIH stands ready to assist you if you want to identify a potential source of support or information in the local or state environmental arena. The Institute has many partners and supporters in the Texas environmental community. These include the organizations represented on the Advisory Board and all of the environmental agencies with programs in the Houston area. Dr. Aumann, the EIH staff and I have worked to increase awareness of the environmental services and information that the UH System can provide.

Glenn Aumann had several opportunities for recognition in 1996. It was the year his diligence as the protector of the coastal prairie at the UH Coastal Center was finally acknowledged. The U. S. Fish and Wildlife Service has identified the Coastal Center prairie as the largest and best fragment locally of Texas coastal prairie. This formerly common habitat is now almost extinct. Dr. Aumann now has a dedicated cadre of grass seed collectors who are using this resource to restore other sites. In October, a regional conference was hosted by EIH at UH Clear Lake on restoration of coastal prairie. Participants were so numerous and enthusiastic that we plan to host similar conferences on a regular basis.

The EIH, through staffer Lynn Spachuk, Dr. John Ramsey (UH), and Dr. Robert Jones (UHCL), has gained national recognition for expertise in environmental education. This expertise has generated partnerships and funded projects with government agencies and business partners. In April 1997, EIH will host a state-wide conference on how to provide balanced, quality environmental education for Texas citizens.

I face 1997 with regret because it will see the departure of three of our strong supporters from the leadership of the UH System. President Glenn Goerke is the reason the Institute exists and is funded by a special item. Chancellor Bill Hobby always provided a sympathetic ear, encouragement, and support. Finally, Regent Beth Morian could be counted on to include EIH in UH System initiatives and to understand the importance of environmental issues. They are all outstanding public servants and environmentalists. EIH is grateful for their support which has made it possible to grow and gain recognition for the expertise and community spirit of faculty, staff and students at UH and UH Clear Lake.

Photo-Decomposition of Organic Pesticides in Water with Light-Activated Semiconductors

Sam Chen, Ph.D., Assistant Professor, UHCL

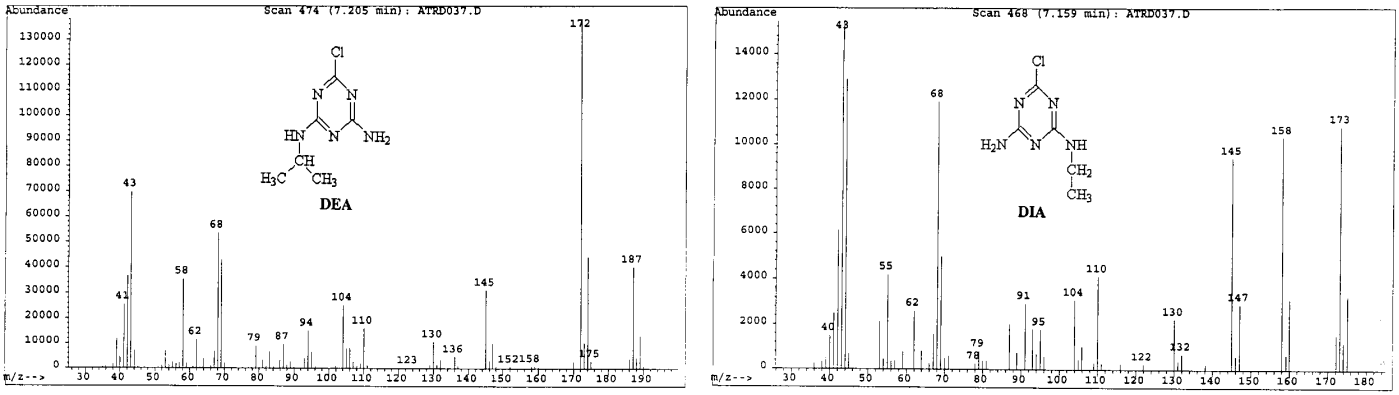


Figure 1. Mass spectra of deethyl atrazine (DEA) and deisopropyl atrazine (DIA) in atrazine aqueous solution exposed to simulated sunlight for 60 minutes with TiO_2 extracted with methylene chloride.

THE GULF OF MEXICO AREA is an ecosystem vital to many people especially fishermen. Extensive use of pesticides, such as atrazine, cyanazine, propazine, and simazine for weed control in agricultural production in the midwest states, have resulted in pollution of the Mississippi River and, subsequently, of the Gulf of Mexico. These triazine herbicides are chemically stable and resistant to biodegradation once released into the aquatic environment. A study to investigate the photolysis of these compounds catalyzed by light-activated semiconductors was initiated.

The photolysis of these compounds in aqueous solutions exposed to light emitted from mercury and xenon lamps and catalyzed by the light-activated semiconductor titanium dioxide (TiO_2) was investigated with GC-MS and HPLC techniques. Aqueous solutions of triazine herbicides were prepared by dissolving the solid analytical standards in deionized water or Galveston Bay water filtered through 0.45 μm filters. The GC-MS data showed that atrazine, cyanazine, propazine and simazine all underwent similar photodecomposition and shared several intermediate degradation products. Decomposition started with loss of the side chains but the chlorinated triazine ring was quite resistant. For example, deethyl atrazine and deisopropyl atrazine were detected as the intermediate degradation products (Fig. 1). The degradation products were generally more hydrophilic than the parent molecules. With TiO_2, disappearance of these compounds at very low concentrations (ppm) occurred within one hour of exposure to simulated solar radiation (xenon lamp). In the presence of semiconductor TiO_2, 90 percent of the herbicides added to Galveston Bay water was destroyed within two hours of exposure to light emitted from a 150 W xenon lamp (Fig. 2). Low-vapor mercury lamps emitting strong short wavelength UV radiation can be used to quickly decompose these herbicides in water provided a catalyst like TiO_2 is present. Solution ionic strength (salinity) seemed to have minimum impact on the photo-decomposition of these herbicides, but higher pH did retard the photo-decomposition. The results demonstrate the importance of photo-decomposition of organic pesticides in aquatic environment and suggest potential large scale applications of light-activated semiconductors and UV light for economical destruction of organic pesticides in drinking water purification and waste water treatments.

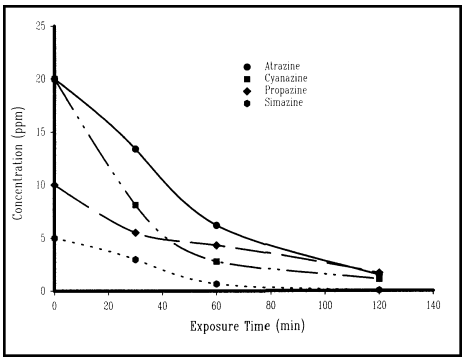


Figure 2. Photo-decomposition of atrazine, cyanazine, propazine, and simazine added to filtered Galveston Bay water as a function of exposure time to simulated solar radiation.

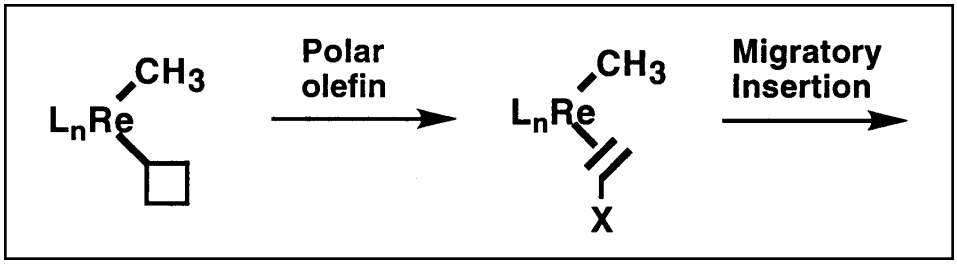
Vertical Fluid Migration in Shallow Fluvial Sediments: A Common Host for Chemical Contamination Along the U. S. Gulf Coast

Regina M. Capuano, Ph.D., Associate Professor, UH

WE HAVE FOUND EVIDENCE of vertical migration of rain water into the shallow fluvial-deltaic clay-rich sediments of the U. S. Coastal Plain. This is important because of the numerous occurrences of hazardous waste spills in this area and the high concentration of municipal landfills. The sediments studied are the Beaumont Formation at the UH Coastal Research Center located approximately 60 km south-southeast of Houston. One focus of this work has been the importance of crayfish burrows to infiltration in these sediments (Bunge and Capuano, 1995). Tunnels of burrowing crayfish are known to extend to the water table at all times, thus, providing a direct pathway for meteoric water to flow through the vadose zone and into the ground water below. Burrow densities at the study site ranges from 1 to 3 burrows/m^2. Pumping tests conducted on the burrows resulted in drawdown at nearby piezometers and monitor wells. Preliminary results indicate that sediment transmissivities between the burrows and the piezometers/wells are on the order of 0.1 cm^2 /sec. These values are high for such clay-rich sediments and comparable to those of the saturated sediments below. A dye tracer study and trenching of the burrows are planned to provide more information on the permeability of these holes. These preliminary results strongly suggest that crayfish burrows, which are common in many areas of the U. S. Gulf Coast, are important migration pathways that must be considered in contaminant migration studies and remediation programs.

The Development of Environmentally Benign Catalysts for the Synthesis of Biomaterials

T. Randall Lee, Ph.D., Assistant Professor; David M. Hoffman, Ph.D., Associate Professor; June-Ho Jung, M.S, graduate research assistant, UH



Scheme 1. Proposed mechanism of rhenium-based Ziegler-Natta polymerization.

THE NEGATIVE IMPACT OF HYDROCARBON solvents on the environment has placed increasing pressure on chemists and chemical engineers to develop water-based methods for the synthesis of new materials. Water-based synthetic methods are more environmentally friendly than conventional hydrocarbon-based technologies because hydrocarbons, which are derived from oil, can pollute the air (due to their volatility) and ground (*via* solvent waste disposal).

The Ziegler-Natta polymerization of olefins (Scheme 1) is an economically viable synthetic method used for the preparation of technologically important polymers. Despite its importance and widespread use, this polymerization method has not been employed in aqueous environments because of the water-sensitive nature of the catalysts.

The broad objectives of our research at the University of Houston are to synthesize a new family of water-based Ziegler-Natta catalysts and to demonstrate their use in the synthesis of new and useful biomaterials. Specifically, we will examine the activity of the new catalysts by polymerizing appropriately substituted olefinic derivatives to generate water soluble biopolymers. These biopolymers will be designed to possess innovative features that will make them useful in applications involving polymeric drugs and/or controlled drug delivery.

As part of our research program, we have synthesized a new potential catalyst, $[Me_2ReO(NCMe(2,2'\text{-bipyridine})]^+$, (Fig. 1). We targeted this type of catalyst system for three reasons. First, the complex is cationic; it will have excellent solubility in water, thus facilitating aqueous polymerizations. Second, the arrangement of the alkyl ligand cis to the labile nitrile ligand provides the opportunity for ligand dissociation and subsequent olefin coordination and polymerization. Third, on the basis of known homogeneous and heterogeneous rhenium-based catalysis systems, we anticipate that complexes of this type will tolerate a wide variety of polar functional groups, thus allowing the synthesis of highly functionalized polymeric materials. The ability to generate highly functionalized and structurally well-defined materials is crucial for the synthesis of polymeric drugs and drug delivery systems.

