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EDITORIAL COMMENTS

Dear MAS Journal Editor (Comments to the Editor),

As a resident of Waveland, Mississippi, I read with interest your October 2007 Katrina Special Edition. As a professor at the University of Southern Mississippi's Gulf Park Campus, I selected the article by Gill, Ladd and Marszalek, "College Students' Experiences with Hurricane Katrina: A Comparison Between Students from Mississippi State University and three New Orleans Universities", for special attention. But I was disappointed to find some of the details about the storm were incorrect, and I would like to take this opportunity to set the published record straight. Not all Mississippi Institutions were closed down for a week or less. Our Campus, located directly on the Gulf of Mexico, took about a month of incredibly hard work before it could re-open at a new location. Thanks to history professor Pat Smith's enthusiasm and Director Pat Joachim's indomitable spirit, as well as a host of other faculty and staff, we were able to reschedule classes on a 10 week 'summer' schedule, and began classes at an alternate facility about a month after the storm.

The article also states that the "context of the catastrophe were significantly different for college students (and residents) of New Orleans than they were for students in Mississippi ... For weeks, New Orleans universities were without electrical power, water, phones, or other basic services." We on the Mississippi Gulf Coast were certainly without basic services for a significantly long time as well. I personally recall waiting over two months to take a hot shower (fortunately it was warm for weeks after the storm). Our situation here on the Mississippi Gulf Coast was much closer to that of New Orleans, than it was to Starkville. Further, they state that the "Pearl River Community College in Waveland, MS was completely destroyed". This is wrong. PRCC has a small extension store front in Waveland that was flooded, but the building was not washed away. That strip mall has been up and in business for over a year now.

They also stated the "a few other small coastal campuses suffered" damage. There were two large University sites on the coast, USM Gulf Park and William and Carey. Both of these suffered extensive damages, and neither campus has yet rebuilt the buildings that incurred major damage. To the best of my knowledge, the USM Gulf Park campus rebuilding decisions have not been finalized. I do not know what William and Carey plan to do.

Even their facts about Katrina are wrong. They state that Katrina "entered the Gulf of Mexico with Category 5 winds". Katrina hit the east coast of Florida as a minimal hurricane, but exited into the Gulf of Mexico as a well organized maximal tropical storm. She quickly strengthened back into a hurricane, and reached her maximum intensity 170 nautical miles SE of the mouth of the Mississippi River (www.nhc.noaa.gov).They also state that "In Mississippi, most damages were a direct cause of wind and storm surges", indicating that the damage in Louisiana was man made, while the damage in Mississippi was caused by nature. In the book "The Storm: What Went Wrong and Why during Hurricane Katrina -- the Inside Story from One Louisiana Scientist", Ivor van Heerden and Mike Bryan argue convincingly that the disastrous water waves that hit the coast of Mississippi originated in part along the Eastern side of the Mississippi River Levee as Katrina approached landfall. The massive amounts of water she was pushing in front of her were held in place by the levee instead of being allowed to flow back out into the Gulf of Mexico. Once the eye of Katrina moved into lake Bourgne, her West quadrant winds threw this piled up water against the coast of Mississippi. If this is true, the most damaging water waves were not

due to storm surge, but, as was the case in Louisiana, to secondary effects from man-made structures. This question is, to my mind, the most important and overlooked detail of Katrina's behavior along the Mississippi Gulf Coast, because it may indicate that similar storm paths may be equally dangerous to the population here on the Mississippi Gulf Coast in the future. It may also indicate that building the levee's higher in Louisiana may exacerbate Mississippi's future storm damage. I think it is a good idea to avoid attributing all of the flooding to natural storm surge causes until the science has been able to separate these two effects.

I will end with a comment on their statement that the "disaster in New Orleans was exacerbated by the mismanaged response by FEMA". Having personally arrived back in Waveland five days after Katrina visited, I can personally attest to the fact that FEMA was no better managed in Mississippi than it was in New Orleans. Perhaps our citizens were more responsible, and even the military may have been more helpful here, than in Louisiana, but FEMA was not.

Sincerely,

Dr. A. Louise Perkins
School of Computing
University of Southern Mississippi, Gulf Park Campus
Long Beach, MS

Passing of a Friend

Dr. Jim Heitz, Past President of the Mississippi Academy of Sciences and long-time Exhibits Coordinator for the Annual Meeting, passed away on August 1 of this year. Jim succumbed to colon cancer and, when diagnosed, in typical Jim Heitz fashion, announced that he was lucky because, while everybody dies, he knew fairly precisely when he was going to die. He was an incredibly positive individual to the very end. Jim worked hard to support the MAS and built a strong core of exhibits for every meeting. He was directly responsible for the Board wine tasting and social before every Annual Meeting and for the reception after the Dodgen Lecture. (In addition to wanting an outstanding Annual Meeting, he also liked a good party!) He was recognized for his work by being awarded the plaque for Outstanding Contributions to the Mississippi Academy of Sciences. Jim Heitz was a rare individual and he will be missed by his friends and by the Academy.

Short-term Spatial Variations in the Beds of *Ruppia maritima* (Ruppiaceae) and *Halodule wrightii* (Cymodoceaceae) at Grand Bay National Estuarine Research Reserve, Mississippi, USA.

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ABSTRACT

Studies have reported extensive losses of Submersed Aquatic Vegetation (SAV) habitat along the Mississippi coast, but the estimates did not account for smaller scale temporal variations. We hypothesized that there were significant spatial and short-term fluctuations in SAV coverage along the Mississippi coast. We tested the hypothesis using field data collected in June/July 2005, October 2005, July 2006, and October 2006 at five sites in Grand Bay National Estuarine Research Reserve, Mississippi. Three-way ANOVA was used to analyze SAV depth distribution and abundance, which we surveyed along gradients of water depth and shoreline orientation. The SAV community, which consisted of *R. maritima* and *H. wrightii*, displayed significant short-term changes in abundance and species dominance, largely attributed to changes in *R. maritima* abundance between summer and fall. Our results on site variation in SAV coverage suggest that shore orientation within the estuarine system might be a contributing factor to the spatial difference in the shallow estuary. The effects of Hurricanes Katrina and Rita in 2005 on the SAV community appeared to be minimal. Despite the significant SAV decrease observed shortly after the storm passages, both species increased fast and significantly in 2006 in the estuarine area. However, *Ruppia maritima* that occurred in Bayou Cumbest has not returned since the hurricanes, probably due to the lack of a viable seed bank and remoteness from the estuarine source populations. Our results suggest that consistent SAV survey efforts are needed to reduce errors in assessments of disturbance/restoration impacts and long-term trends.

INTRODUCTION

Submersed aquatic vegetation (SAV) is the group of vascular hydrophytes that completes its life cycle under water. Estuarine SAV consists of freshwater species that tolerate brackish salinities (e.g. *Vallisneria americana* Michx and *Najas guadalupensis* (Spreng.) Magnus), euryhaline species that tolerate a wide-range of salinities (e.g. *Ruppia maritima* L. sensu lato and *Potamogeton pectinatus* L.), and true seagrass species (e.g. *Halodule wrightii* den Hartog and *Thalassia testudinum* K.D. Koenig). SAV is an element in essential fish habitat, which is defined by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (http://swr.nmfs.noaa.gov/pir/hcd/efh.htm). SAV is regarded as a vital internal factor of estuarine ecosystems (Carpenter, 1981) because healthy SAV beds affect processes, evolution, and fate of an estuary through dampening waves and currents, stabilizing sediments, and assimilating excessive plant nutrients and some toxic matter (Koch, 2001). Therefore, the status and type of an estuarine system can be inferred from studies of its SAV (Moore et al., 2000).

The decline of coastal environmental quality has become a global trend (Boesch et al., 2001), which results in the worldwide loss of SAV and its habitat. Sometimes, SAV habitat is destroyed or degraded as a result of projects of reclamation, freshwater diversion, or shoreline stabilization that are intended to restore coastal habitat (Poirrier et al., 1999). The

number of reports on SAV decline resulting from various natural and anthropogenic causes continues to increase (Larkum et al. 2006) despite rapidly increasing coastal restoration efforts.

Studies have reported extensive loss of SAV habitat along the Mississippi coast (Eleuterius, 1971; Eleuterius, 1973; Eleuterius and Miller, 1976; Eleuterius, 1987; Moncreiff et al., 1998). Eleuterius and Miller (1976) estimated a 33% seagrass loss after Hurricane Camille in 1969; Moncreiff et al. (1998) estimated that nearly half of the SAV existing in Mississippi Sound in 1967-1968 had been lost by 1992. The reports also described the significant or complete losses of the seagrass species *T. testudinum, Syringodium filiforme* Kutzing, and *Halophila engelmannii* Asch. ex Neumayer. The primary causes for this general decline in SAV habitat and the loss of species are likely water quality degradation and physical disturbances such as hurricanes (Moncreiff et al., 1998).

SAV distribution maps presented in the aforementioned reports and publications have been used as a critical indicator of the general long-term trends of SAV habitat in Mississippi Sound. However, estimation of the temporal changes in acreage were made largely based on the results of a few one-time boat surveys, which did not account for the fact that SAV abundance, composition, and distribution can significantly fluctuate seasonally and annually. Seasonal and annual variation probably have become more pronounced in the Mississippi SAV beds due to the declines of seagrasses such as turtlegrass (*T. testudinum*) and manateegrass (*S. filiforme*) which display more stable biomass (Hall et al., 1999).

The loss of *T. testudinum* and *S. filiforme* have resulted in the relative increase in abundance of wigeongrass (*R. maritima*) and shoalgrass (*H. wrightii*) in estuaries and along barrier islands of the northern Gulf of Mexico (Kahn and Durako, 2005; McGovern and Blankenhorn, 2007). Both *R. maritima* and *H. wrightii* exhibit opportunistic growth (Patriquin, 1975; Orth and Moore, 1988). In particular, *R. maritima* areal coverage and biomass are known to fluctuate considerably seasonally and annually elsewhere (Pulich, 1985; Lazar and Dawes, 1991; Cho and Poirrier, 2005). Moncreiff et al. (1992) stated that the primary production in the *Halodule* beds off Horn Island, Mississippi, varied significantly between summer and winter, but this was due mainly to the significant increase in epiphytic algal productivity during summer.

We hypothesized that there were significant spatial and short-term fluctuations in SAV areal coverage and species dominance along the Mississippi coast, especially due to the increased relative abundance of *R. maritima* and *H. wrightii* in the area; these fluctuations needed to be considered in evaluating long-term changes in the SAV community. We tested the hypothesis by analyzing the distribution of each SAV species along gradients of water depth and shoreline orientation using field data collected from biannual surveys conducted from June 2005 through October 2006 at five SAV bed locations in Grand Bay National Estuarine Research Reserve (NERR), Mississippi.

Grand Bay NERR was established in 1999 to preserve and protect one of the largest remaining expanses of estuarine environment along the Mississippi coast. The goal of the National Estuarine Research Reserve System (NERRS; Grand Bay NERR is one of 27 reserves in the system of the U.S.) is to monitor the health of the nation's estuaries and to foster wise stewardship of natural resources through research and education. Because the NERRS recognizes the importance of the SAV resource for fisheries production, cultural identity, and coastal protection, many reserves conduct seagrass surveys.

Prior to our study, there had not been any studies to systematically assess the seasonal changes in SAV abundance and species composition in the vicinity of Grand Bay NERR. Our study results also serve as a critical record of how the Grand Bay NERR SAV beds changed immediately after, and also approximately one year after, the 2005 passage of Hurricane Katrina.

The objectives of this study were three-fold: 1) understand short-term changes in the distribution and abundance of each SAV species in Grand Bay NERR; 2) determine if the passage of Hurricane Katrina in 2005 had any effects on SAV distribution and abundance; and 3) examine environmental factors (i.e., water temperature, salinity, pH, water column light extinction (K_d), and turbidity) for the study period to illustrate the general habitat water quality condition.