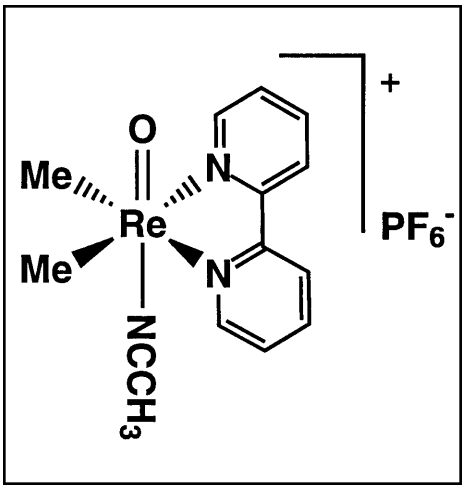


Figure 1. Proposed structure of new cationic rhenium-based complex.

Adaptive Fuzzy PID Controllers for Environmental Pollution Control

Heidar A. Malki, Ph.D., Assistant Professor; G. Ron Chen, Ph.D., Associate Professor; Denny Feigenspan, graduate research assistant; Dave Misir, graduate research assistant, UH

UNIVERSITY OF HOUSTON RESEARCHERS seek to develop and test a new fuzzy logic control technique, the adaptive fuzzy proportional-integral-derivative (PID) control, as an effective method of alternative control for the control of environmental pollution in chemical reactions and for temperature control in process control industries.

This project was divided into two tasks: (1) the design and analysis of the adaptive fuzzy logic PID controller, and (2) a test of the proposed design on both simulated and real-process data.

For the first task, investigators developed a new design method and implemented it on a PC-based algorithm. The controller's gains are self-tuned during the control process following the fuzzy logic IF-THEN rules, which are designed according to the classical adaptive control principles under the fuzzy logic environment.

For the second task, the proposed method was first tested with computer simulated data, in comparison with both the conventional PID controller and the non-adaptive fuzzy PID controller. Simulation results have shown that the new design is overall better in the sense that it can handle highly nonlinear models and track relatively rapidly changing setpoints with better control performance.

The designed controller has also been tested using isothermal temperature control of an aluminum heat sink provided by the Dow Chemical Company, as shown in Fig. 1. The objective of this test was to control isothermal temperature better or close to $\pm 0.02^{\circ}$C. The result of this test by both conventional and adaptive fuzzy PID controllers is shown in Fig. 2. It is clear from this illustration that the fuzzy PID controller has less overshoot and steady-state error.

The next step in this research project is to test and improve the design for chemical reaction data, which has more rapid changes in processing and, hence, is much more difficult to control.

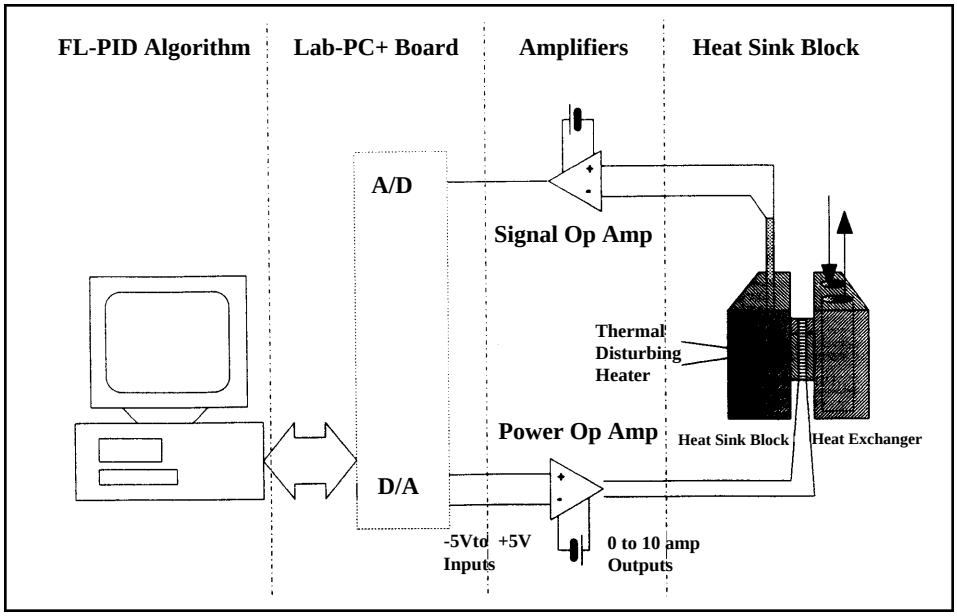


Figure 1. Physical set-up of the adaptive fuzzy logic-PID temperature control forthe heat sink.

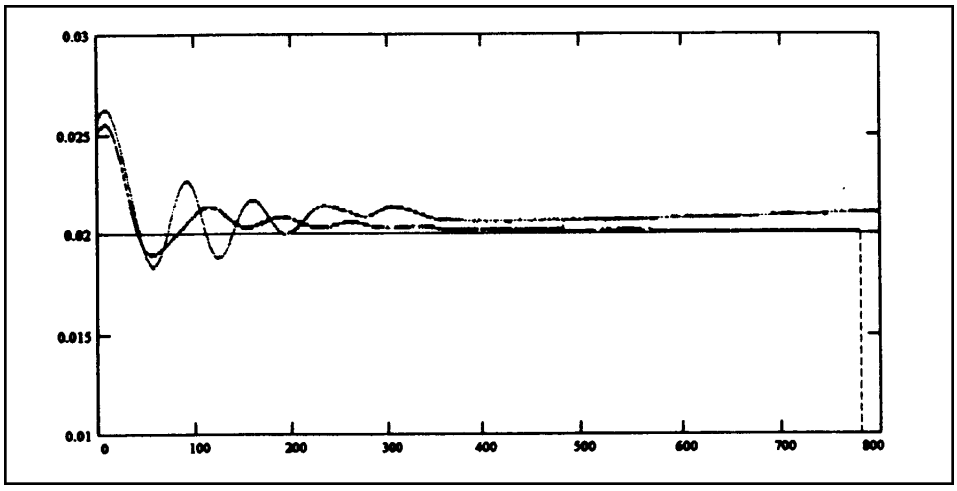


Figure 2. Output response of the conventional and adaptive fuzzy logic-PID controller for isothermal temperature control.

Effect of Habitat Fragmentation on Demographic and Genetic Structure of Natural Populations: A Metapopulation Analysis

Guy N. Cameron, Ph.D., Professor; Edwin H. Bryant, Ph.D., Professor; Julie A. Robinson, Ph.D., Research Assistant Professor; Jan M. Williams, graduate research assistant, UH

THE EFFECT OF FRAGMENTATION on populations is a major concern for resource managers and conservation biologists. Most scientific studies of fragmentation have focused on forest habitats and bird populations. In the interest of seeking a new, broader understanding of the effects of wetland fragmentation, investigators in this project sought to understand the effect of fragmentation of coastal salt marshes on the population dynamics of the marsh rice rat, *Oryzomys palustris*.

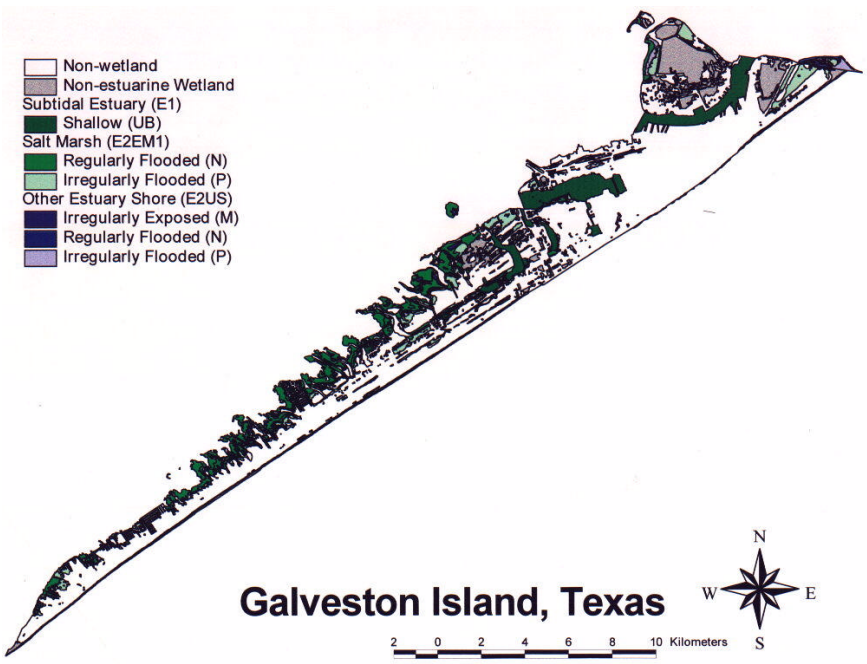
To meet this objective, we developed and initiated a set of three related field investigations:

Live-trapping study

The objective of this study is to compare the population demography of fragmented and unfragmented coastal salt marshes. We identified six potentially linked habitat fragments in a bayou system entering Galveston Bay and an area to be used as a control. After obtaining permission from the owners, we conducted a three-month pilot study to finalize tagging techniques and establish trapping grids. This pilot study augmented other small-mammal trapping conducted in the area over the past year. To finalize our experimental design, we performed power analyses to confirm that our experimental method could detect the differences between habitats forecast by the pilot studies.

Using pilot data, we also evaluated the effect of grid-size on parameter estimation. Parameters were estimated using 12 months of data for grids containing 42, 28 and 20 traps. Data obtained from each grid size was used to estimate 30 different demographic parameters. In response to these pilot analyses, modifications have been made in the grid setup and the overall experimental design.

The study was expanded to include one more species, the cotton rat (*Sigmodon hispidus*). The finalized field experiment began in August 1996.



Maps of the Gulf Coast region have been digitized for computer analysis for purposes of comparing the population demography of fragmented and unfragmented coastal salt marshes. This map shows the distribution of wetland and estuarine habitats on Galveston Island.

Presence/absence study

The purpose of this study is to determine which aspects of a fragmented habitat patch allow the persistence of a small mammal population. Using a sample of 30 habitat fragments remaining in the Galveston Bay system, we will assess the landscape and vegetation characteristics of the patches and the presence or absence of rice rats and cotton rats. In order to identify the habitat fragments 7.5' National Wetlands Inventory maps, downloaded and converted into ARC/INFO coverages, were edge-matched to produce a map of the different types of wetlands associated with Galveston Bay. These maps will be used to unambiguously identify fragment boundaries and calculate landscape metrics. Mammal presence/absence will be assessed by an intensive trapping effort in September when populations are at their peak.

Radio telemetry study

One of the results of our pilot studies was our discovery that we could not obtain sufficient information on individual movements from capture/recapture studies alone. We have hypothesized, however, that differences in movement behaviors will be one of the most important effects of fragmentation. Thus, we are developing a third study which will use radio telemetry to track individual movement behaviors.

Radios used in previous studies have been returned for remanufacture and adaptation for conducting pilot telemetry studies this fall. We expect to begin full-scale telemetry work in January 1997.

Paleoclimate Reconstruction in Reef Coral Skeletons: Interpretation of Stable Carbon Isotopes

Gerard M. Wellington, Ph.D., Professor; Andrea Grottoli-Everett, graduate research assistant, UH

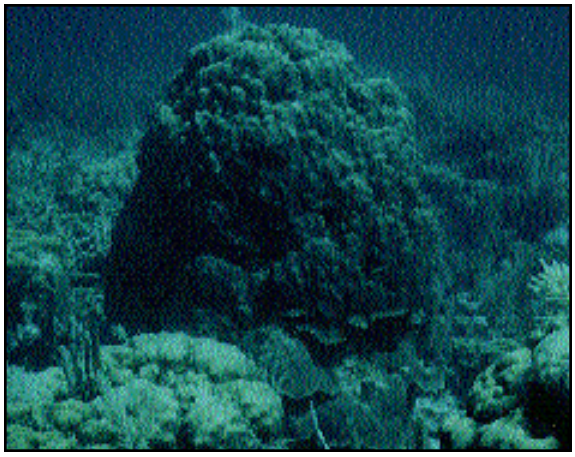


Photo by Gerard Wellington

ANTHROPOGENIC POLLUTANTS have potentially altered global climate patterns over the past decade. The greenhouse effect imposed by these pollutants (*e.g.* CO_2) results in the retention of long-wave radiation in the troposphere. Increasing levels of fossil fuel burning are believed to be the main source of excess carbon dioxide. Recent studies show that the steady increase in atmospheric CO_2 parallels observed increase in air and sea surface temperature over the past 10 years.

In order to assess changes in climate over time, a detailed record of both past and present climate conditions is needed. Historical instrumental data extend only as far back as 100 years, at best. Recent research, however, indicates that the stable isotopic record in scleractinian coral skeletal can be used to reconstruct high resolution paleoclimatic records from tropical latitudes. Corals can live for several hundred years, depositing a calcium carbonate skeleton in distinct bands that reflect the isotopic composition of the surrounding environment. In seawater the ratio of light to heavy stable isotopes ($\delta^{18}O$) decreases as temperature increases due to differential evaporation and thus yields a reliable temperature record of $\pm$ 0.2 C.

Solar radiation also plays a pivotal role in climate patterns. Evidence indicates that heavy stable carbon isotope ($\delta^{13}C$) levels in coral skeletons may be a reliable indictor of irradiance levels: (1) coral tissue $\delta^{13}C$ levels are higher in corals exposed to enhanced light levels, (2) skeletal $\delta^{13}C$ levels decrease with depth, and (3) skeletal $\delta^{13}C$ varies seasonally in accordance with light levels. Unlike the oxygen isotope, carbon composition is affected by metabolic fractionation that varies with photosynthetic activity as well as $^{13}C/^{12}C$ in seawater. Fractionation refers to the kenetics of isotopes. The lighter ^{12}C is preferentially used in metabolic processes. As a result, the relative proportions of heavy and light carbon in the coral skeleton depend upon the physical properties of the surrounding seawater and physiological processes in the coral animal.

How then can skeletal $\delta^{13}C$ serve as a light sensor? In symbiotic corals photosynthetically-derived carbon contributes up to 90 percent of carbon pool. Since photosynthesis is dependent on light, and carbon is metabolically fractionated in corals, variation in light levels should be reflected in the coral skeleton $\delta^{13}C$ signature.

To address this question, and determine its applicability to paleoclimate research, we conducted a field experiment to sort out the contribution of light and zooplankton (heterotrophic food source for corals) to the skeletal carbon isotopic signature. We measured the effect of light and zooplankton on skeletal $\delta^{13}C$ levels in a fast growing (*Pavona clavus*) and the slower growing massive coral (*P. gigantea*) at two depths (1 m and 7 m). Corals were subjected to four main treatments: (1) ambient light and zooplankton, (2) reduced light-ambient zooplankton, (3) ambient light-reduced zooplankton, and (4) reduced light and zooplankton. For *P. clavus* there were significant differences in skeletal $\delta^{13}C$ between light and zooplankton treatments independent of depth. Increases in light and/or decreases in zooplankton resulted in skeletal $\delta^{13}C$ enrichment. *P. gigantea* had similar results with the addition of a significant depth effect. Thus, light and plankton levels have a direct influence on skeletal $\delta^{13}C$ levels. This finding is consistent with the hypothesis that carbon fractionation observed in the skeleton $\delta^{13}C$ signal is metabolically driven. Coupled with a temperature signal derived from the oxygen isotope signal in the coral, the results of these experiments should enable use to partition the relative contribution of various environmental parameters principally, temperature, light and zooplankton levels (a proxy for upwelling) in the $\delta^{13}C$ skeletal record.

Coral-based climate reconstruction will provide us with a better understanding of the natural variability of tropical climate and its effect on global climate change. Once a base line for past global climate is fully characterized, we can assess the effect of anthropogenic pollutants on current trends in climate change.

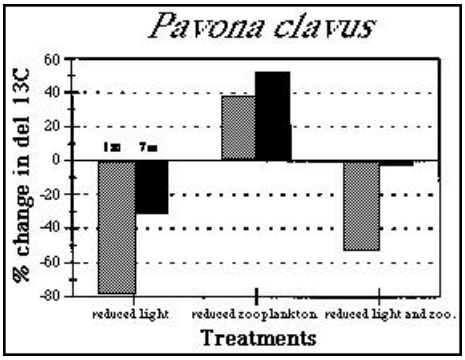


Figure 1. Percentage change in $\delta^{13}C$ in field experiments where colonies of the massive coral *Pavona clavus* were subjected to reduced light, reduced zooplankton, or reduced light and zooplankton at 1 and 7 meters depth (gray and black bars, respectively). Results were significantly different from controls at both depths with the exception of the combined reduced light and zooplankton treatment at 7m. Here, treatment effects were approximately equal but opposite, thus cancelling one another. Results show that under reduced light coral skeleton is enriched in ^{12}C, and depleted when zooplankton is reduced. These findings clearly show that levels of light and plankton influence metabolic fractionation of the $^{13}C/^{12}C$ ratio in coral skeleton and thus can potentially reveal changes in the climate.

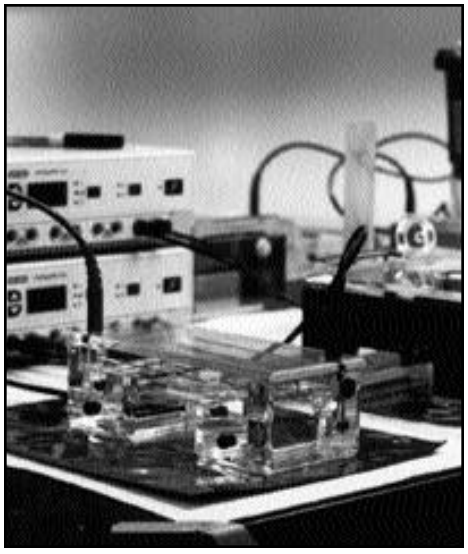
Molecular Conservation Genetics of Texas Wetland Birds

David Zeh, Ph.D., Assistant Professor; John Waddington, graduate research assistant, UH

THE WETLANDS OF THE TEXAS GULF COAST support an extraordinary diversity of biotic resources, including many endangered and threatened species. The aim of this study is to develop molecular genetic techniques (mitochondrial DNA sequencing and microsatellite DNA allelic assays) to use as powerful diagnostic tools for assessing the impact of habitat fragmentation on gene flow and population structure in selected species of Gulf Coast wetland birds. By quantifying the variation within populations and the differences between populations at several localities along the Texas Gulf Coast, molecular genetic data will permit the identification of geneticallly distinct populations, as well as populations with reduced genetic diversity whose capacity to respond to environmental change may be impaired.

In this first year of a three-year project, we have focused on the seaside sparrow (*Ammodramus maritimus*), a habitat specialist occurring exclusively within a narrow corridor of salt marshes extending from New Hampshire in the northeast to the Nueces and Copano Bays on the southern Texas Gulf Coast. The irregular distribution of this species along this corridor has been attributed to Pleistocene geology, with periodic changes in sea level alternately expanding and dividing its range. More recently, further population subdivision has been the result of the development of agriculture and industry along the coast. By 1938, 90 percent of salt marsh habitat from Virginia to Maine had been seriously compromised as a result of ditching and diking for drainage. Wetland loss in the U. S. coastal zone has increased about 0.5 percent annually from 1950-1995. Of the nine most generally recognized races or subspecies of seaside sparrow, two are now extinct, and one is seriously threatened. This species serves as a valuable indicator of the ecological integrity of certain types of coastal marshes sensitive to habitat modification. There are thus ecological, aesthetic, and economic benefits to be derived from the development of diagnostic and prescriptive tools which could be implemented in conservation efforts aimed at protecting subpopulations of the seaside sparrow occurring along the Texas Gulf Coast.

John Waddington, graduate student in biology, is shown at the thermocycler that allows researchers to amplify sequences of DNA. By using blood samples drawn from small amounts of blood ortissue, scientists can conduct research without endangering animals.



DNA sequence data are used to assess gene flow between bird populations. Researchers sample a number of birds to determine if there is genetic variation within and between populations.

To this end, in November 1995, we initiated a pilot study involving sampling molecular genetic variation at four sites of varying degrees of habitat fragmentation. After consultation with Dennis Jones, Texas Parks and Wildlife Region 4 Interpretive Specialist, and upon completion of training with the Harris County Mosquito Control Avian Unit, we were able to submit an application for and receive a National Biological Service Master Banding Permit, a Federal Scientific Collecting Permit, and a Texas Parks and Wildlife Scientific Investigation Permit as well as individual site-by-site permits to collect on state and federal public lands.