MATERIALS AND METHODS

Site selection and survey for shoreline distribution

A pilot survey to locate feasible transect survey sites was conducted using a 5.5-m flat bottom boat in May and June of 2005. Shoreline SAV distribution was surveyed by raking (dragging a rake along the bottom sediment) and wading in the areas of Middle Bay, Bayou Cumbest, Crooked Bayou, Bangs Bayou, Bayou Heron, North Rigolets, western Grand Bay, Grande Battures, and Pt. aux Chenes Bay (Fig. 1). Based on pilot survey observations, permanent transects were established at five survey sites, two in Middle Bay (Sites 1 and 2), one in Grand Bay (Site 3), and two in Pt. aux Chenes Bay (Sites 4 and 5), during June 2005 (Fig. 1). These areas represent approximately 60% of the SAV beds that exist in the Reserve. The sites were marked using PVC posts, and the coordinates at the posts were recorded using a GeoXT GPS (Trimble Navigation Ltd, Sunnyvale, CA) (Table 1, Fig. 1).

SAV depth distribution survey

The depth distribution surveys were conducted using fixed transects in June and July 2005, October 2005, July 2006, and October 2006. The dates of the transect surveys are presented in Table 1. At each site, three replicate transects were established using reel tapes and metal and PVC posts. First, a 30-m-long straight line was extended from the permanent PVC survey post, nearly parallel to the natural shoreline at each site. The 0-, 10-, and 28-m points were identified along the 30-m line. Then the three replicate transects were extended from these three (0, 10, 28m) points toward the water (perpendicular to shore and parallel to each other). The bearing for the transect extension at each site is presented in Table 1.

The first 200-m section of each transect was surveyed by snorkeling. While snorkeling each transect, we continuously measured and recorded the start and stop distances (to the nearest 1 cm) of SAV patches that were intercepted by the transect lines, and we recorded SAV species (i.e. *R. maritima*, *H. wrightii*, mixed beds, or bare substrate) of the patches. Vegetation density (dense, sparse, and bare) was visually estimated and recorded for the patches: dense for vegetation cover > 30% in the patch; sparse for 0% < vegetation < 30%; and bare for 0% vegetation. Water depth was measured to the nearest 5 cm using a graduated wooden stick at every 3 m along each transect starting from the shoreline.

When SAV was growing past 200 m from shore, SAV distribution was determined by raking from a boat as we followed the designated bearing (Table 1). The distance from shore to the deepest edge of SAV patches was calculated using the GPS. SAV species was observed and recorded at every 30 m along boat transects. Water depth was also measured at approximately 30-m intervals.

Monitoring of PAR, water temperature, salinity, pH, and turbidity data

Surface and underwater PAR (Photosynthetically Active Radiation; $umols^{-1}m^{-2}/uA$) was monitored at three sites, Grande Battures, Pt. aux Chenes Bay, and Middle Bay (Fig. 1; Table 1), twice a month from September 2005 to October 2006. Two of these sites (Middle Bay and Pt. aux Chenes Bay) were near SAV survey sites reported herein. PAR was measured using a LI-COR model LI-193SA underwater quantum sensor and photometer (LI-COR Environmental, Lincoln, Nebraska). We collected PAR readings at multiple depths at each site: 1) just above the water surface, 2) just below the water surface, and 3) 1.0 m below the water surface. When the site maximum depth did not reach 1.0 m due to low water conditions, PAR was measured at the maximum depth possible and this depth was recorded. During each series of collections, surface radiation (above the water surface) was read a second time to determine if changes occurred due to cloud cover. If the two surface measurements differed by more than 10%, all readings were discarded and the series of PAR measurements was collected again. All readings were 15 s averages and were collected in unshaded water between 1000 and 1500 hrs CST; no cloud cover was present during data collection.

We obtained data on water temperature (°C), salinity (ppt), pH, and turbidity (Nephelometric Turbidity Units; NTU) from YSI 6600 series datasondes (YSI, Yellow Springs, Ohio, USA) deployed at the mouth of Crooked Bayou in Pt. aux Chenes Bay (Fig. 1), one of the locations for long-term water quality monitoring at Grand Bay NERR. The water quality data were collected at 30-min intervals until June 21, 2006 and at 15-min intervals thereafter. This datasonde was moved to a sampling location in Pt. aux Chenes Bay, approximately 900m from, and in the same water body as, SAV sampling sites 4 and 5 (Fig. 1) during August 2005 because the equipment probes regularly became exposed during low tide events in the original location. We used data from June 2005-October 2006 to illustrate monthly patterns and changes in the water quality parameters during the study period.

Data analyses

Spatial and temporal variations in SAV depth distribution and species composition

Prior to the following analyses, water depth was calibrated to the mean water level by adjusting for the predicted tide level (http://www.usm.edu/gcrl/MStide/). SAV patches along the transects were adjusted for vegetation density by multiplying the segment length (m) of the SAV patches by SAV density (1 for dense, 0.3 for sparse, and 0 for bare). Then the coverage for each species along an entire transect was converted to proportion of vegetation per meter by dividing the

coverage in meters by the corresponding transect length. The proportions were then arcsine transformed to ensure normality and compared using three-way analysis of variance (ANOVA). The three independent variables were survey time (June/July 2005, October 2005, July 2006, and October 2006), site (Sites 1 through 4), and depth (three classes: 0 - 0.5 m; 0.5 -1.0 m; and 1.0 -1.5 m). Site 5 was excluded from the analyses because we were unable to collect data during October surveys due to severe weather that lasted for more than two weeks. Any significant differences in the arcsine transformed vegetation proportion between each combination of time, site, and depth variables were determined using Tukey's honestly significant difference tests. P values equal to or smaller than 0.05 were considered statistically significant for all analyses.

Water transparency and water quality parameters

The two surface PAR readings were averaged, then the vertical absorption coefficient (K_d) was calculated using Beer-Lambert Law, $K_d = (\ln I_0 - \ln I_z) / Z$, when I_0 is PAR at the water surface and I_z is PAR at a depth of Z (Cole, 1994); a lower K_d indicates a higher water clarity The values of K_d were transformed using natural log. Then the transformed values were compared using repeated measures ANOVA with month as a repeated measure and site as an independent variable. Site difference was determined by Tukey's honestly significant difference test.

Values for water quality parameters were averaged by month. We modified the 15-min interval data to be consistent with the 30-min interval data by removing data recorded at 15 min and 45 min after the hour. Our results and discussion of the water quality parameters focus on data collected only at the Pt. aux Chenes location because these data were more likely to represent conditions at our sample sites

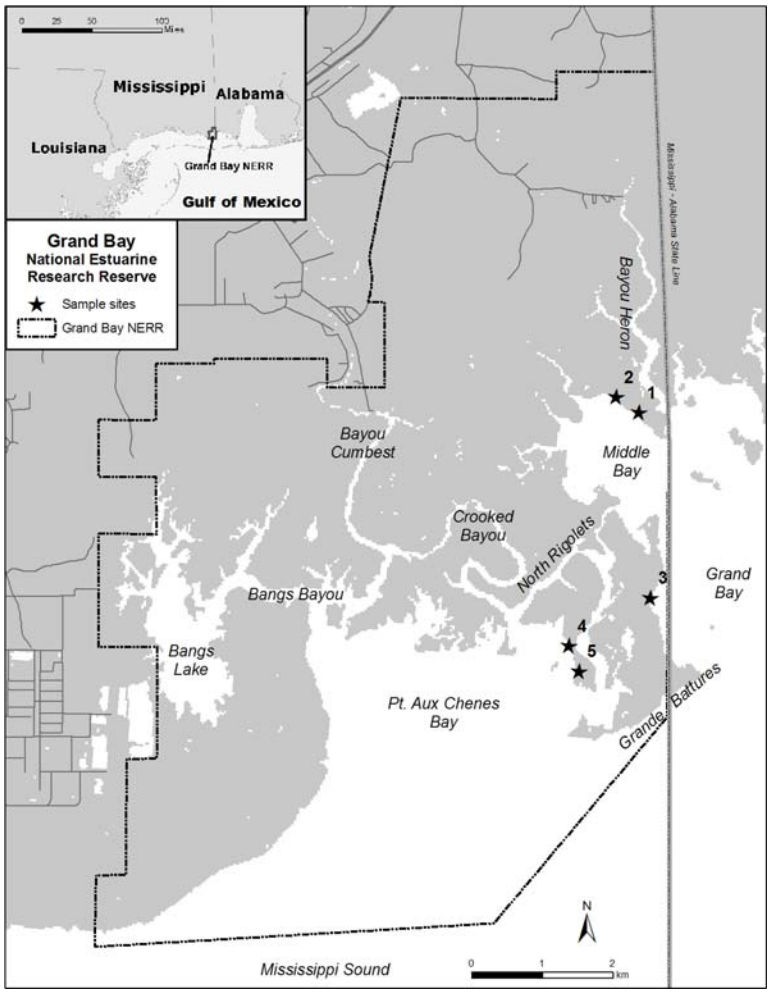

Fig. 1. Submersed aquatic vegetation transect survey sites in Grand Bay National Estuarine Research Reserve, Mississippi. The map in the inset indicates the location of the Reserve in the state.

Table 1. Locations, geographic coordinates, bearings for survey transects, and survey/sampling dates of the transect survey sites and Photosynthetically Active Radiation (PAR) monitoring sites for Grand Bay National Estuarine Research Reserve, 2005 – 2006.

	Site Location	Latitude	Longitude	Transect Bearing	Survey/Sampling dates
SAV Transect Survey	Site 1 (Middle Bay)	30.3828 N	88.3983 W	235°	6/21/05, 10/21/05, 7/3/06, 10/6/06
	Site 2 (Middle Bay)	30.3853 N	88.4006 W	235°	6/21/05, 10/21/05, 7/3/06, 10/6/06
	Site 3 (Grand Bay)	30.3617 N	88.3988 W	78°	7/26/05, 10/21/05, 7/3/06, 10/6/06
	Site 4 (Pt. aux Chenes)	30.3523 N	88.4093 W	252°	7/26/05, 10/21/05, 7/3/06, 10/6/06
	Site 5 (Pt. aux Chenes)	30.3555 N	88.4108 W	250°	7/26/05, 7/4/06
PAR Monitoring	Middle Bay				Biweekly, Sept 05 – Oct 06
	Grande Battures				Biweekly, Sept 05 – Oct 06
	Pt. aux Chenes Bay				Biweekly, Sept 05 – Oct 06

RESULTS

Spatial and temporal variations in SAV depth distribution and species composition

Ruppia maritima and *Halodule wrightii* were the only SAV species found at the study sites as well as in the entire estuarine area of Grand Bay NERR. Total SAV coverage at the study sites in the Reserve was significantly different among the survey times, depths, and sites; all the two-way and three-way interactions of survey time, depth, and site were significant (Table 2). The combined *R. maritima* and *H. wrightii* coverage was higher in July than in October in both 2005 ($P < 0.001$) and 2006 ($P = 0.05$) (Fig. 2). Total SAV cover was not significantly different between July 2005 and July 2006 ($P = 0.186$), but SAV cover was significantly lower in October 2005 when compared to October 2006 (Fig. 2; $P < 0.001$). The significant difference in SAV cover among sites was due to Site 3 (Fig. 3) where the SAV growth pattern was not similar to any other sites (P values < 0.05).

Ruppia maritima coverage was significantly different

among survey times, depths, and sites; all two-way and three-way interactions of survey time, depth, and site were significant (Table 2). *Halodule wrightii* coverage was also significantly different among times, depths, and sites, but the seasonal change in *H. wrightii* abundance and depth distribution was not significantly different among sites (Time x Site and Time x Site x Depth). The other two-way interactions of Time x Depth and Site x Depth were significant (Table 2).

In Grand Bay NERR, *R. maritima* was more abundant than *H. wrightii* in summer 2005, then *H. wrightii* became the dominant SAV species by October because *R. maritima* significantly decreased by fall 2005 ($P < 0.001$). Total *H. wrightii* abundance for all sites was not different between summer and fall 2005 ($P = 0.061$). Middle Bay, which supported only *Ruppia* in summer 2005, displayed the most significant vegetation loss with more than a 90% decline of the mean SAV coverage per transect (%) in that area (Fig. 3).

Ruppia coverage increased significantly in summer 2006 compared to coverage in October 2005 ($P < 0.001$), but H. wrightii coverage did not ($P = 0.556$) (Fig.2). The coverage of both species increased in 2006 even when compared to that of summer 2005 ($P < 0.001$ and $P = 0.05$, respectively, for *Ruppia* and *Halodule*) (Fig. 2). Due to seasonal changes in relative abundance of the two species, the mean transect coverage ratio of *Ruppia* to *Halodule* varied considerably: 5.1:1 in summer 2005, 0.1:1 in fall 2005, 5.4:1 in summer 2006, and 1.7:1 in October 2006.