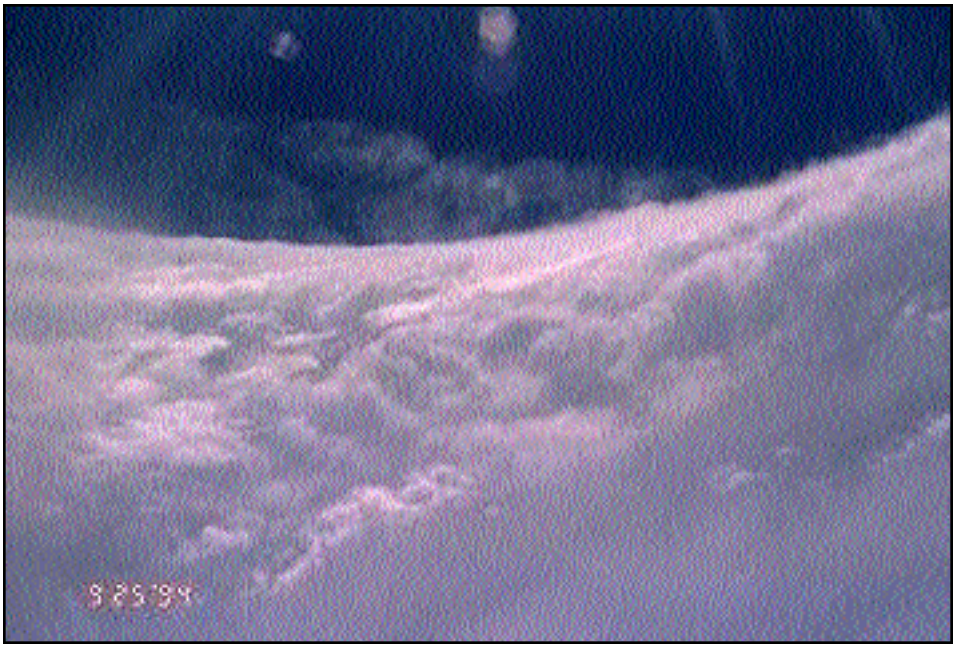
From March to June we netted and sampled (150-250 µl whole blood taken from the jugular) 25 Seaside Sparrows from three sites and procured a tissue specimen from Louisiana State University to serve as a geographic outgroup. We have now successfully extracted high molecular weight DNAfrom these samples.

Initially, we considered a straightforward evaluation of the mitochondrial cytochrome *b* gene, which is well characterized and widely used in avian phylogenetics. During the trapping period, however, we were able to obtain newly-developed *mt*DNA primers designed to amplify a 1 kilobase region spanning the rapidly evolving and highly informative ATPase 6-8 region (graciously provided by Dr. G. Seutin and Dr. E. Bermingham of the Smithsonian Tropical Research Institute). Although using these new primers has necessitated extensive experimentation to optimize PCR and sequencing conditions, in the long term, the benefits of assaying this rapidly-evolving gene region will offset any initial costs. We are now at the point where we can reliably amplify the target gene from genomic DNA and are now gathering our first sequence data.

We plan to complete a study comparing *mt*DNA variation in two mainland (Anahuac and Brazoria) and island sites (Galveston and Matagorda) which vary extensively in levels of habitat fragmentation.

Establishment of a Joint Mexico-U.S. Program for the Study of the Stable Isotopic Composition of East Pacific Hurricanes

James R. Lawrence, Ph.D., Associate Professor, UH



Photos by NOAAHurricane Research Division

The research of University of Houston investigators in tropical cyclones along the Mexican coast generated interest in joint research projects with faculty of the *Universidad Nacional Autónoma de México* in the area of atmospheric pollution.

THE UNIVERSITY OF HOUSTON has established an academic relationship with the *Universidad Nacional Autónoma de México* for the purpose of conducting joint studies in atmospheric chemistry. Proposals for joint research will be submitted to the National Science Foundation International Studies Program and the Mexican National Science Foundation.

A joint studies program has been developed with Dr. Armando Baez and Hugo Padilla of the *Centro de Ciencias de la Atmósfera* of the *Universidad Nacional Autónoma de México* in Mexico City. Their research interests are primarily in the field of atmospheric pollution chemistry in Mexico City. Because of the very high population and the growing use of automobiles and buses, Mexico City suffers one of the most polluted atmospheres in the world.

My research interest in the study of tropical cyclones along the Mexican coast was the original impetus for this cooperation. We have agreed to use UH analytical capabilities to conduct both research programs in the future.

From February 29 to March 2, 1996, I traveled to the *Universidad Nacional Autónoma de México* in Mexico City to deliver a talk to faculty and graduate students of the *Centro de Ciencias de la Atmósfera*. Dr. Armando Baez and Hugo Padilla, a graduate student, showed strong interest in conducting joint studies. As a result of our mutual interests, we arranged a second meeting to take place during the passage of a tropical cyclone along the Mexican coast. On July 2 to 5, Tropical Storm Cristina made landfall along the south coast of Mexico. Hugo Padilla assisted me by providing transportation and field assistance. A set of rain and water vapor samples were obtained from the tropical storm for stable isotope analysis. In turn, I accompanied Mr. Padilla to Mexico City and a mountain site nearby to collect rain and water vapor samples in conjunction with Padilla's collection of rain samples for the purpose of studying pollution transport in the vicinity of Mexico City. Samples from both research projects have been analyzed. The Ph.D. thesis of Hugo Padilla will incorporate this data in his evaluation of air pollution in Mexico City. Data obtained from Tropical Storm Cristina will be presented at National meetings and in publications.

Another trip to the east coast of Mexico enabled us to collect rain and vapor samples from Hurricane Dolly. This trip was completed on August 24, 1996.

An attempt to have Mr. Padilla register for a summer session at the University of Houston in order to conduct joint research studies could not be implemented. Dr. Baez and Mr. Padilla assisted in my study of tropical cyclones the summer of 1996 and has promised to do so in the future. In turn, I have agreed to analyze samples from the air pollution studies in Mexico City. We plan to publish joint papers and proposals in both research areas.

Domestic Wastewater Facility Permit Non-Compliance

Richard C. Allison, Ph.D., Professor; Susan Wilder, graduate research assistant, UHCL

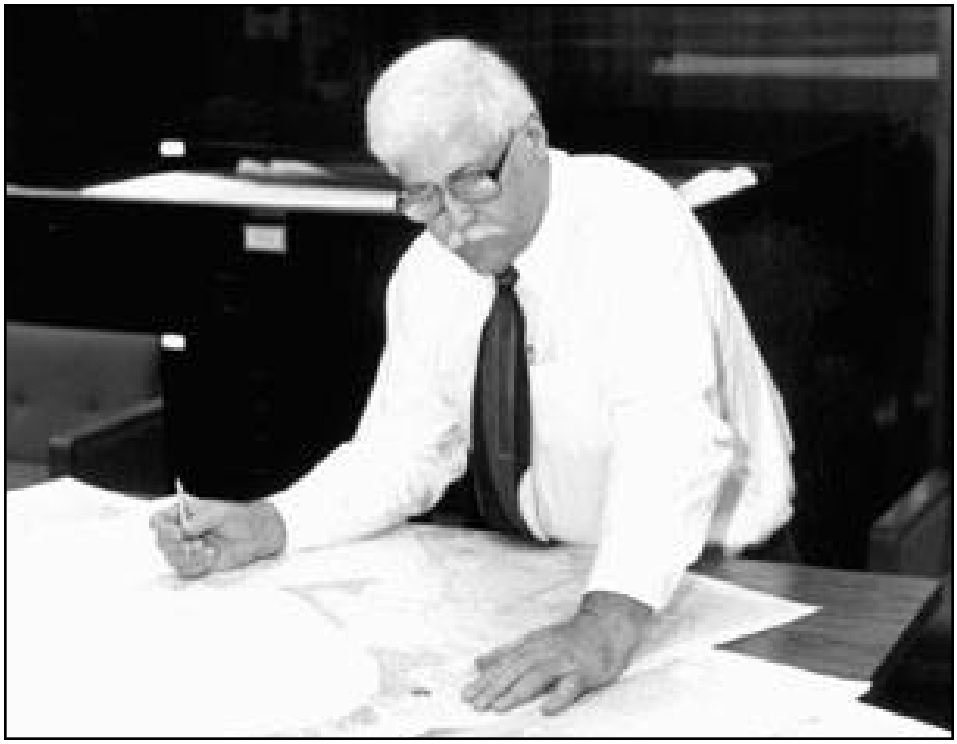
THIS PROJECT WAS ORIGINALLY INTENDED to evaluate the most common reasons for wastewater permit non-compliance and to determine if certain management practices, *e.g.* better staffing, increased budget, employee training, could be implemented to reduce or eliminate noncompliance and thereby enhance water resource protection and prevent pollution. The focus of the research changed, however, as management problems surrounding the TNRCC's self-monitoring program became evident. For this reason, results from an analysis of wastewater permit violations will be discussed, as well as problems with the use and accuracy of the self-monitoring data encountered in this project.

The results of statistics based on the self-monitoring data are mostly inconclusive. However, three important results did emerge, 1) the smallest facilities had the most violations, 2) two of the most common overall violations were parameters most targeted in wastewater permits (TSS and NH3-N), and 3) no consistent improvement trend was evident in violations over time.

In order to determine measurable associations between management practices and numbers of violations, additional research must be conducted into the daily operation of the wastewater facilities. Research is also necessary to determine why two of the parameters most commonly violated are also two of the parameters of greatest concern in a wastewater permit. More data must also be collected on management practices in the facilities to determine why there has been no improvement in the number of violations over the six-year period evaluated in the project.

The usability and accuracy of the self-monitoring data altered the progress of research in this project. While working with the data, we discovered that self-monitoring data stored in a database at the TNRCC can be retrieved only in a form not conducive to working on a spreadsheet. For this reason, most of the information had to be processed by hand from the paper print-out of the data to an EXCEL file so that numbers could be manipulated. This process invites error.

Another problem discovered in the progress of the project was the inaccuracy of data. Two possible reasons may explain the errors: improper data management at the TNRCC and insufficient management at the wastewater facility. Self-monitoring report forms are sent out and received by the Agriculture and Watershed Management Division of the TNRCC Austin, but entry into a database is performed by contractors. Even with an error detection system on the database program, inaccurate information can be entered due to human error. Errors at the wastewater facility could be attributed to untrained personnel, lack of procedural guidelines, the use of uncertified laboratories, and problems filling out forms. These aspects are related to management.



Prof. Richard Allison checking a map for discharge points to Galveston Bay in the Newman Library at the University of Houston Clear Lake (UHCL).

Management issues concerning the self-monitoring program must be studied further from the perspectives of both the agency and the wastewater facility.

Using Remote Sensing Techniques to Estimate Total Suspended Solid Load in Galveston Bay

Theron D. Garcia, Ph.D., Associate Professor, UHCL

THE BIOLOGICAL health of an estuary can be profoundly affected by the total amount of suspended solids (TSS) in the water column. High concentrations of suspended material reduce the light available for the photosynthesizing organisms that reside at the base of the estuarine ecosystem. Sessile, filter-feeding organisms, can suffer high mortality rates if they entrain large amounts of suspended sediment during the feeding process. Many of the contaminants present in the bay system are transported and distributed by suspended solids.

Prof. Theron Garcia is shown using a settling tube to determine the total suspended solid distribution in Galveston Bay samples.

While the importance of gaining a better understanding of the TSS in estuaries is clear, developing appropriate methods for studying the TSS has proven difficult. The traditional method of sampling the water column is not feasible in an estuary as large as Galveston Bay where hundreds of samples would be required for a reliable study. Additionally, the sampling should be done synoptically since the TSS load in estuaries can change rapidly.

Last summer, investigators in my laboratory, through a collaborative effort with NASA-JSC, conducted a preliminary study to determine if images from the Space Shuttle could be used to estimate the TSS load of Galveston Bay. We took water samples at various places within the bay and noted the location with a GPS. Centrifugation was used to extract the suspended solids, thus, providing us with a known value of sediment at a specific site. Within 24 hours of the sampling procedure, the shuttle crew took an image of Galveston Bay, which we then digitized and geo-referenced. The TSS data was then placed on the image, thus, directly correlating the TSS concentration values obtained through sampling to the intensity value of the given pixel. The multiple regression analysis of the data indicated an *r*-square value of 70. The equation generated was then used to create a new thematic image of the TSS load that corresponds to the May 21, 1996 shuttle image.

Efforts to verify the results of our initial work and to further refine the technique are continuing.

Bioluminescent Reporters for Detection of Mutagenic and Carcinogenic Environmental Contaminants

Richard C. Willson, Ph.D., Associate Professor, UH

WE HAVE DEVELOPED A SIMPLE, RAPID, and sensitive bacterial method for measuring mutagenicity (DNA damaging activity) in process streams and waste site samples. Mutagenicity correlates strongly with carcinogenicity to humans, and mutagenic wastes require careful detoxification. A rapid assay for mutagenicity would be useful in risk assessment for site characterization, and would help minimize chemical waste production by allowing tighter control of processes to minimize production of carcinogenic wastes.

The assay is based on measurement of light produced by the enzyme luciferase. Light emission can be easily detected with remarkable sensitivity (detection limit ~10^{-15} mole, or roughly 40 active *E. coli* cells) in samples of less than one mL. We have used this activity for mutagen detection by the random reversion of luciferase genes bearing inactivating mutations, and, more recently, by constructing cells harboring active luciferase genes in a format which is induced in response to DNA damage. This second assay lacks the advantage of mutagen typing by use of strains harboring different luciferase mutants, but gives a very rapid, sensitive response to mutagen exposure. After initial development at UH, as described in our paper in *Environmental Science and Technology*, we are continuing the testing and development of this assay in collaboration with Prof. Paola Poli of the University of Parma, Italy an established expert in microbial reversion assays for environmental toxicants.

Certification and Registration of Environmental Professionals

Lisa B. Gossett, J. D., Assistant Professor; Susan Wilder, graduate research assistant, UHCL

THE EMERGENCE OF THE ENVIRONMENTAL professional is a relatively new phenomenon. While medicine, law, accounting, teaching, and engineering have long traditions, often dating back thousands of years, the credentials of the "environmental professional" are still being defined.

Most of the established professions have statutory licensing, registration, or certification requirements which serve to protect and inform the public. These include entry requirements and mechanisms to discipline or remove those who prove incompetent or unethical.

The environmental profession does not have a uniformly recognized licensing or registration program. While some engineers or attorneys work in the environmental arena, their licensing procedures generally do not focus on environmental issues. In many instances, there are no clear competency requirements for professionals working in the environmental field.

This project involved legal and factual research, beginning in the libraries and on the Internet, and continuing with requests for additional information from agencies and organizations involved with licensing, registration, and certification of personnel who work in the environmental arena. Follow-up requests and interviews were conducted, as appropriate.

The greatest level of regulation was found at the technician level, with the Texas Natural Resource Conservation Commission (TNRCC) overseeing fourteen occupational certification programs. Examples of those being regulated are municipal solid waste technicians, underground storage tank contractors, and wastewater treatment plant operators who must meet education and experience requirements and pass examinations before they can be licensed. Licensing programs vary from state to state.

Lisa Brunn Gossett, J. D., Assistant Professor of Environmental Management, studies licensing requirements for professionals.

In contrast, the treatment of white collar environmental workers is not as clear, running a broad spectrum of control and credibility. On one end are those working in established licensed professions such as law or engineering. Some environmental statutes require that a registered professional engineer certify plans or conduct specified tests. For many environmental activities, an engineer is not the most appropriate professional, and there are few legal restrictions on who may perform diverse operations.

In the middle of the spectrum are various voluntary certification or registration programs for environmental professionals. These voluntary programs serve to inform the public, employers, and clients of experience and competency levels. The two leading interdisciplinary credentials are the Certified Environmental Professional (CEP) and the Qualified Environmental Professional (QEP). Both have their roots in established, nonprofit professional organizations. Many other professional certifications exist in narrower areas of expertise.

On the other end of the spectrum are organizations that primarily provide environmental registrations and certifications which have neither a clear legal recognition nor an affiliation with an established professional organization. These have given rise to charges of opportunism, as they generate fees from courses, exams, and annual renewals.

Again, the relative youth of the environmental professions contributes to the current state of confusion. It is often difficult to compare the validity of various credentials. Some argue for increased legal recognition of environmental credentials, while others argue that the industry should be given more time to evolve means of regulating itself. The solution will probably be a hybrid. The environmental profession is too broad for a single certification to apply. However, the certification process needs more uniformity and organization, possibly weeding out some of the less valid credentials, and consolidating competing programs.

A law review article on the subject was submitted. The project is continuing with a survey to determine how environmental employers view some of the existing voluntary certification programs.

Building a Collaborative Decision Processes Between Stakeholders in TED Controversy —At Issue are Shrimp and Turtles

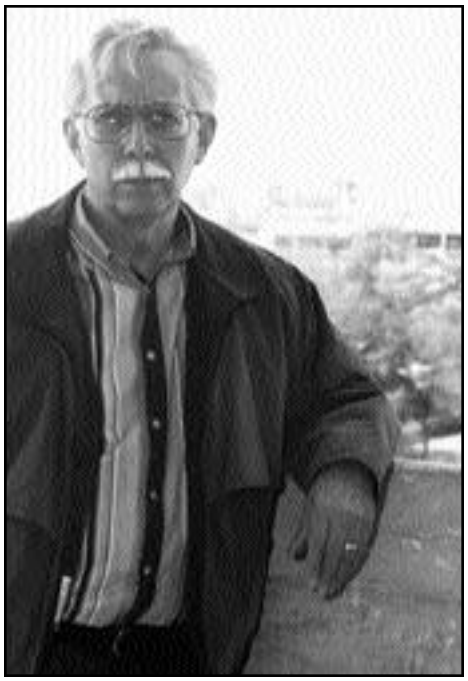
Robert L. Heath, Ph.D., Professor and Director, Institute for the Study of Issues Management, UH; Priscilla A. Weeks, Ph.D., Research Associate, UHCL

RESOLVING CONFLICTS among key entities that work to exert their interests in the Gulf Coast region can be a key function of academic institutions like the University of Houston. A UH study on conflict resolution entailed surveying key players to determine their willingness to participate in collaborative decision making efforts to solve the regulation of shrimp harvesting in ways that are environmentally sound. Letters were sent to 200 key players in Texas and around the country seeking their comments on the advisability of such an effort and their willingness to participate in collaborative decision groups to solve the problem of shrimper TED regulation. The researchers in this project believe that if the key players are favorably disposed to such an effort, funding can be obtained to support collaborative decision making panels so that the battle is not waged in court or in the news media, but occurs at the conference table.

Responses to the letters indicated that key environmental group members, state legislators, scientists, regulators, and shrimp industry persons believe that open, constructive, and sustained dialogue can be useful to resolving the controversy. For the most part they indicated they would be willing to participate in such efforts. However, two extremes indicated reluctance to participate, preferring to litigate or protest.

This research effort has attempted to review efforts by others engaged in collaborative decision making efforts. One effort in 1988 was unsuccessful. Another attempt was made in 1995. Researchers are monitoring the latter effort to determine whether those persons who attended sessions designed to reduce conflict believe it was successful. The researchers will survey persons who did not attend to determine their reactions. This effort will continue to lead to a definition of the problem.

Project team members are interested in continuing this project to determine the strengths and weaknesses of previous collaborative decision making efforts. Three outcomes are projected. One is the creation of articles regarding the problems faced in past efforts to bring the players together in ways that effectively resolve the controversy. The second is the development of alternative collaborative decision-making methods and protocols. The final objective is to obtain funding that can be used to create and sustain collaborative decision making panels that effectively resolve the controversy regarding the design, selection, and use of TEDs as a means for protecting sea wildlife, especially turtles.



Dr. Robert Heath in the Institute for the Study of Issues Management is concerned about conflicts that arise amongst fishing interests in the Gulf of Mexico. While commercial interests need to harvest crops to stay alive, Gulf species need to be protected with TEDs.

Where does one find information about efforts to resolve conflicts on environmental policy?—

Use the electronic databases in the University of Houston and UHCL libraries to locate journals such as:

Communication Yearbook
Human Communication Research
Institute of Environmental Sciences (IES)
Journal of Experimental Psychology
Journal of Public Relations Research
Progress in Communication Sciences
Public Opinion Quarterly
Risk Analysis
Science Citation Index (SCI)
Social Science Citation Index (SSI)
Speech Monographs

Data searches can be con - ducted at the Electronic Publications Center on the ground floor of the M. D. Anderson Library on the main campus of the University of Houston.

Default Controller Unit for Reducing Traffic Congestion

John C. Watson, Ph.D., Assistant Professor; Burt Marlow, graduate research assistant, UH

REDUCING FUEL CONSUMPTION and exhaust emissions caused by vehicles stalled at malfunctioning traffic signal lights is the objective of the default traffic signal light controller project.

Most traffic signal lights are controlled by a microprocessor-based traffic controller which has been programmed to provide the desired traffic signal light display sequence based on traffic surveys, rush-hour traffic patterns, and time-of-day. These controllers are usually traffic-actuated in that they adjust the signal light display sequence to accommodate special conditions such as granting a left turn signal to vehicles detected in the left turn lane of an intersection. On major streets, traffic-actuated controllers will attempt to maintain right-of-way to through traffic, if possible, without violating the maximum allowable green signal light "on" time constraints.

Microprocessor-based controllers generate 24 VDC digital output signals which drive triac load switches. The load switches power the 110 VAC traffic signal lights suspended over the intersection. Since it is possible for a load switch to fail in the "on" state, there exists the dangerous scenario in which conflicting green signal lights could be simultaneously displayed in error. A conflict condition occurs whenever a traffic signal light display sequence grants the right-of-way to lanes of traffic that could result in a collision. For example, displaying a left turn signal when right-of-way has been granted to oncoming traffic would be a conflict condition. To prevent this potentially dangerous failure, the conflict monitor shown in Fig. 1 tests the 110 VAC field wiring for conflicting patterns. Should a conflicting display be detected, the traffic signal lights are immediately placed in the flashing red sequence.

Many primary controller failures are not necessarily due to failed load switches. It is not uncommon for an electrical power surge, noise spike, skipped CPU clock cycle, or software glitch, to cause the microprocessor-based primary controller to fail activating the conflict monitor.