SAV was most abundant in the water depth class of 0.5 - 1.0 m for both species. Overall, 12%, 66%, and 22% of *Ruppia* occurred in depth classes of 0 - 0.5 m, 0.5 - 1.0 m, and 1.0 - 1.5 m, respectively. *Halodule* depth distribution was 14%, 76%, and 10% in the same depth classes. SAV occurred up to depths of 0.9 - 1.3 m depending on site and season. SAV depth distribution changed significantly between June/July and October 2005 ($P < 0.001$). The majority of SAV that occurred in depths greater than 0.6 m was lost by October 2005. However, maximum SAV depth increased again in summer 2006. In summer 2006, SAV coverage along the transects extended up to 800 m from the shores of the survey sites, but the maximum depth of SAV growth was still 1.3 m due to the shallow basin and gradual shoreface of Grand Bay NERR.

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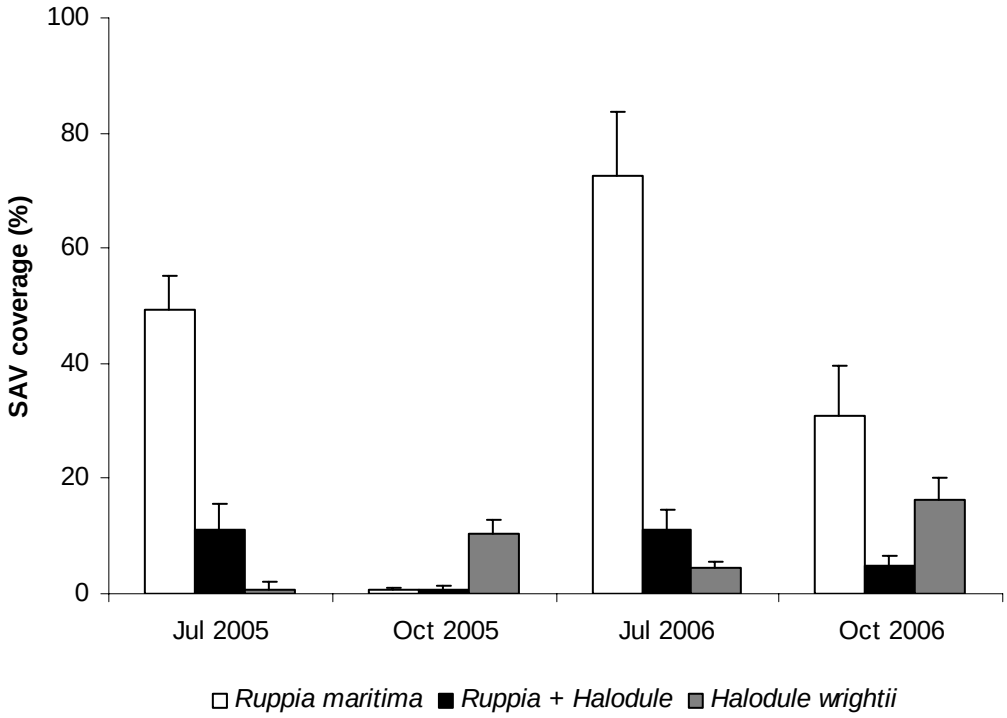

Fig. 2. Temporal changes in percent SAV coverage (mean proportion of transect length that is covered by SAV shoots) at Sites 1 - 4. Site 5 was not included in this because it was not surveyed in October 2005 and October 2006. Error bars indicate standard errors.

Table 2. Three-way ANOVA results of SAV coverage for *Ruppia maritima* and *Halodule wrightii*. The SAV coverage was compared for interactions among four survey times (June/July 2005, October 2005, July 2006, and Oct 2006), four sites (Sites 1-4), and three depth classes (0-0.5, 0.5-1.0, 1.0-1.5 meter). Site 5 was not included in the analyses because it was not surveyed during October of 2005 and October of 2006.

	Source	SS	DF	MS	F	P
Combined coverage of *Ruppia maritima* and *Halodule wrightii* = total SAV	Survey Time	7.951	3	2.650	33.442	<0.001
	Site	5.465	3	1.822	22.985	<0.001
	Depth	11.125	2	5.563	70.192	<0.001
	Time x Site	2.754	9	0.306	3.861	<0.001
	Time x Depth	3.731	6	0.622	7.846	<0.001
	Site x Depth	3.288	6	0.548	6.916	<0.001
	Time x Site x Depth	7.507	18	0.417	5.262	<0.001
	Error	7.370	93	0.079		
	Total	140.220	141			
Ruppia maritima	Survey Time	15.187	3	5.062	70.014	<0.001
	Site	1.806	3	0.602	8.826	<0.001
	Depth	5.781	2	2.890	39.976	<0.001
	Time x Site	3.667	9	0.407	5.635	<0.001
	Time x Depth	4.424	6	0.737	10.198	<0.001
	Site x Depth	1.026	6	0.171	2.364	0.036
	Time x Site x Depth	3.681	16	0.230	3.182	<0.001
	Error	6.652	92	0.072		
	Total	92.272	138			
Halodule wrightii	Survey Time	1.385	3	0.462	6.131	0.001
	Site	6.549	3	2.183	28.985	<0.001
	Depth	2.415	2	1.207	16.032	<0.001
	Time x Site	0.775	9	0.086	1.143	0.341
	Time x Depth	1.829	6	0.305	4.048	0.001
	Site x Depth	2.075	6	0.346	4.593	<0.001
	Time x Site x Depth	1.689	16	0.093	1.235	0.257
	Error	6.929	92	0.075		
	Total	42.664	138			

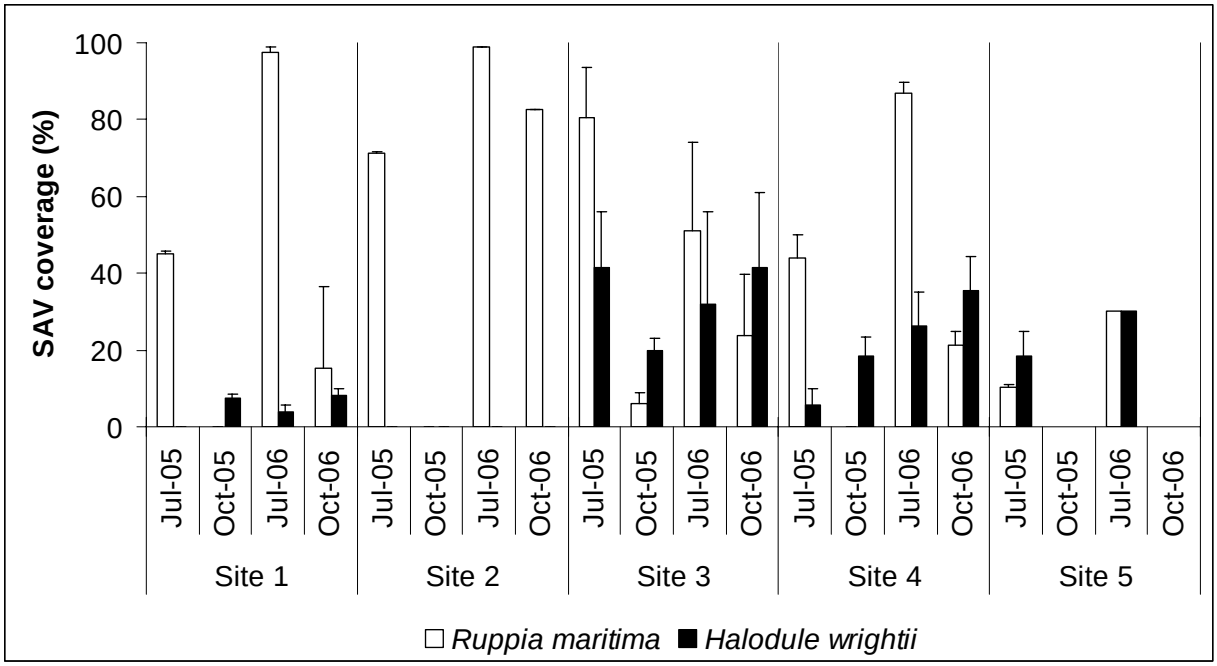

Fig. 3. Mean SAV coverage (% of a 200-m-long transect) at each of the SAV survey sites for each sampling occasion. Error bars indicate standard errors. Site 5 was not surveyed in October 2005 and October 2006. Sites 1 and 2 are in Middle Bay, Site 3 is located in western Grand Bay; and Sites 4 and 5 are in Pt. aux Chenes Bay.

The mean vertical absorption coefficient (K_d) value was 1.48 at Grande Battures, 1.63 at Pt. aux Chenes Bay, and 1.63 at Middle Bay. At Grande Battures, an offshore site, water clarity was statistically higher than at Pt. aux Chenes Bay ($P = 0.047$) and higher, but not significantly so, than at Middle Bay ($P = 0.087$) (Fig. 4). The difference between Pt. aux Chenes Bay and Middle Bay was not significant ($P = 0.968$). The seasonal changes in water clarity condition were not different among sites (Month x Site; Table 3).

Water temperature during the study ranged from 12.2°C to 31.0°C; mean salinity was 24.7 ppt (range: 19.1 - 29.5); mean pH was 8.1 (range: 7.9 - 8.2); and turbidity ranged from 1.4 to 334.7 NTU (Fig. 5). The highest water temperature occurred in August and the lowest temperature in December. Salinity was highest during the dry season (October-December) and drought conditions (summer 2006); low salinities occurred during the spring of 2006. Water pH was slightly alkaline and relatively constant during the study. Turbidity data showed one spike during November 2005, but was otherwise below 30 NTU.

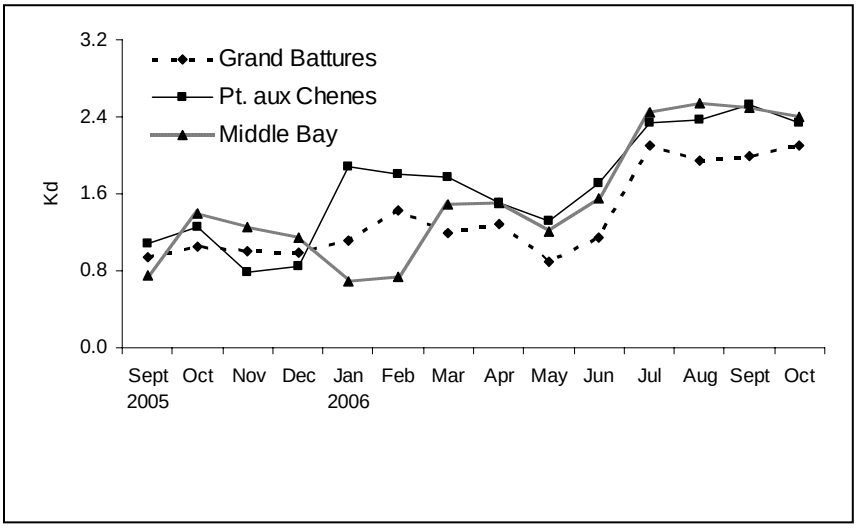

Fig. 4. The mean values of vertical absorption coefficient (K_d) at three monitoring sites. Vertical absorption coefficient was calculated using the biweekly PAR (Photosynthetically Active Radiation) data collected at water surface and at a depth of 1 m at the sites.

Table 3. Results of general linearized model repeated measures ANOVA for vertical absorption coefficient (K_d). The vertical absorption coefficient values were derived from the biweekly PAR (Photosynthetically Active Radiation) measurements made at three sites (Middle Bay, Pt. aux Chenes Bay, and Grande Battures) during a period from September 2005 to October 2006. Site is the independent variable and month is the repeated measure.