The default controller module shown in Fig. 2 installs in the existing traffic control box where it continually monitors the primary controller 24 VDC output signals. When the default controller detects a 24 VDC contact level failure, it sends an interrupt signal to the primary controller and places the traffic signal lights in a pre-timed signal light phase sequence. The default controller sends a serial message through the RS-232 port notifying maintenance personnel of the primary controller failure. Although the default controller will not perform actuated traffic control, it will allow vehicles to safely proceed through the intersection until the primary controller can be repaired.

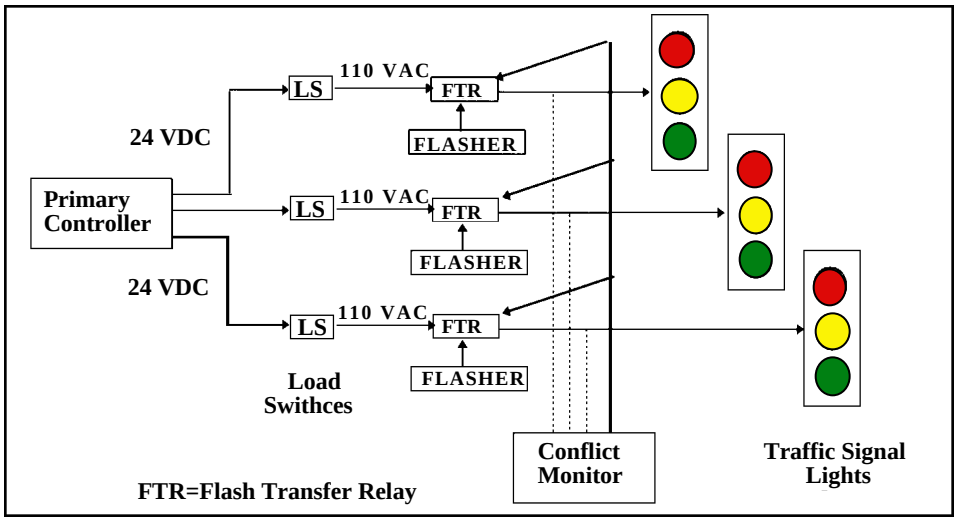


Figure 1. Traffic Signal Light Controller with Conflict Monitor

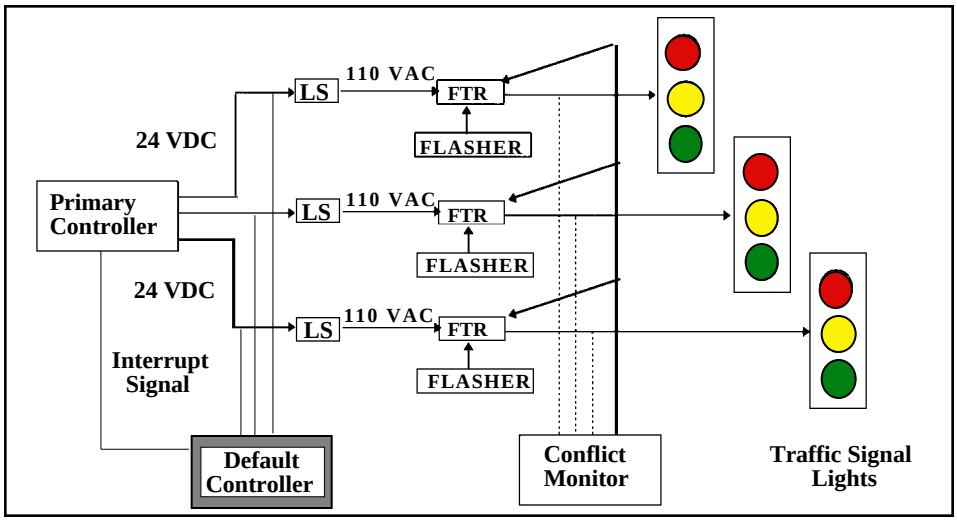


Figure 2. Default Controller Implementation within Existing Traffic Control Box

Research demonstrates the feasibility of installing a default controller unit which could recognize primary controller failure and maintain a pre-timed traffic signal light phase sequence. The default controller must acquire control of the traffic signal lights within 200 milliseconds before the conflict monitor automatically transfers control to the flash transfer relay. The primary difficulty concerns the legal issue in that to provide backup control of the traffic signal lights, the default controller must preempt the conflict monitor.

Development of an Air Pollution Course for the Environmental Engineering Program

Dennis Clifford, Ph.D., Professor, UH; John A. King, Ph.D., Shell Development Company

THE ENVIRONMENTAL INSTITUTE OF HOUSTON (EIH) supported the development of an air pollution course at the University of Houston needed by students in the Environmental Engineering Program. Although air pollution is one of Houston's major environmental problems, courses in air pollution have not been available to students in the Environmental Engineering programs at either the University of Houston or Rice University.

Some graduates of the Environmental Engineering Program have lamented the absence of an air course in their degree program because they have been faced with air-related problems on the job. Students desiring certification as a "Professional Environmental Engineer" must pass the National Council of Engineering Examiners Principles and Practice of Engineering (PE) test, which includes at least one mandatory air pollution problem.

As a result of this EIH grant, Dr. John A. King, a Research Engineer with Shell Development Company's Environmental Technology Directorate was able to develop and teach a graduate course titled "Air Dispersion, Emissions and Controls" at the University of Houston during the spring of 1996. Dr. King gained permission to participate in the educational program at UH under the aegis of A. B. Krewinghaus, Manager of Environmental Technology at Shell Development Company.

Dr. King's financial support was provided by the UH Department of Civil and Environmental Engineering. Graduate students from the University of Houston, supported by this EIH grant, assisted in developing the course by performing library research, preparing class notes and computer artwork for lectures and handouts, and by solving and grading homework assignments.

The course covered the following areas:

- Air Pollution Fundamentals, Overview, History
- Sources, Causes and Effects of Air Pollution
- Particulate Emissions and Control Technologies
- Gaseous Emissions and Controls
- Emissions Estimation and Measurement
- Source Sampling
- Pollutant Monitoring
- Dispersion Modeling for Air Toxins, Criteria Pollutants and Odors
- Accidental Release Modeling
- Mobile Sources
- Climactic Change

Dr. Dennis Clifford, chair, Department of Civil and Environmental Engineering (*l.*), is shown (left) at the FlamAtomic Absorption Spectrometer (FAA) with Thannhi Nguyen (*r.*), graduate student in environmental engineering. This equipment analyzes toxic metals in water, air particulates, and soil. The Flame AAis part of $1,000,000 worth of equipment purchased through the instrumentation upgrade program of the National Science Foundation, with matching HEAF funds. UH environmental engineering was one of three programs in the nation awarded this NSF funding on a competitive basis in 1996.

"Thanks forteaching the course. I got a lot out of it. At the TNRCC show in Austin two weeks ago, I went to some of the seminars about air dispersion modeling and I understood exactly what they were talking about. It was a change from some of the ones I'd attended before."

"Thanks it was a very interesting class. Some day I may need to do air modeling...."

"I learned a lot this semester, but I came to realize that I have picked up quite a bit along the way these past twelve years just doing this for a living."

"It was a very good course you put together. Thank you for the effort you made."

Guest lectures were presented to the class by experts in the areas of grid-based photochemical modeling (Dr. D. C. Baker), ambient and stack monitoring (Dr. K. R. Loos), dense gas releases (Dr. G. E. DeVaull), and wastewater treatment emissions (Dr. S. Rajagopalan).

Twenty-nine graduate students enrolled in this class, including students of the departments of environmental engineering and chemical engineering. Several more audited the lectures, reflecting the strong demand for this course and the importance of its subject matter.

As a result of planning and preparation, the Environmental Engineering program has strengthened its offerings, and students are now in a better position to treat subjects of environmental pollution. Efforts are under way to offer this course to environmental engineering students on an annual basis.

‘Writers in the Park’–Experiment in Urban Education

Terrell Dixon, Ph.D., Associate Professor, UH

THE FRIENDS OF HERMANN PARK in Houston and the Environmental Institute of Houston sponsored an experimental program in urban environmental education. The Friends of Hermann Park contributed through a grant from the Lila Wallace Foundation’s Urban Parks Initiative. The purpose of the program was to create interest in the environment and develop the writing skills of inner-city children, predominantly children in the third to fifth grades in elementary schools near Hermann Park.

Mr. Snake

Slick,
Sly,
Some are shy.
Some are rough.
Some are dry.
Some are old and some are new.

–Shelby Simon

To accomplish this, environmental educators on the staff of the Friends of Hermann Park staff met with Dr. Terrell Dixon of the English Department and selected literature and creative writing graduate students from UH and Rice University to take part in instructional activity. These students, all of whom had a special interest and training in environmental writing and literature, worked with Dr. Dixon and the staff to design an environmental education curriculum that utilized the natural features of Hermann Park—the trees, wildflowers, and birds—and the human-made features—the Zoo, the Museum of Natural History—to provide inner city students with a hands-on education about the workings of nature. All of the inner-city students wrote about what they saw and investigated. Selections of their written work were printed in a booklet at the end of the class. The conclusion of the class was also the occasion for a program at the Children’s Museum where parents and family members came to hear the children read their work from the class booklet. This final event was covered by the media and attended by members of the Houston Parks Board and board members of The Friends of Hermann Park as well as by representation of the Environmental Institute of Houston. Graduate students in environmental literature who planned and taught in the course were Steven Browning, Claire Lawrence, Jimmy Langston, Pam McCaul, John Michael Riveria (UH) and Lisa Slappey (Rice University).

Because this experimental, incubation version of “Writers in the Park” was successful, plans are being made and funding is being sought to repeat and expand the program next summer. This innovative project in urban environmental education will be featured in at least one conference paper (the meeting of the Association for the Study of Literature and the Environment) and a journal article.

I AM

I am a tiger roaring for food.
I am a flower being showered with water.
I am an elephant protecting my family.
I am an eagle taking flight.
I am a bird exploring my planet.
I am a tree growing tall.
I am a dolphin swimming.
I am a cricket singing with songs of joy.
I am a bee stinging people with anger.
I am a cat growling at my enemies.
I am a dog biting the mailman
when he comes without letters for me.
I am crickets leaping with joy.
I am a plant dying as nature grows.
I am ants eating everybody’s food.
I am a snake slithering away with fear.
I am a human dying as nature goes on.

Susan Payne

I AM

I am handsome like the water that goes through rivers.
I am smart like a cheetah.
I am sensitive like grass.
I am helpful like myself in nature.
I am nine years old like the fish in rivers.

Jesse Thompson, Jr

Spider

I was a spider once; I feared humans.
So now that I’m human again
I don’t kill them anymore
Cause I know how they feel.