Source	SS	DF	MS	F	P
Month	2.368	11	0.215	1.620	0.137
Site	0.882	2	0.441	3.318	0.048
Site X Month	0.334	17	0.020	0.148	1.000
Error	4.519	34	0.133		
Total	22.941	65			

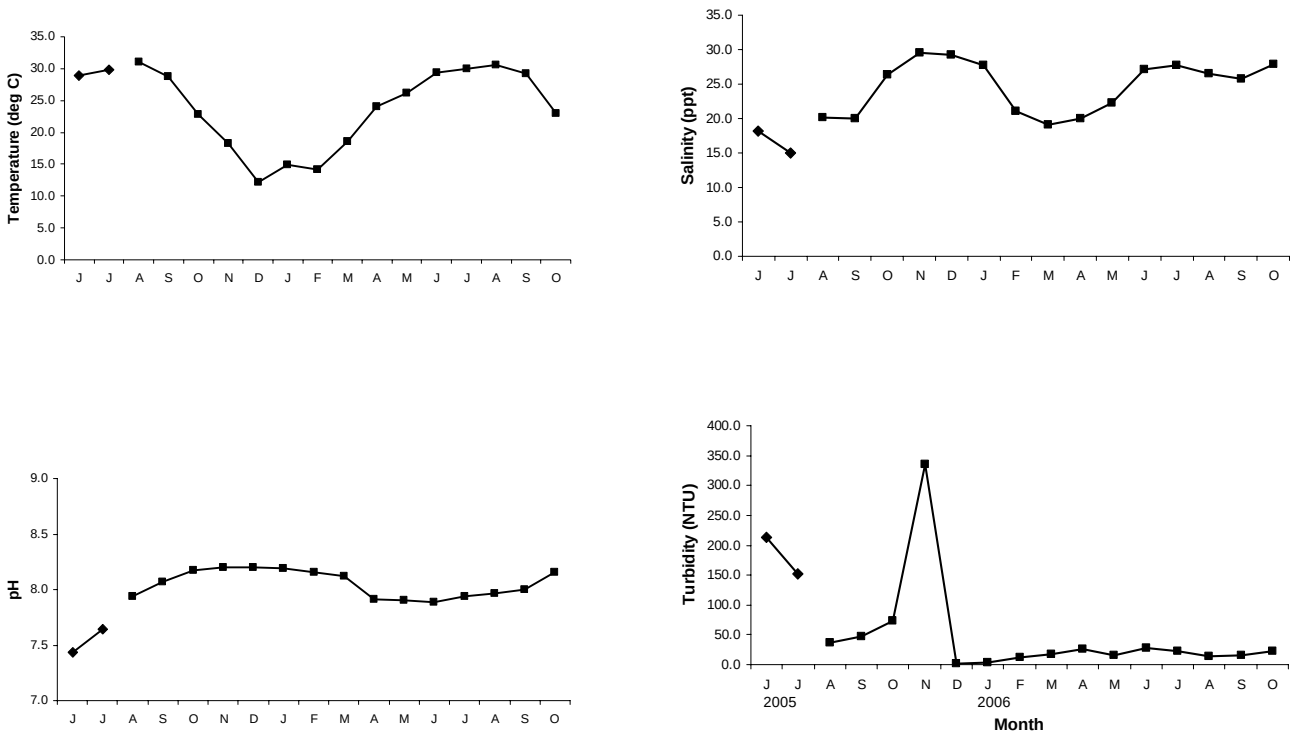

Fig. 5. Monthly means of water temperature, salinity, pH, and turbidity from monitoring stations located near SAV sampling Sites 4 and 5. Stations were located in Crooked Bayou (June-July 2005; black diamonds) and Pt. aux Chenes Bay (August 2005-October 2006; black squares).

DISCUSSION

Seasonal changes in SAV abundance at Grand Bay NERR

As we hypothesized, the SAV community in Grand Bay NERR displayed significant short-term temporal changes in overall abundance and species dominance between *Ruppia maritima* and *Halodule wrightii* (Table 2; Figs. 2 and 3); much of the changes was due to variation in *R. maritima* abundance. The growth pattern of *R. maritima*, growing abundantly in early summer and declining in fall, is likely an adaptation to co-occur with *H. wrightii*, which shows later growth in the area. In tropical or subtropical estuarine habitats, *R. maritima* displays two seasonal growth peaks per year when it grows without other co-occuring SAV species (Flores-Verdugo et al., 1988; Pulich, 1989; Cho and Poirrier, 2005). The second seasonal growth of *R. maritima* in fall is also not observed elsewhere where it co-occurs with *T. testudinum* or *H. wrightii* (Pulich, 1985; Lazar and Dawes, 1991). The reduced growth of *R. maritima* in fall is probably not caused by water temperature changes. *Ruppia maritima* flowered and set seeds twice a year in May/June and October/November in the Lake Pontchartrain estuary, southeastern Louisiana, which is located at similar latitude as Grand Bay NERR (30^{o}N) and has comparable seasonal water temperature range and pattern (Cho and Poirrier, 2005). In contrast, we did not find any flowers or seeds in the Grand Bay NERR *R. maritima* population during October surveys.

In seagrass habitats where *T. testudinum* and *H. wrightii* occurred together, seasonal and annual changes in the vegetation cover were mainly from changes of *H. wrightii* abundance at the margins of seagrass patches (Robbins and Bell, 2000). In Grand Bay NERR, where *H. wrightii* grows with *R. maritima*, *H. wrightii* growth appears to be more stable compared to that of *R. maritima* (Figs. 2 and 3). The temporal SAV dynamics in Grand Bay NERR were mainly attributed to changes in *R. maritima*, especially in water deeper than 1.0 m.

Spatial variation in SAV and underwater light conditions

Despite substantial seasonal variation within a year, *Ruppia maritima* was abundant at all of the surveyed sites (Fig. 3), whereas *H. wrightii* was more abundant at Sites 3, 4, and 5. Compared to the Middle Bay area where the substrate type was muddy and unconsolidated, Site 3 in Grand Bay and Sites 4 and 5 in Pt. aux Chenes Bay were closer to open water and had a higher sand component in the sediment (Sanchez-Rubio, 2004). Eleuterius also reported that extensive *Halodule* beds occurred on sandy substrates (Eleuterius, 1973) and *Ruppia* occurred on muddy substrates (Eleuterius, 1971) in Mississippi Sound.

The significant site variation in the combined *Ruppia* and *Halodule* abundance (Table 2) was mainly due to the pattern at Site 3, which was different from those of other sites (Fig. 3; P values < 0.001 when compared to each of the other sites). One possible explanation for this was that SAV beds at Site 3 had higher proportions of *H. wrightii* than Sites 1 or 2 (Fig. 3). Larger beds of *H. wrightii* resulted in less seasonal fluctuation in total SAV coverage at Site 3. The fundamental difference that distinguished Site 3 from all other sites, however, probably came from the location of the site in the estuary (Fig. 1). Unlike other sites that were located on shores facing the southwest, Site 3 was located off an east-facing shore. In this shallow estuarine area, wind-driven waves efficiently increase turbidity and physically affect shores facing the directions of the predominant winds (Cho and May, 2006; Cho, 2007). Therefore, shore orientation within the estuarine system might be a contributing factor for the spatial difference in SAV growth and abundance.
The overall greater water clarity at Grande Battures probably resulted from the highly sandy substrate at this offshore site. Although it was not included in this transect study, SAV along Grande Battures has been surveyed since 2004. The sandy shoals that extend northeast and southwest from Grande Battures, which is the remnant of the eroded Grande Battures barrier islands, support large patches of *Halodule wrightii* during summer. Light attenuation in the water column is influenced not only by the amount of total suspended sediment, but also by organisms and other matter that can vary in composition and particle size. Finer particles are easily suspended by wind-driven waves, and water with finer suspended particles transmits less light than water with coarse suspended particles because smaller particles have a larger surface area to scatter light (Bhargava and Mariam, 1991). Water quality parameters were within tolerances for *R. maritima* (Kantrud, 1991) and *H. wrightii* (Fong and Harwell, 1994; Koch et al., 2007) during our study. The seasonal decline in *R. maritima* could not be attributed to a change in any single water quality parameter. This decline occurred within a 2 to 3 week period during August of both years (C. May, pers. obs.). Both mean monthly water temperature and salinity changed little during the decline. Due to our sampling schedule, we did not document any change in SAV following the spike in turbidity during November 2005.

Short-term effects of Hurricane KATRINA in 2005 on Grand Bay NERR SAV

There were significant declines in total SAV cover by October 2005 compared to June and July at all survey sites. When adjusted for vegetation density, the mean SAV coverage per 200-m transect was 71.7 m in summer, but it was reduced to 13 m by fall. In addition to

the natural seasonal decline of *R. maritima*, the dramatic SAV decrease by October 2005 may have been affected little by the physical disturbance and sedimentation associated with the active 2005 Hurricanes Katrina (Landfall August 29, 2005) and Rita (Landfall September 24, 2005). *R. maritima* loss between July and October 2005 was more significant in depths greater than 0.5 m. The *H. wrightii* coverage, on the other hand, was not changed significantly, with a mean coverage along transects of 11.7 m in summer and 11.4 m in October. Therefore, Middle Bay, which supported only *R. maritima* in summer, displayed the most significant vegetation loss with more than a 90% decline of the mean SAV coverage (%) per transect in that area. The loss after Hurricane Katrina cannot be attributed only to the storm, however, due to the regular seasonal decline of this species that was observed in the 2006 dataset (Figs. 2 and 3). In fact, the *Ruppia* in Middle Bay had declined substantially by August 23 2005, six days before hurricane landfall, and much of the substrate of the bay was bare.

The abundance of Grand Bay NERR SAV, both *R. maritima* and *H. wrightii*, however, recovered by 2006 in the estuarine area (Figs. 2 and 3). Byron and Heck (2006) also did not find any significant loss of seagrass in the western coast of Alabama after Hurricane Katrina. However, we noted a different effect of the hurricanes on SAV in a bayou of the reserve. In addition to the surveys at the transect sites, we surveyed bayous in the Reserve area before and after Hurricane Katrina. *Ruppia maritima* was observed growing in Bayou Cumbest in July 2005, but had disappeared by October 2005 and had not returned by our last survey in July 2007. *Ruppia maritima* in the bayou was rarely flowering or bearing seeds, whereas the plants in the estuarine area had abundant seeds and flowers at that time. The failure of *R. maritima* to recolonize Bayou Cumbest is probably due to the lack of a viable seed bank and the remoteness from the estuarine source populations

CONCLUSIONS

The SAV community at Grand Bay National Estuarine Research Reserve, Mississippi, is dominated by two species, *Ruppia maritima* and *Halodule wrightii*. Changes in the SAV abundance and species dominance between summer and fall largely can be attributed to the fluctuation of *R. maritima* between summer and fall. The two species have become predominant SAV species not only at the Reserve but along the Mississippi coast; their relative abundance has also increased in estuaries and along barrier islands of the Gulf of Mexico (Kahn and Durako, 2005; McGovern and Blankenhorn, 2007) with the loss of large beds of *Thalassia testudinum*, *Syringodium filiforme*, and *Halophila engelmannii*. Our results suggest that inconsistencies in SAV areal coverage among past studies may have been due, in part, to differences in the timing of surveys and methods. Coastal vegetation surveys are often associated with disturbance events (Michot et al., 2003; Byron and Heck, 2006), and conclusions may be drawn with little existing data on the status of the resource before the event. The spatial scale of previous surveys may also have introduced erroneous conclusions (Meehan et al., 2005). Remote sensing may have missed beds or resulted in biased estimates of areal extent. For these reasons, consistent, long-term SAV survey efforts at varying scales need to be implemented, especially in the areas that have experienced community shifts and the resultant changes in climax community structures.

ACKNOWLEDGEMENTS

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Geospatial Distribution Of Pesticide Use And Disparities In Breast Cancer Mortality In Mississippi Women

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Abstract

Breast Cancer is the most common form of cancer among women in the United States. Established risk factors include advancing age, early menarche, late menopause, positive first relative, late age at first birth and socioeconomic status. Mississippi has a combination of risk factors making it suitable for studying the pathways of breast cancer etiology. Data for this study consisted of secondary analyses of the Mississippi age-adjusted breast cancer mortality aggregated by two periods (1970-1994 & 1996-1999) and total number of acres of planted crops (as a proxy for pesticide exposure) for 1997-2001. Descriptive statistics, Pearson correlations as well as geospatial analysis (GIS) by State Economic Area (SEA) were used as methods to analyze the data. We found significant correlation between pesticide exposure and risk of breast cancer mortality in three SEAs: Yazoo, Vicksburg and Corinth. Statistically significant linear associations were found between level of pesticide exposure (acres planted) and breast cancer mortality rate in Mississippi women per SEA for the first period of study 1970-1994. Significant associations ($p<0.05$) using Pearson correlation analysis (r) were found for Greenville SEA with both white (r=0.882) and black females for cotton (r=0.4187) and the rice crop (r=0.678). In contrast, Hattiesburg SEA showed significant associations only for black females with the soy crop (r=0.720) and wheat (r=0.570). Yazoo SEA showed correlations for black females and the soy crop (r=0.507) as well as white females with the catfish crop (r=0.592). Columbus SEA, however, showed associations that are significant for white females with the soy crop (r=0.792) and black females with the catfish crop (r=0.720). A significant association was found for Corinth SEA for black females with total plants (r=0.667). Correlations for .Greenville and Vicksburg SEAs were not significant for total plants with both black and white females. Our findings may well relate to the pesticide bioaccumulation hypothesis, where over time, pesticides will make their way into the soil, food chain and finally human fatty tissues. Data collected on income and health care levels showed a variable distribution and skewed disparities towards low income and black women. We conclude that there are moderate statistically significant associations between the number of acres planted, type of crops, race and the mortality rates for breast cancer in Mississippi women.

Introduction and Background

The Mississippi River basin contains the largest and most intensively farmed region in the nation. In order to increase yields from crops, large amounts of pesticides are used to protect against weeds, insects, and other pests. The major categories of pesticides are herbicides, insecticides, and fungicides. It is estimated that about two-thirds of all pesticides used for agriculture in the United States are applied to cropland and pasture land in the Mississippi River Basin (Gianessi and Puffer 1991; Phillips et al, 1997; Lee, et al 2007). The intense use of pesticides is of concern because of potential adverse effects on the quality and use of water resources. A study by Mitra et al, 2004 linked environmental risk factors to breast cancer and another study by Mitra and Faruque,

2004 found a significant link between breast cancer incidence and the maximum emissions of environmental chemicals in 82 counties in Mississippi. The most immediate concerns are for aquatic life and for the 18 million people in the basin who rely on surface-water sources for drinking water (Abdalla et.al, 2003).

According to the U.S. Geological Survey (USGS, 1991), the Mississippi River Basin contains about sixty-five percent of the total harvested cropland in the nation, producing about eighty percent of the corn and soybeans, and much of the cotton, rice, sorghum, and wheat (U.S. Department of Agriculture. 1985; U. S. Department of Commerce, 1993). Many of the pesticides used in the basin are present in the Mississippi River and its tributaries. A regional study of the upper Midwest showed that large amounts of herbicides are flushed into streams during storm runoff in late spring and summer each year following cropland application drained down to the state of Mississippi (Thurman et al. 1992). Storm runoff produces high concentrations of many herbicides in streams across the upper Midwest from Nebraska to Ohio for periods of several weeks to several months. Concentration of herbicides in some small streams may exceed 100 micrograms per liter (µg/L) for short periods of time. Flow from these streams, in turn, transports significant amounts of herbicides into large rivers such as the Missouri, Ohio, and Mississippi, and eventually to the Gulf of Mexico (Pereira and Rostad 1990; Goolsby et al 1991; Duell et al, 2001; Pereira and Hostettler 1993).

There have been recent concerns that long-term exposure to certain persistent organochlorine compounds may increase breast cancer risk by affecting estrogen metabolism. There are several equivocal risk factors where evidence is conflicting: hormone replacement therapy, pesticide exposure and ultra violet radiation, oral contraceptives prior to first pregnancy, smoking, ionizing radiation and benign breast disease. Only about 30-40 percent of breast cancer risk can be explained by the established risk factors and the roles of environmental risk factors in breast cancer have long been suspected in influencing breast cancer risk (Ames, 1979; Krieger, 1989; Valentagas and Daling, 1994; Aspelin, 1997; Anderson et al, 2002; Boarders and Verbeek, 1997; and Mitra et. al, 2004).

Xenoestrogenic pesticides currently in wide use in agriculture are the chlorinated hydrocarbons Endosulfan and Methoxy-chlor. They are much less persistent than DDT and are not stored in body fat. Other pesticides besides the chlorinated hydrocarbons, however, may increase the risk of breast and other cancers in women. Atrazine, a persistent herbicide that is the most widely used in the US, and an extensive groundwater contaminant, causes mammary cancer in rats and is linked to ovarian cancer in agricultural areas (Donna et. al. 1989; Theo-Colborn et al, 1993; Charlier et al, 2003; USATS, 1994; Davis et al, 1997).

Human breast milk is contaminated with xenoestrogenic and carcinogenic pesticide residues worldwide and that pesticide contamination of breast milk has been found even in remote villages in the third world (Rogan et al, 1986). The preliminary findings of a possible link between pesticides and breast cancer are already having an impact on the pesticide debate. The involvement of women as well as concerned citizens and scientists in the pesticides issue, even if only peripherally, can support efforts towards pesticide reform. In breast cancer research, pesticides are only one of several environmental exposures that are being considered as risk factors for the disease (SCDPR, 1985; Rogan et al, 1986; LWVEF, 1989; Brody and Rudel, 2003; PAN, 2007).

According to the bioaccumulation hypotheses (Theo-Colborn et al, 1993; Reddetzke and Applegate, 1993; Schafer et al, 2004), substances remain in the environment (soil, water, etc.) long after their use. As a

result, the food chain can become biologically affected through hormonal and molecular transformations. Furthermore, the water topology in Mississippi serves as both a reservoir and a carrier of previously used chlorinated insecticides. These insecticides are primarily transported on sediment particles and persist in the food chain due to long soil half-life. In comparison to other areas of the country, residents of Mississippi were being at greater risk of exposure to bioaccumulation of pesticides over very long periods of time. This environment is brought about by at least three factors: (1) the heavy cropland concentrated in areas drained by the Mississippi River Basin; (2) the majority of crops in the nation are harvested in Mississippi river basin; and (3) two-thirds of all agricultural (crop and pasture) use of pesticides in the nation are applied to the Mississippi river basin. The endogenous hormonal effects caused by pesticides, accumulation of metabolites in water bodies, and their inhabitant fish, may contribute to increased development of breast cancer in MS. The high proportion of water bodies in the state and the high consumption of fish and high saturated fat food preparation, may add to carcinogenic promotion and the development of breast cancer (Solly and Shanks, 1974; Roddetzke et al, 1993; Wolf, 1993; Marshall, E. 1993; Schafer et al, 2004, PAN, 2007).

Pesticides may have adverse effects on aquatic life, however, the U.S. Environmental Protection Agency (IARC, 1979; USEPA, 1987; IPCS, 1991) has established maximum standard contaminant levels for aquatic life for only very few current-generation pesticides. As a result of increasing pest resistance, combining pesticides, increasing applications, substitution of more expensive, toxic, or ecologically hazardous pesticides has occurred more frequently. In addition to the problem of pesticide resistance, millions of dollars worth of crops have been lost as a result of improper pesticide application (Benbrook et al. 1996). Consequently, more and more farmers and other pesticide users are seeking to better target their use of pesticides and implement pesticide-use-reduction and alternative strategies. Most pesticides including chlorinated hydrocarbons are animal carcinogens and may increase the risk of breast and other cancers in women (Donna et al, 1989, Hunter and Kelsey, 1993; PAN, 2007).

The economic value of the pesticide market is quite significant. In 1995, almost one billion pounds of conventional active pesticide ingredients were used in the United States, amounting to approximately 4.6 pounds of pesticides per person. About three-fourths of the total annual pesticide use is for agriculture (Aspelin et al. 1997). Most of the pesticides used in the Mississippi River Basin are herbicides used for weed control (Gianessi and Puffer 1990). More than 40 pesticides and pesticide degradation products were detected during 1987--92 in water samples collected from the Mississippi River or from the mouths of large rivers that flow directly into the Mississippi (Goolsby and Battaglin1993). Many pesticides are highly persistent in stream water and in reservoirs, but very little specific information is available on pesticide half-lives in natural water bodies (Duell et al, 2001, Abdalla, 2003). The information that is lacking about pesticides include the level of toxicity, health effects resulting from specific exposure or combination of exposures, and complete test data on the 270 varieties of pesticides

Breast cancer is the most prevalent cancer in women in the US where estimates are that 40,730 will die from the disease in the year 2008 and a total of 271,530 will be diagnosed with the disease (ACS, 2008). During the period of 1950 to 1989, the incidence of breast cancer increased by 53% and since 1940, mortality rates have been increasing by about 1% a year in industrialized countries (Davis et al. 1997). The cause is unknown for 70% of the cases and the remaining 30% have known risk factors, the most significant are lifetime exposures to female

hormones (estrogens), which play a critical role in the development of breast cancer. According to the American Cancer Society (ACS 2008) breast cancer case estimates were at 1,630 with 440 deaths in Mississippi for the year 2008.

Since there wasn't a clear understanding of the role of agricultural occupational exposure to pesticides and breast cancer mortality, the objective of this study was to analyze the association of pesticide exposure and breast cancer mortality in Mississippi. Specifically, to determine if there are associations between pesticide exposure and risk of breast cancer mortality, and whether or not the associations persist over time, after controlling for socioeconomic status and access to early detection of breast cancer. In this regard, we will test four hypotheses: 1) there are linear associations between level of pesticide exposure (number of acres planted; proxy) and female's breast cancer mortality rates in Mississippi; 2) the association between level of pesticide exposure and breast cancer mortality rate/level will persist after controlling for race; black women will be more likely to have significant correlations between exposure and breast cancer mortality; 3) the association between level of pesticide exposure and breast cancer mortality rate will vary by type of crop planted; and 4) there is a persistent association over time between level of pesticide exposure and female's breast cancer mortality in Mississippi.

Material and Methods

Population and Sample Selection:

The samples for the analysis consisted of women who died from breast cancer between 1970-1994 and 1996-1999 in Mississippi. The first set of data was obtained from the National Cancer Institute Web site, aggregated by State Economic Area (SEA), and the second set of data was obtained from the Mississippi Cancer Registry, aggregated by county. The statistical power for both samples differed; the first sample consisted of only nine units (SEA), whereas the second sample consisted of the 82 counties in the state. The State of Mississippi is divided into nine State Economic Areas (SEA): Jackson, Greenville, Yazoo, Vicksburg, Corinth, Columbus, Meridian, Hattiesburg, and Biloxi.

Initial analysis using these nine categories indicated that two SEAs did not produce findings due to less than five counties per SEA having planted crops (Jackson and Biloxi). A decision was made to collapse these two SEAs into other larger SEAs in order to obtain significant findings across all units. It was felt that in doing this, the groupings were not biased as the water topology; economic areas and concentration of planted crops did not vary. The only essential difference or bias introduced is that the Jackson SEA, which is essentially Hinds County, contains the great majority of primary care providers (n=447). However, the final analysis was not controlled by this measure. Statistical correlations (data not shown) indicated no significance between the numbers of primary care providers and the breast cancer mortality rate in a given SEA. Given the relatively small sample sizes of the unit of analysis (modified SEA), A significance level of .05 was defined as statistically significant, and borderline significance at the $0.05 < p < 0.10$ was also noted in the findings.

Statistical analysis to test the hypothesis included descriptive tabulations with accompanying graphs, correlation analysis by race, and controlling by SEA. The independent variables for both time periods were those representing the pesticide exposure (total acres of planted crops, and number of acres planted for each type of crop). The dependent variables for both time periods were the female breast cancer mortality rate (per 1000,000 age-adjusted to the 1970 U.S. Census population). Both independent and dependent variables were continuous measures with a normal distribution curve. Therefore, the statistical analysis for a

normally distributed continuous variable, Pearson correlation, was used for the main findings. The analyses were controlled by three nominal measures: race (white, black), SEA (7 geographic areas), and type of crop planted.

Data files were constructed by downloading data from websites into Excel files, or data was manually entered directly into excel files. Accuracy of data retrieval and entry was achieved by repeated visual inspection. Analyses were performed using the Statistical Analysis Software (SAS, version 8e). Data integrity was preserved by calculating and comparing averages and standard deviations in both software packages, SAS and Microsoft Excel. In addition, the Geographic Information System (GIS) software was used to allow visualization of information in a manner that reveals relationships, patterns, and trends not visible with other systems.

Geographical Information System GIS:

GIS is an information system that is designed to work with data referenced by spatial or geographic coordinates GIS is a database system with specific capabilities for spatially referenced data, as well as a set of operations for analysis of the data. (Dunn, 1987; Selvin, 1988; Star and Estes 1990; Marshall, 1991, Haslett, 1992; and Walter, 1993).