Ja’Maer Callagain

Spider photo by Ed Nieuwenhuys

Geography Institute for Teachers: Analyzing Global and Environmental Geography with Space Age Technology

Joan N. Maier, Ed.D., Assistant Professor and Director, Geography Institute for Teachers, UHCL

TWENTY-TWO K-12 TEACHERS, representing 12 private and public school districts in Texas, actively and enthusiastically participated in the Geography Institute for Teachers: *Global and Environmental Geography with Space Age Technology*. The 22 teachers, selected from a pool of applicants, also received 115 Space Shuttle photographs and slides, a set of five wall maps, a United States Atlas, and other classroom curricular materials worth hundreds of dollars. Three university professors, three NASA Earth Observation scientists, and two National Geographic Society Teacher Consultants (NGSTCs) constituted an interdisciplinary team of instructors.

The Institute was conducted for a total of three weeks during the summer of 1996 at the University of Houston Clear Lake. The first two weeks included content lectures connected directly to the 115 specific space shuttle photographs, basic training in interpreting those space shuttle photographs, and hands-on practice in problem-solving instructional strategies. In addition, teachers participated in a physical, environmental, and cultural geography field trip to Galveston Island that demonstrated instructional strategies which integrated geographic field work techniques, geographic content knowledge, and space shuttle photography. During the field trip the teachers kept a journal to record written and graphic description of their field observations.

During the third week, the teachers individually consulted with the Institute's team of instructors to complete the development of a total of 66 different problem-solving lessons and 66 different classroom activities that utilized space shuttle photographs to teach environmental problems and other related topics. Some teachers developed interdisciplinary lessons and utilized multimedia technology. Each teacher was required to demonstrate a "Binko Method" problem-solving lesson and one activity to the class.

The teachers provided written peer feedback of each demonstrated lesson. The NGSTCs provided written feedback and evaluation of each lesson presented. The written lessons and activities were evaluated by the Institute's director and the NGSTCs.

Photo by NASA

Education programs utilize photographs of the Galveston Bay Region taken from space platforms showing weather and land use patterns.

The twenty-two teachers plan to utilize their developed curricular materials and the space shuttle photographs to teach their students. Seventeen of the 22 teachers indicated that they plan to design and implement approximately 28 in-service workshops to district, local, state or national professional meetings based on curricular and space shuttle photographs from the institute.

Four of these teachers, for example, presented their demonstration lessons at the Texas Alliance for Geographic Education Conference, September 14, 1996.

The success of The Geography Institute for Teachers will continue to be evaluated for effectiveness through follow-up surveys and telephone interviews with participating teachers.

The Institute received exceptionally high ratings from these teachers who expressed renewed enthusiasm and commitment to "passing the torch" to the next generations of dedicated citizens who will search for solutions to environmental problems.

The Sanitary City

Martin V. Melosi, Ph.D., Professor; Tom Kelly, graduate research assistant, UH

THE SANITARY CITY: *Technology, Environment, and Urban Growth in America, 1790-1990*, was the focus of research conducted under the aegis of the Public History Program at the University of Houston.

History graduate student Tom Kelly was engaged to conduct several bibliographic searches and to collect pertinent material to be utilized in the writing of the last chapter or chapters of a book to be published with the title *The Sanitary City*.

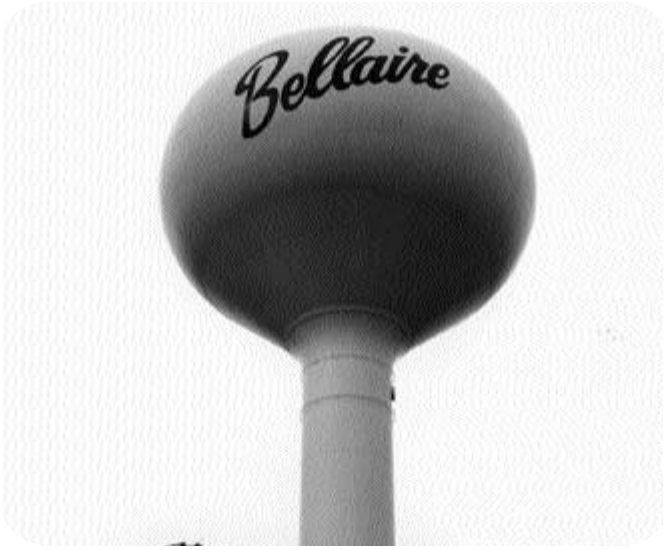
Kelly has collected an extensive bibliography for the last segment of the book (a period covering 1970-1990 and dealing with water supply, wastewater, and solid waste).

We have evaluated those lists and identified material essential to the writing of the last chapter.

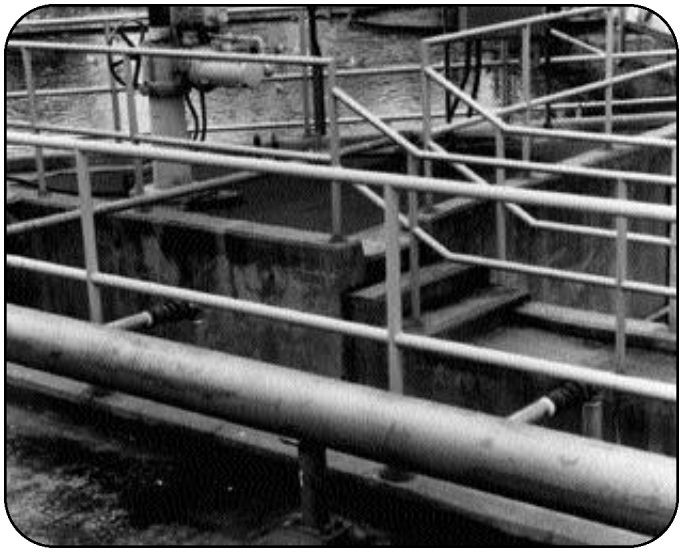
As of this date, I have revised more than 700 pages of the manuscript (covering a period from the colonial era to 1970) with each of the seven sections divided into four chapters each. In September 1996 efforts were underway to complete the last section of the book (four chapters) based on the materials collected under the terms of the EIH grant. The complete manuscript should be ready for submission to the publisher in 1997.

The grant helped to complete a crucial segment of research. We have been able to uncover a substantial body of literature, that will add to the substance of the book. The period 1970-1990, currently under study, is crucial to the overall conception of the volume and will provide insights that will broaden the public policy appeal of the volume.

This water tank in Meyerland in Southwest Houston at the corner of North Braeswood and South Rice Avenue was rebuilt in 1996 to increase pressure for residential housing.



The City of Bellaire in Southwest Houston reconstructed its water tower to meet increased demands for upscale housing where two-floor dwellings are supplanting one-story ranch-style homes built in the early '50s.



Between the busy thoroughfares of Beechnut and S. Braeswood in Southwest Houston, the City of Houston has expanded its wastewater facilities to serve a burgeoning population near the intersection of Highway 610 south and west adjacent to apartments and residential shops.

Sustainable Environmental Education Partnerships (SEEP)—Year-in-Review

Lynn Spachuk, Educational Coordinator, Environmental Institute of Houston

SCHOOLYARD HABITATS ARE GAINING momentum around the country. Three years ago EIH worked only with one school that had constructed a natural habitat; this year that list topped 40, a number of them featured at the Schoolyard Habitat Roundup scheduled in March 1996.

The Institute works with Texas Parks and Wildlife and the U. S. Fish and Wildlife Service in this effort. The wildlife agencies have the technical expertise, and EIH understands the needs of the formal K-12 classroom. The most effective event that EIH holds for the schoolyard habitat sites is the annual workshop. This year it was held at San Jacinto Intermediate School in Pasadena ISD and a tour of their habitat was included. EIH coordinates the effort of local experts in delivering presentations and answering questions for the teachers.

This year the hit of the event was a new curriculum designed by Dr. Carole Basile (UH visiting assistant professor) entitled "Nature at Your Doorstep." These outdoor classrooms, as some call them, are popular because they encourage students' interest in nature, facilitate learning, and integrate all the subjects into a central theme.

Photo by Linda Merritt

Connie Garland (*l.*) with Ryan Garza (*r.*) examining fish and shrimp seined from a saltwater pond at the Cedar Bayou power plant of the Houston Lighting & Power Company. Madelyne Tucker (*far r.*) looks from her vantage point.

Outreach Events

For environmental education to be people-centered, organizations like EIH must participate in outreach efforts. This year, we participated in **Trash Bash** which is a program focused on people coming together to pick up trash along the rivers, bayous, and bays. In this effort, the Texas Natural Resource Conservation Commission enlists the help of industry, nonprofit organizations, schools, and individuals.

For **Earth Day**, EIH worked with the Jesse Jones County Park in north Houston to provide educational activities to area citizens. The focus was on water since this is the site at which Spring and Cypress Creeks meet. The event was identified as the WET FEST.

Bay Day is an event designed to center attention upon the value of Galveston Bay and the fact that humans have always relied on the bay for numerous resources from food to recreation.

In February, the writing team for the new Texas Essential Knowledge and Skills program (K-12 standards) converged at NASA and Space Center Houston. EIH was present, highlighting the value of schoolyard habitats in providing a place for hands-on, process oriented instruction.

Training

Dr. Robert M. Jones leads the training efforts of EIH. Working with local teachers and graduate students, he is developing a handbook for corporate personnel who volunteer their expertise in classrooms. The handbook provides a checklist of *do's* and *don'ts*. The program was field-tested with 67 Houston Lighting and Power employees and their families at their Cedar Bayou facility. Parents learned as much as their children, and HL&P was surprised about how little some of their employees knew about various environmental initiatives of the company.

The graduate course on "Teaching Environmental Science" was sponsored by Houston Lighting and Power in partnership with the Texas Natural Resource Conservation Commission and UHCL. Dr. Jones and Lynn Spachuk worked with local industry, nature centers, government agencies, and other area experts to create a course that looked at issues of the environment from multiple perspectives. The course was held at six Texas Universities, and, although it was UHCL's first year, the local course was rated by participants at the same level as sites that had conducted the course for a couple of years. The course invokes a message of personal responsibility toward the environment which Dr. Jones and Ms. Spachuk emphasize as a pivotal point of understanding in the field of environmental education.

- Trash Bash
- Earth Day
- Bay Day

EIH works to involve many participants in the environmental education arena. It is this participatory partnership approach that has vaulted EIH into a leadership role.

Publications

Edwin H. Bryant

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A lone figure faces the Houston wastewatertreatment facility in Southwest Houston constructed between N. Braeswood and Beechnut outside Loop 610.

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Regina M. Capuano

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Sam Chen

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Lisa Gossett

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James R. Lawrence

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L. James Lester

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Melosi, M. V. "Sanitary Engineers in American Cities," Engineers as Policymakers: The Myth of the Apolitical Engineer, Amer. Soc. of Civil Engineers, Washington, D. C., 1996.

Melosi, M. V. "Theodore Roosevelt: Rough of the Progressive Movement," President, Politics, and the People series, Houston Seminar, Houston, TX, 1996.

Lynn Spachuk

Spachuk, L. "How the Environment is Important to Urban People," Houston Read Commission, Houston, TX, May 1996.