Spatial Analytic Techniques:

Spatial variation in health related data is well known, and its study is a fundamental aspect of epidemiology. Representation and identification of spatial patterns play an important role in the formulation of public health policies. The spatial analytic techniques used here are limited to those involving a graphic exploratory analysis of data. These spatial techniques include point, line, area, surface and contour patterns.

Area Patterns:

The first stage of data analysis is to describe the available data sets through tables or one-dimensional graphics, such as the histogram. For spatial analysis, the obvious option is to present data on maps, with the variable of interest divided into classes or categories, and plotted using colors or hachure within each geographic unit, known as a choropleth map (Marshall, 1991). A literature search on spatial analysis revealed that among seventy-six papers, fifty-four percent used the choropleth map as an analytical tool (Walter et al,. 1993).

The most common maps use pre-specified classes of health events, or the mean and standard deviation of their distribution. The maps are usually represented using administrative boundaries such as counties, municipalities, health districts, and so on, where data are usually collected. Major variables used for area pattern analyses are incidence rates, mortality rates, and standardized mortality ratio (SMR). The latter is most common in health atlases (Walter et al,. 1993). At times, area pattern analysis uses statistical significance rather than raw data.

Area pattern analysis also uses empirical Bays estimates of the relative risk (Marshall,.1993). When two or more health-related variables are available in each area unit, multivariate analysis, can synthesize the information. Measures of coherency between two variables were used as the variable of interest to explain the spatial pattern of disease or event occurrence.

Surface and Contour Patterns:

Data of epidemiological or public health interest often occur as spatial information during each of several time epochs. The analytical techniques described previously require the pooling of information in administrative areas with well defined geographic boundaries (e.g., counties, municipalities, and health districts), and the presentation of the spatial process with maps constrained to them. These maps are often unable to capture health problems at the locality

or sub-county level. As well, epidemiological variables do not necessarily recognize political boundaries. To overcome the limitation of administrative regions for mapping, surface, and contour pattern analysis presents an alternative by representing the distribution of the health event. The advantage of this spatial analytical technique is that the variable under study is treated as a continuous process throughout the region.

Surface and contour analysis assumes that a health event is a continuous process observed at a set of geographic points, known as sampling points. Using the x and y coordinates of these sampling points, with an associate z value corresponding to the health event, the estimated spatial relative risk is depicted as a three-dimensional map or surface. The contour map, known as an iso-line or iso-pleths, is the projection of the surface in a plane, and corresponds to constant z values of the defined surface.

Although these techniques may overcome the limitations of political boundaries and help in the representation of spatial processes collected as point data, they are often not used by health researchers. This may be due to the very fact that they lose the geopolitical information known to the researcher. One possibility, which is already available in some GIS packages, is the capacity of overlaying the geographic map of the region with one of these analytical techniques.

Study Strengths and Limitations:

This type of study uses an ecological study design. (in this case, this is a correlation ecological study). The strengths of this type of study are that large areas, such an entire state, can be studied, assessing relationships over long periods of time and it is not labor-intensive as archival data can be easily used. Thus, it is very cost-effective to carry out this type of study. However, casual and temporal association cannot be determined. For instance the concentration of pesticides cannot be determined exactly by region. Also, the onset of the accumulation of pesticides in specific communities and penetration into human systems cannot be determined. Furthermore, other endogenous and exogenous factors, such as diet, immunity, exposure to synthetic estrogens and other carcinogens that may contribute to incidence of breast cancer are unknown and beyond the scope of this study. Individual level data are needed to be able to determine some of these additional exposures in relation to breast cancer. Finally, a prospective design would be needed to be able to determine a causal relationship between exposure to pesticides and breast cancer events in general

RESULTS AND DISCUSSION

The objective of this study was to determine if the bioaccumulation hypothesis could be applied to study the long-term health effects of harmful environmental agents. Specifically, to determine if there are associations between pesticide exposure and risk of breast cancer mortality and whether or not the associations persist over time after controlling for socioeconomic status and access to early detection of breast cancer.

Data presented here include graphic representations and descriptions of the water topology and crops planted using GIS software. It also included a description of the patterns of breast cancer mortality in the U.S. and in Mississippi using geospatial maps and data tabulations. A geospatial map showing the distribution of primary care providers in the state is also presented to emphasize the relationship between access to early detection of breast cancer and subsequent reduction of breast cancer disparity/mortality. Results on four tested hypotheses were also included.

Breast Cancer Patterns in the U.S:

In reference to the national GIS maps from the NCI web site for the graphic representation of the spectrum of breast cancer mortality for 1970-1994 (data not shown). The published breast cancer maps illustrate the national distribution of breast cancer mortality for black and white women. This pattern shows that white women die from breast cancer in all areas of the country with the greatest mortality rates in the northeastern part of the country. In comparison, a pattern for black women is concentrated in the southeast regions of the country with the highest mortality rates for this group. This finding is consistent with national incidence patterns of breast cancer, in which case, white women have much higher incidence of this cancer compared to black women. However, due to lack of early detection, black and other minority women tend to get diagnosed at later stages of the disease and therefore, to have poorer survival rates (www.nci.gov).

Table 1. Breast Cancer Incidence in the State of Mississippi**.**

Table 1**:** Mean Age-Adjusted Breast Cancer Incidence Rates and Standard Deviations Mississippi, 1970-1994 & 1996-1999 (N=82)

Year/Race		Mean	S.D.	Minimum	Maximum
1970-1994	Whites	20.8	4.0	6.0	34.7
	Blacks	22.7	6.5	9.0	45.4
1996-1999	Whites	113.9	40.9	0	200.0
	Blacks	101.5	48.0	0	285.1

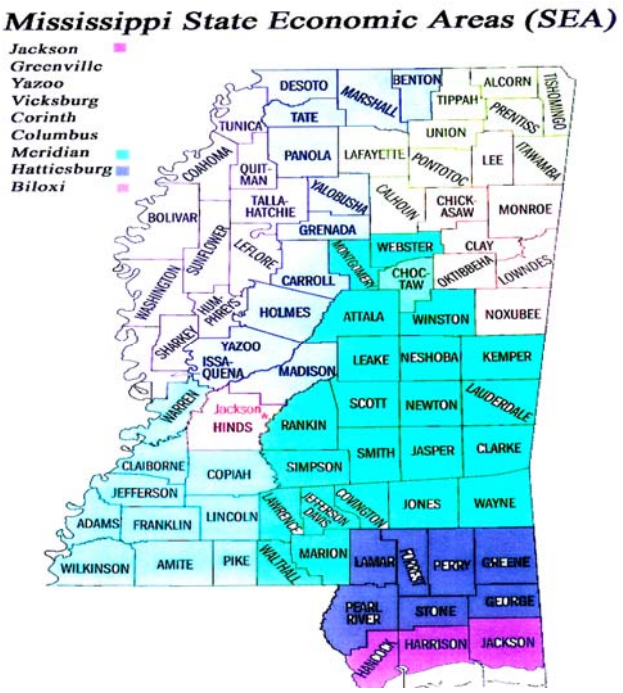


Figure 1: Mississippi State Economic Areas Including different counties

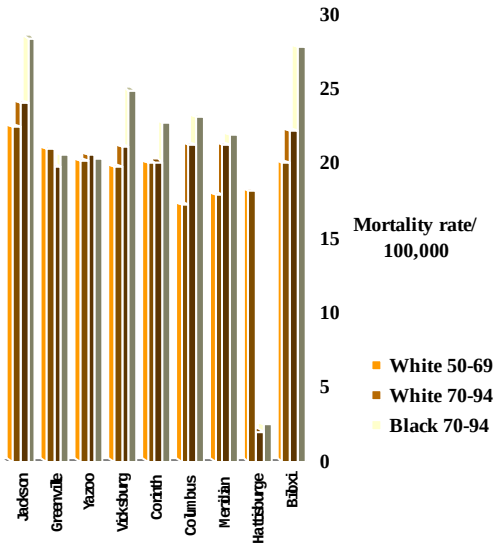


Figure 2: MS Breast Cancer Mortality by State Economic Area (SEA)

Table 1 illustrates the increase in lifetime prevalence of breast cancer in Mississippi women, with the rate of breast cancer mortality more than five-fold in 1996-1999 compared to 1970-1994 (110.6 vs. 20.8 for white women and 107.6 vs. 22.7 for black women). The rate for black women in both time periods had the highest rates (maximum values) across both time periods (285.1 vs. 45.4 during 1996-1999 and 200.0 vs. 34.7 during 1970-1994). It should be noted that statistics such as mortality and incidence rates are more stable when aggregated over several years. While the time period of 1970-1994 brings great statistical stability, it is not comparable to the fewer years of data in the period of 1996-1999. However, any bias that this difference may carry is not felt to interfere with the correlation analysis as the mathematical formula involved in calculating the Pearson correlation uses the slope of the change in one axis over the other, and not the magnitude of the difference between the two.

The age-adjusted incidence rate for Mississippi women for two periods of time is shown in table 1. For 1970-1994 period, there was a slightly higher rate difference between black and white women (22.7 vs. 20.8). During the period of 1996-1999, the white women had a higher incidence than black women, but it could be generally noticed that the rate was almost five fold higher compared to the first time period. This points out to a trend for increased

incidence with time for generally unknown reasons.

State Economic Areas (SEA):

Figure 1 shows the Mississippi State Economic Areas (SEA). The state is divided into nine areas. For purposes of gaining statistical power, the Jackson SEA was combined with the Yazoo SEA, and the Hattiesburg SEA with the Biloxi SEA. This yielded seven areas in the analysis. The map also shows the eighty-two county boundaries and labels in the State.

Figure 2 shows the State's breast cancer mortality rates/SEA for both white and black women during 1950-1969 & 1970-1994 and 1970-1994 respectively. The data showed rate differences within different SEA

Topographic predisposition of Mississippi to pesticide contamination:

Water Topology of Mississippi:

Figure 3 show the water topology and the Mississippi major lakes, rivers and catfish farms. The figure shows the feasibility of these scattered water bodies in contribution to the transport of pesticides (planted acres as a proxy of source) from one place to another across the state through water runoff. As can be seen on the map, the catfish farms are concentrated particularly in the Mississippi delta region of the state. The accumulation and transport of pesticides across the water topology and the introduction of pesticide metabolites into the food chain, especially from catfish farms, poses a great risk for long-term health effects.

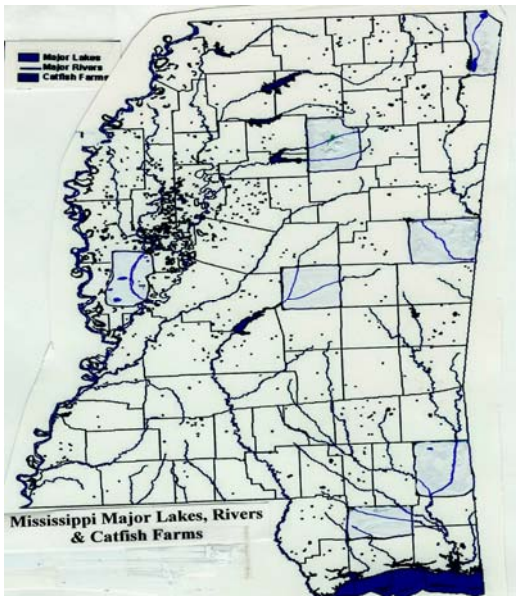
Cropland in Mississippi

Figure 4 shows the total number of planted acres by SEA; Greenville, Yazoo, Jackson, Vicksburg and Columbus SEAs showed the highest number of planted land.

Figure 5 is a GIS overlay map showing the total planted acres in Mississippi for the year 1997-2001 and the age-adjusted breast cancer mortality rate for each of the years 1996-1999. The SEAs with the highest number of acres of crops planted include Greenville, and parts of Yazoo, Vicksburg and Meridian. Scott, Benton, Lee, Holmes and Stone counties have the highest number of planted crops in the state. The overlay shows county mortality ratios and planted acreage as depicted in a pie chart for comparison.