Spachuk, L. "Issue Investigation," Rice School Workshop, Houston, TX, July 1996.

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John C. Watson

Watson, J. C. "Spread Spectrum SCADA Communication Systems for Energy Management." Engineering & Architecture Symp. (E&A'96), Jan. 30-31, 1995.

Watson, J. C. "Interfacing UNIX Relational Database Management Systems to the World Wide Web/Internet." Engineering & Architecture Symp. (E&A '96), Feb 5-6, 1996.

Watson, J. C. "Low-Rate Spread Spectrum Communications for Remote Monitoring Applications." Engineering & Architecture

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Priscilla Weeks

Weeks, P. "Environmental Education and Other Cultures?" Amigos Workshop, Houston, TX, Jan. 1996.

Weeks, P. "Global Local Linkages in Fisheries Aquaculture Development," panelist, Soc. for Applied Anthropology, Baltimore, MD, March 1996.

Weeks, P. "Stewardship, Science, and Other Ideological Barriers to Co-Management," Int'l Assoc. for the Study of Common Property, Berkeley, CA, June 1996.

Weeks, P. and B. Heath. "By Catch Policy: The Next Step," Texas Academy of Science, Galveston, TX, Feb. 1996.

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Gerard M. Wellington

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Grants and Proposals

Edwin H. Bryant

"The Relationship Among Domestication, Levels of Genetic Variation and Population Size: Implications for Managing Endangered Species." NSF Dissertation Improvement, D. Reed, 1995-97, $7500.

"The Translocated Male Determining Factor in *Musca domestica*: a Model System for the Study of Sex Chromosome Evolution." NSF Dissertation Improvement, M. Clark, 1995-97, $10,000.

Guy N. Cameron

"Analysis of Rare Resources in Texas." Texas Natural Heritage Program, Texas Parks and Wildlife Dept., 1995-96, $25,000.

"Effect of Climate Change on Distribution, Diversity, and Productivity in Grassland, Forest Habitats: a Regional Perspective." National Inst. for Global Environmental Change, Dept. of Energy, 1994-96, $162,894.

"Effect of Prescribed Burning on Productivity, Structure, and Nutrient Content in a Gulf Cordgrass Habitat." Nature Conservancy of Texas, 1996-97, $4,900.

"Effects of Habitat Fragmentation on Biodiversity: Implications for Management of Wetlands." U. S. Fish and Wildlife Service, 1995-96, $12,164.

"Herbivory and Granivory by Rodents at La Reserva de la Biosfera Sierra de Manantlan." NSF, 1995-97, $14,711.

"Using Remotely-Sensed Data to Measure Primary Production." Research Fellows Program, Midwestern Regional Center, Nat'l Inst. for Global Climate Change, 1995-97, $3,500.

Regina M. Capuano

Aluka, I. J. and R. M. Capuano. "Predicting the Leachability of Trace Elements in Fly Ash." Department of Energy, 1996-99, $107,381; pending.

G. Ron Chen

"AFuzzy Expert System for Fault Management of Water Supply and Recovery in the ALSS Project." Principal Investigator: J. Li; NASA-JSC, Intelligent Systems Division, 1995-97, $100,000.

"Robust Optimal Digital Control of Uncertain Multi-Rate Sampled-Data Systems." Principal Investigator: L. S. Shieh; US Army Research Grant Program, 1994-96, $180,000.

"Adaptive Robot Vision and Control." Principal Investigator: H. Ogmen; Texas ATP Program and NASA-JSC, 1994-95, $135,000.

"Fuzzy Logic Package for Thermal Instruments and Manufacture Process Controls." Co-Principal Investigator: H. A. Malki; Dow Chemical Company, Freeport, TX. 1995-97, $10,000.

"A Fuzzy Logic Based Expert System Design for Water Supply and Recovery in Spacecraft Life Support Systems" Co-Principal Investigator: J. Li; NASA Headquarters, April 1996, $324,574; submitted.

Sam Chen

"Photo-Decomposition of Triazine Pesticides with Light-Activated Semiconductors in Aqueous Media." Gulf Coast Hazardous Substances Research Center, $20,321; unfunded.

Robert L. Heath

"Community Empowerment Strategies: Environmental Justice along the Houston Ship Channel." Co-Investigator: G. M. Vasquez; Environmental Protection Agency, $273,000; submitted.

"Community Survey Regarding the Success and Challenges for the Community Emergency Response Communication Campaign." Deer Park and LaPorte, Local Emergency Planning Committees, $15,000.

"Focus Groups and a literature Review to ascertain the Variables Involved in Environmental Justice/Equity." Co-Investigator: G. M. Vasquez; Houston Coastal Center, $5,000.

Limited Grant in Aid funding to Travel to Washington, DC to Support EPA Environmental Justice Proposal, $995.00.

"A Survey of Patterns of Uncertainty Regarding Risk Related Issues." Co-Investigator: G. M. Vasquez; Houston Coastal Center, $3,500

"A Survey on Risk Perception and Emergency Response Preparedness." Fort Bend County Emergency Response, Local Emergency Planning Committee. $14,000.

James R. Lawrence

"Detection of Tropical Cyclone Activity in the Past from Stable Isotopic Analysis of Clam Shells and Tree Rings." Risk Predictive Initiative of the Atlantic Global Change Inst., June 1, 1996-May 31, 1997, $80,627; submitted.

"Detection of Tropical Cyclones of the Past: Development of a New Stable Isotope Paleoclimatic Tool." NSF, $220,785; submitted.

"Stable Isotope Ratios of Precipitation and Water Vapor and the Water Balance of Hurricanes." Texas Higher Education Coordinating Board, Jan. 1994-Aug. 1996, $100,000.

"Stable Isotope Studies of the Natural Waters of SE Texas." Houston Coastal Center, $1000.

L. James Lester

"Partnership Grants for Schoolyard Conservation Sites." USFWS, July 1996-June 1998, $5,000.

"Cruising the Wetlands." EPA, Sept. 1996, $10,000.

Joan N. Maier

Institute for Space Systems Operations, UH, $13,925.00.

Faculty Research Fund, $5,000.00.

Texas Alliance for Geographic Education, $6,000.00.

HeidarA. Malki

"AHeuristic Approach to Determine the Gains of a Fuzzy PID Controllers." LGIA, 1996, $2000.

"Material Synthesis Using Neural Networks." Co-Principal Investigator: A. Bensouala; PEER, 1996-97, $5000.

"Development of a Neuro-Fuzzy Based Oil/Gas Producibility Model," Energy Lab, 1996, $6,350.

"Fuzzy PID Controllers Design for Space Robotics Applications." Principal Investigator: G. R. Chen; NASA, $56,350.00.

"Design of a Neural-Network Based Controller for Advanced Material Synthesis." Principal Investigator: A. Bensouala; NASA, $59,997.00.

"Fuzzy Logic Package for Thermal Instruments and Manufacture Process Controls." Principal Investigator: G. R. Chen; Dow Chemical Company, Freeport, TX, 1995-97. $10,000.

John C. Watson

"Automating the Transfer of Contractor Parts Data to a Common Database Using X-Windows and Shell Programming." Institute of Space Systems Operations, 1995, $2,500.

"Optimizing SCADACommunication Systems for Energy Management." Energy Lab, 1994-1995, $4,242.

"Remote Electric Metering Using Spread Spectrum Radio." Energy Lab, 1995-1996, $3,556.

"UNIX Operating Systems and Shell Program Development Laboratory." IBM UNIX Laptop Computer Donation, 1996, $80,000; awarded eight laptops.

"Test platform for Verifying Performance of NTCIP Compatible Traffic Signal Light Controllers." Metro Transit, $13,132.98; pending.

Priscilla Weeks

"Global Partners? Transnational Environmentalism and the In-Country Environmental Organization." NSF, July, 1996, $73,201.

Cultural Models of Scientific Fisheries Management." Wenner-Gren, Nov. 1996, $11,000; pending.

Gerard M. Wellington

Grottoli-Everett, A. U. S. Environmental Protection Agency Academic Fellowship Award, $25,000/yr.

"Patterns of Climate Change in the Central and Eastern Sectors of the South Pacific." NSF, Climate Dynamics Program, $26,056.

Richard C. Willson

Gulf Coast Hazardous Substances Research Center, 1995.

UH Shell Scholars Program, 1997.

The Environmental Institute of Houston Advisory Board, 1995-96

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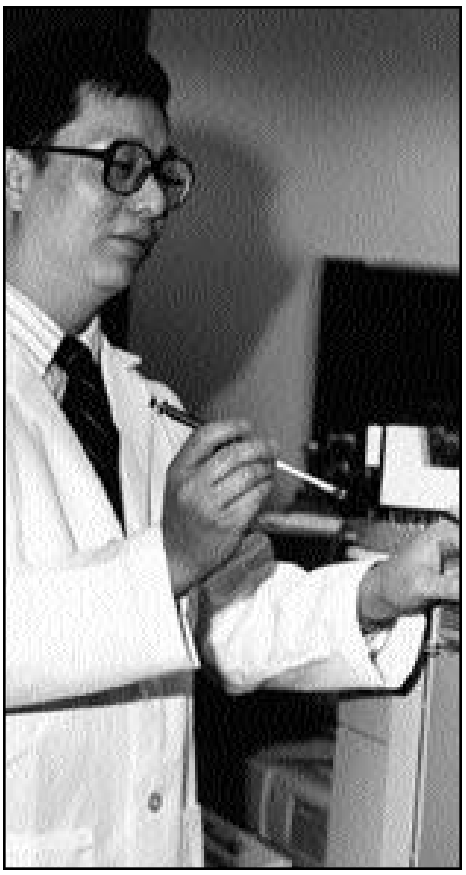

Principal Investigators

Prof. Sam Chen, (UHCL), is working on the photodecomposition of the pesticides atrazine and cyanazine with a light-activated semiconductor, TiO_2, as the catalyst using a gas chromatography mass spectrometer (GCMS) [p. 2].

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Photo by John Waddington

The molecular conservation genetics of Texas wetland birds, p. 7.

BACK COVER—Dr. Terrell Dixon, Director of the Scholars' Program at the University of Houston and a specialist in environmental literature, is shown with Claire Lawrence, doctoral student in creative writing, and John Langston, doctoral student in literature, at Sims Bayou—within five miles of the University of Houston—where flood control efforts are nearing completion. Apartments near the bayou have been demolished, the bayou widened and the banks reinforced with steel rods and concrete forms.

Dr. Dixon led the Writers-in-Hermann Park program, whereby school-age youngsters from the 2nd through the 5th grades studied environmental problems and used their studies as the basis for writing exercises. Their poetry appears on page 15. He was assisted by graduate students in English, among them Ms. Lawrence, a tutor in the Writers in the Schools program, and Mr. Langston.

The Environmental Institute of Houston
1996 Annual Report

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Houston, Texas
March 1997

Flood Control Project at Sims Bayou

The Environmental Institute of Houston
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