Table 2 shows the analysis of different crops planted in the state, showing the highest percentages for rice followed by cotton and catfish. The table present descriptive data for the independent, dependent and control variables studied. The table also shows the percent distribution by type of crop, mean planted crops in acres, standard deviations, and range (minimum, maximum). In the state of Mississippi, rice (6,231 acres), cotton (960 acres) and catfish (800 acres) account for the majority of the distribution of acres of crops planted, out of a total of 7,321 acres planted between the years 1997-2001. The dispersion (S.D. and range) of acres among the SEAs varies greatly with several areas not having at least one of the crops planted and some having several types of crops planted in the SEA.

Table 3 Shows the Pearson correlation and p-value analysis for crop correlations with SEA and race. There are combinations of different correlations with regards to the three parameters.



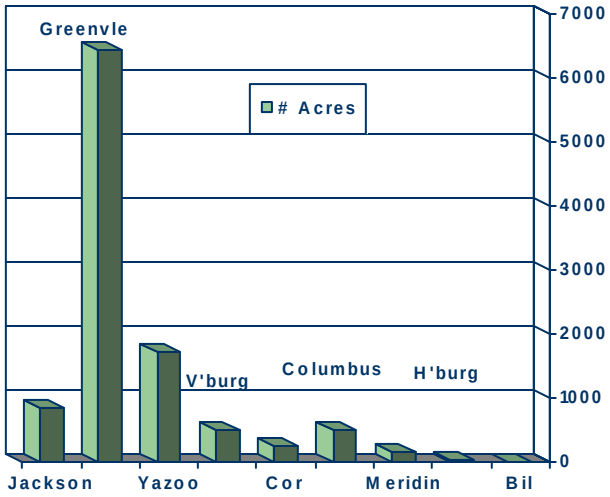


Table 2: Percent Distribution and Mean Number of Planted Crops (Acres), Standard Deviations, and Range Mississippi. 1997-2001 (N=7,321)

Type of Crop	% N=7,321	Mean	S.D.	Minimum	Maximum
Corn	1.9	139.1	46.6	0	137.7
Cotton	13.1	959.1	361.8	0	960.0
Rice	71.5	5,334.5	2,083.0	0	6,231.0
Soy	0.5	36.6	12.4	0	33.1
Sorghum	1.4	102.5	29.0	0	101.1
Wheat	0.7	51.2	22.4.0	0	52.5
Catfish	10.9	798.0	88.3	0	800.0

Table 3: Association of Breast Cancer mortality and Planted Acres

SEA	Independent	Dependent	Pearson (r)	P-value
Greenville	T Plants	Blacks	0.573	0.066
Greenville	Catfish	Blacks	0.648	0.031
Yazoo	Rice	Whites-94	0.674	0.030
Vicksburg	T Plants	Whites-69	0.607	0.062
Corinth	T Plants	Blacks	0.667	0.049
Greenville	Cotton Rice Rice	Blacks Blacks Whites	0.419 0.678 0.888	0.050 0.035 0.049
Hattiesburg	Soy	Blacks	0.720	0.050
Yazoo	Wheat Soy Catfish	Blacks Blacks Whites	0.570 0.506 0.592	0.030 0.072 0.044
Columbus	Catfish Soy	Blacks Whites	0.720 0.792	0.050 0.033

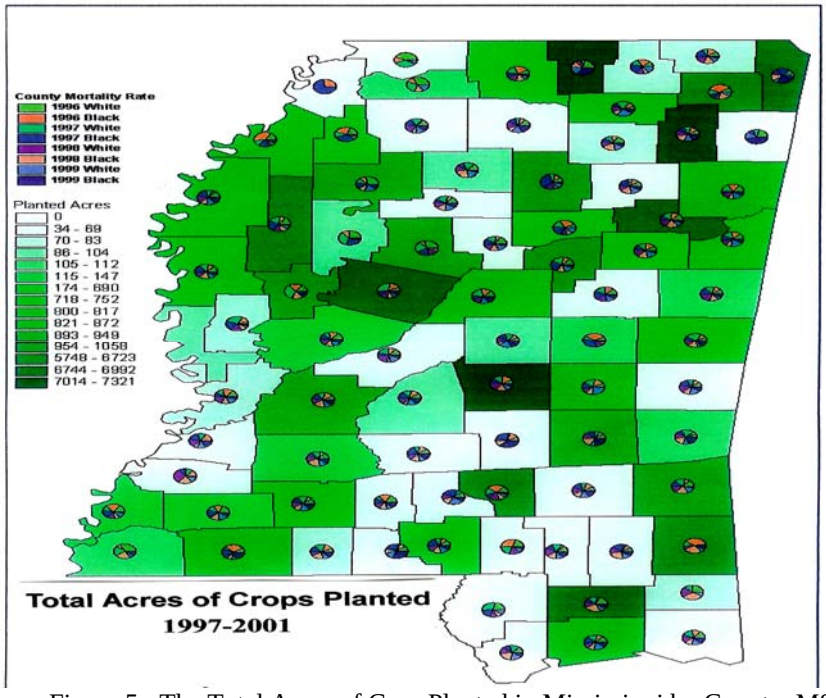


Figure 5: The Total Acres of Crop Planted in Mississippi by County MS and Breast cancer mortality 1997- 2000

Health Care and Income Disparities:

Distribution of Primary Care Providers in Mississippi:

The impact of access to health care and to early detection of cancer is generally linked to access to a regular primary care provider. As seen in Figure 6, the distribution of primary care providers in Mississippi is concentrated in the metropolitan areas of Hinds county (state capital) and along the Gulf Coast. Most of the other areas, especially the Mississippi delta where most black Mississippians live and work in the agriculture fields, have very few providers with some counties having less than five providers for ten to forty thousand persons

Table 4 provides some useful information on the economic and access indicators for the people in Mississippi. The average household income, percent of people living below the poverty line and the number of primary care providers are well below national averages.

Figure 6 shows the distribution of health care providers within the 82 counties in MS. There is a clear disparity within counties and hence SEAs regarding the level of health care especially within rural Mississippi.

Table 4**:** Mean Income, Percent Poverty and Primary Care Providers by County Mississippi, 1995 (N=82)

Factor	Mean	S.D.	Minimum	Maximum
Income ($)	23,573	5,011	14,382	41,241
Poverty (% below)	24.1	7.9	8.8	44.9
Primary Care Providers (#)	20.0	51.0	0.0	447.0

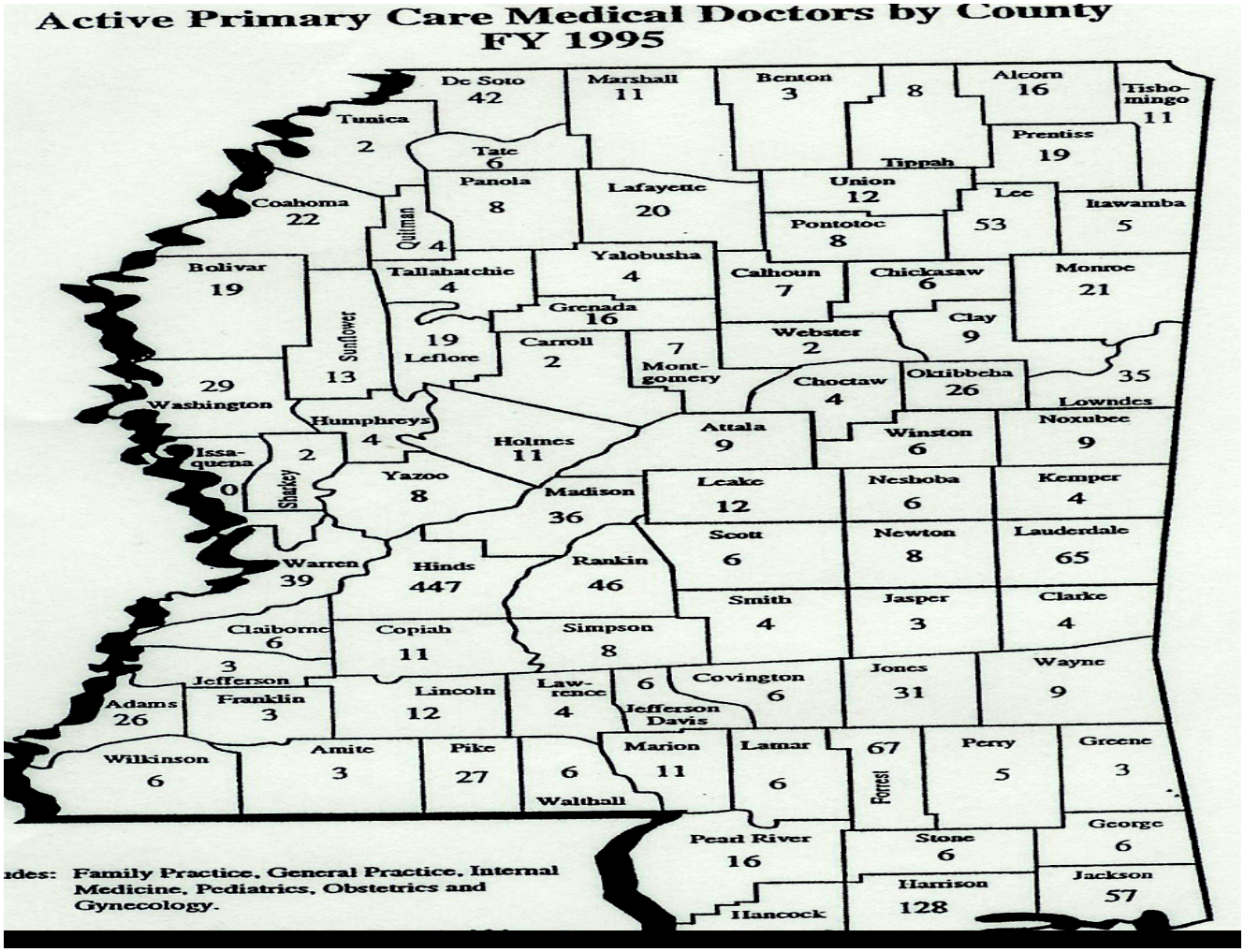


Figure 6: Mississippi Active Primary Care Medical Doctors

Findings from Hypothesis Testing

Hypothesis1:

There is a linear association between level of pesticide exposure (number of acres planted) and breast cancer mortality rate. The findings indicate that this hypothesis is supported (overall trend in Table 3 and fig 5). There is a linear association between level of pesticide exposure and breast cancer mortality rate (although not statistically significant across the board (SEA, race and type of crop). In both time periods that were studied (1970-1994 and 1996-1999), there were both positive and negative but linear associations ($p<.05$) for rice ($r = 88819$, $r = .67844$, $r = 0.63370$) soy ($r = 0.72034$, 0.79209), and a lower Pearson Correlation for cotton ($r = 0.41878$). Both time periods had positive linear associations, while only the period 1970-1994 had some unexplained negative linear associations (data not shown), which may possibility be an indication of spurious (by chance) events?

Hypothesis 2:

The association between level of pesticide

exposure and breast cancer mortality rate persists after controlling for race; black women will be more likely to have significant correlations between exposure and cancer. The findings in support these hypotheses were shown only for the second time period. As shown in Table3 and figure 4 and 5, the association between acres of crops planted by type of crop and breast cancer mortality rate is linearly and significantly associated but differs by race and type of crop planted, and by SEA.

For the years 1970-1994, there are moderate statistically significant correlations between the breast cancer mortality rate for the black and white females and the use of pesticides in the State of Mississippi. The association varies by SEA, race and type of crop. Black females are at increased risk of breast cancer mortality rate in areas with planted acres for catfish, wheat, soybeans and rice. White women are at risk in areas planted with rice and catfish; all of which are food crops and require massive exposures during their cultivation and harvest, in contrast to cotton which is not a food crop and mostly dried in its cultivation. The association persisted after controlling for race only in the period 70-94; the association was significant for the rice crop for both white (r =0.88818) and black women (r =0.67844). Black women were more likely to have significant correlation with the total number of planted acres of soy (r =0.72034) for 70-94, as well as for cotton (r =0.41878) and rice (r =0.6780), and wheat (r=o.5700). White women were having significant correlation with the soy crop (r = 0.79203) for 70-94, Catfish (r=0.59200 and rice (r = 0.88820). White women have a significant association only for total plants (r = 0.60709) in 1996-1999. Variations within SEAs existed (table 3).

Hypothesis 3: The association between level of pesticide exposure and breast cancer mortality rate will vary by type of crop planted .

This hypothesis was not supported. The associations varied by type of crop planted in addition to variation by race, as shown in Table3 and figures 4 and 5 which were discussed in findings for hypothesis 2. The association between level of pesticide exposure and breast cancer did vary by type of crop planted, only for wheat, rice, soy and catfish crops. There was a persistent association per time period (70-94 to 96-99) between level of pesticide exposure and breast cancer mortality for rice and soy crops. In 1970-1994 the association for both white and black women living in Greenville SEA for the rice crop was statistically significant (table 3).

Hypothesis 4:

There is a persistent association over time between level of pesticide exposure and breast cancer mortality. This hypothesis is supported. There is a persistent association over time, in 1970-1994 and 1996-1999 data (Table 3 and figures 4 and 5). Table 3 shows the correlation coefficients (r) between crops, planted acres and age adjusted breast cancer mortality rate by State Economic Area for the period 1970-1994. There is a high correlation between the rice crop and the white female breast cancer mortality rate in Greenville SEA and a moderate correlation with the black females for the same area. There was a positive correlation between the soy crop and the black females in the Hattiesburg/Biloxi SEA. A positive correlation was found between the black females and wheat in Yazoo SEA, and finally a positive correlation between the soy crop and white females in Columbus SEA.

Table 3 also shows similar findings for the period 1996-1999. There is a positive correlation between the rice crop and the black females in Greenville SEA, a positive correlation between the soy crop and the white females in Columbus. SEA and finally, there is a positive correlation between black females and the soy crop in Yazoo SEA.

DISCUSSION

An ecological study design model was used to analyze secondary data to establish correlations and test four hypotheses related to pesticide exposure and the risk of breast cancer mortality in the state of Mississippi. Findings from the study showed moderate correlations between total planted acres as a proxy of pesticide use, as well, positive correlations using Pearson analysis model (SAS software) were established for different crop types, and race for pesticide use/exposure and the risk of mortality from breast cancer in Mississippi women. Disparities in income levels and health care provision (providers within the 82 counties ranged between 0-447 and there were 24% of the population who have income levels below the poverty line; table 4 and Figure 6) were also established from data analysis. Studies supporting the role of environmental exposure to chemicals and the risk of cancer were published by Mitra et al, 2004. Mitra and Faruque, 2004 did a similar study in 82 counties from the state of Mississippi relating chemical emissions to breast cancer incidence, where they have found statistically significant correlations in support of our findings. Even though emissions offer direct exposure potential, their volatility and dilution by ambient air, will generally reduce the effective concentrations that may be involved unlike our study where the persistence of pesticides in soil, plants, food and water make a stronger argument for occupational/residential exposure and related consequences (Abdalla et al, 2003, PAN, 2007)..

The Mississippi River basin contains the largest and most intensively farmed region in the nation. The intense use of pesticides is of concern because of potential adverse effects on the quality and use of water resources (Gianessi and Puffer 1991). A number of studies have described the ability of technical pesticides (eg.chlorodane) and its metabolites to disrupt endocrine pathways. Disturbance of the endocrine system may occur through changes in the activity of liver microsomal enzymes that are important in the metabolism and degradation of ovarian and thyroid hormones. Endocrine disruption may also occur at the level of target tissues including the breast (Marshall, 1993; Anderson, 2002; and Fan et al, 2007).

Many chemicals are essential for life and are beneficial, while exposure to other chemicals can be harmful and affect our health. Some chemicals need to be activated by enzymes in the body to become cancer-causing chemicals (Carcinogens). A number of chemicals also pose no cancer risk, while others may act as beneficial agents. It's impossible to make generalizations about environmental chemicals. Much of the concern about whether pesticides affect breast cancer risk stems from observations of higher rates of cancer in male workers with high exposure to pesticides. However some scientists have found higher cancer rates in farmers exposed to certain pesticides (Flower et al, 2004; Fan et al, 2007; Lee et al, 2007).

Many chemicals have to be activated in the body to become carcinogens. Some people have differences in certain genes that control these activation pathways. This is an example of a gene-environment interaction. More research needs to be done to identify important gene-environment interactions. This will help identify groups of women who may have a higher breast cancer risk if they are exposed to certain chemicals (LWVEF, 1989; IPCS, 1991, and Pereira et al, 1997).

If a higher level of the active form of the carcinogen exists, this may put individuals at greater risk for developing certain cancers, including breast cancer. For example, women with high body levels of environmental chemicals called polychlorinated biphenyls (PCBs) usually do not have a higher risk of breast cancer. However, in one study breast cancer risk was higher in a group of women

who had both high level of PCBs and variations in the activation of a gene called CYPIAI (Moysich et al. 1999). Chlordane is extremely persistent in the environment (Phillips et al. 1997). Chlordane is one of the chemicals that had been most widely used for termite control. Adipose tissue level of chlordane rose in the week following ingestion of a solution of technical chlordane, indicating tissues redistribution of this chemical.

We are exposed to thousands of naturally occurring and synthetic chemicals over our lifetime. Many chemicals are essential for life and are beneficial, while exposure to other chemicals can be harmful and affect our health. There are many ways our bodies can be exposed to chemicals. This includes exposure in air, food and beverage, and through skin contact. Fetuses can be exposed to chemicals that cross the placenta during pregnancy. Some environmental contaminants can pass from a mother's body to an infant through breast milk. Certain chemicals can be stored in the fat of fish or animals, becoming more concentrated as they pass up the food chain (Theo-Calborn et al, 1993; PAN, 2007).

Factors consistently associated with a higher breast cancer risk are called established risk factors. Established risk factors include progressing age, starting menstrual periods earlier in life, late menopause, having a relative (mother or sister) with breast cancer, and past exposure to breast disease. Breast cancer rates vary widely in different parts of the world. Breast cancer rates are much lower in Japan, China, Africa and India (IARC, 1979; Globecan 2000). It is not clear why there are geographical differences in breast cancer rates. Studies of breast cancer rates of Japanese women who migrate to the US suggest an environmental influence on the risk of breast cancer. Within one or two generations, the breast cancer rate of descendants of migrant Japanese women increased and became similar to the higher breast cancer rate in western women (Shimizu 1991). Results of studies on twins in Scandinavia also suggest that a woman's environment plays a significant role in determining her breast cancer risk, and that environmental factors play a major role in determining the risk of breast cancer (Lichtenstein 2000).

There are very few studies that have evaluated whether female farmers have a higher risk of breast cancer (Blair 1995). The results of this small study suggest that breast cancer risk may be increased in some female farmers with high exposure to pesticides. Early reports suggested that women with high levels of DDE in their blood or fat had a higher risk of breast cancer. However, the majority of the more recent, well-controlled studies have looked at breast cancer risk in white women living in North America and Europe. For dieldrin, and other organochlorine pesticides, there are too few studies in women to make conclusion of whether or not body levels are associated with breast cancer risk (Snedeker 2001). For example, preliminary research suggests that occupational exposure to the environmental estrogen 4-octylphenol is associated with a higher risk of breast cancer (Aschengrau et al. 1998). EPA is in the process of validating screening tests for more than 865 pesticide active ingredients and about 150 high volume industrial chemicals for endocrine-disrupting effects. Exposure to cancer-causing chemicals when the breast is developing may affect breast cancer risk later in life. Studies have shown that breast development may affect breast cancer risk later in life. During pregnancy breast cells undergo changes making them more mature (BCERF, 1998).

There are many types of exposures on the farm that may affect cancer risk, including exposure to pesticides, solvents, fuel exhaust, and toxins from molds that from in stored crops. However some scientists have found higher cancer rates in farmers exposed to certain pesticides.

In a study of North Carolina female farmers, overall breast cancer rates were lower in women who lived or worked on a farm compared to women who did not work or live on a farm. It has been suggested that these female farmers/farm residents may have lifestyles or risk factors that could have reduced their risk of breast cancer (earlier age of first pregnancy, higher number of pregnancies, less likely to smoke or drink alcohol, higher level of exercise). However in this study, one group of females on farms who did not wear protective clothing or gloves when applying pesticides had two-fold higher risk of breast cancer compared to women who took proper precautions. The results of this small study suggest that breast cancer risk may be increased in some female farmers with high exposure to pesticides. This study illustrates the importance of reducing exposures to pesticide in the workplace (Duell et al 2000).

Breast cancer takes many years to develop- often up to thirty or more years- because of the many changes that must occur before a normal cell becomes a cancerous cell that divides out of control. Scientists are concerned that some environmental chemicals can either mimic the effect of hormones or growth factors, or affect how fast the body makes or breaks down these hormones. Through these actions, an environmental chemical could affect the delicate balance that controls cell division. More than half of all breast tumors depend on estrogen for growth. Chemicals that mimic the effect of estrogen may play a role in supporting the growth of estrogen-dependent breast tumors. For example, preliminary research suggests that occupational exposure to the environmental estrogen 4-octylphenol is associated with a higher risk of breast cancer (Aschengrau et al. 1998).

In addition to concerns about how environmental estrogens may affect breast cancer risk, there is also evidence that these"xenoestrogen" can affect reproduction in wildlife and possibly in humans (Fan et al. 2007). Because of these concerns, the US Congress passed the Food Quality Protection Act in 1996. This legislation mandates that all pesticide active ingredients be tested for their estrogen mimicking and other hormone disrupting effects. Childhood and adolescence are critical periods of breast development. Exposure to cancer-causing chemicals when the breast is developing may affect breast cancer risk later in life. Studies have also shown that breast development may affect breast cancer risk later in life. Studies have shown that the developing mammary glands (breast tissue) of young rats and mice have bud-like structures composed of rapidly dividing cells. These dividing immature breast cells are more susceptible to the damaging effect of cancer-causing chemicals. During pregnancy breast cells undergo changes making them more mature. Mature breast cells appear to be more resistant to the effects of carcinogens, and can more easily repair damage caused by cancer – causing chemicals (BCERF. 1998).

Health disparities research is at the forefront of the health care and public health agenda. There are various studies that support the socioeconomic and race disparities within minority, black and white women with regards to breast cancer and special reference to pesticides and farmland setting as risk factors (Krieger, 1989; Worthing and Hance, 1991; Whitten, 1993; Moormier, 1996; Newman and Alfonso, 1997; Simon and Severson, 1997; Lannin et al, 1998; McCarthy et al, 1998, Hill, 2002; and Lee et al, 2007),. Our findings support the need to address the health disparity problem related to breast cancer in minority women within cultivated lands in Mississippi.

CONCLUSION

For the years 1970 and 1994, there are moderate statistically significant correlations between the breast cancer mortality rate for the black and white females and the use of pesticides in the

State of Mississippi. The association varies by SEA, race and type of crop. Black females are at increased risk of breast cancer mortality in areas with planted acres of catfish, wheat, soybeans and rice. For the years 1996-1999 there are moderate statistically significant correlations between the breast cancer mortality rate for the black and white females and the use of pesticides in the State of Mississippi. Black women are at increased risk of breast cancer mortality in areas with planted acres of rice, soybeans, wheat and catfish and White females are at risk in areas planted with rice, catfish and soybean crops

There is chemical persistence in the environment and great potential for continuous human exposure. There are several studies that are currently being conducted to address the research needs to determine whether environmental contaminants, including organochlorine pesticides and other chemicals increase the risk of breast cancer among women. More studies are needed to examine if there is an association between the levels of organochlorine residues in serum and increased risk of breast cancer among African American females.

There are lots of available areas to test and examine the relation between pesticide use and breast cancer mortality. The State of Mississippi local agencies need to address this issue and advance the research agenda in this area to estimate this risk of breast cancer and its impact on the State population.

As a result of the new mammography and early detection activities that has been added to different communities in Mississippi, the mortality rate is expected to decrease over time, due to diagnosis at earlier stages and longer survival rates. However, from the results shown in this study, there is evidence of a persistent association between pesticide exposure and breast cancer mortality that may be explained by the bioaccumulation hypothesis where over time, pesticides will make their way into the soil, food chain and finally human fatty tissues and the threat may not be limited to farm exposures.

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Discovering The Patient's Definition Of A Medical Emergency

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ABSTRACT

Purpose: To discover what motivates patients to seek emergency department (ED) care through their definition of a medical emergency.
Design and Methods: A qualitative design using a general inductive approach was conducted with 55 patients at three southeastern EDs. Triangulation of data collection was achieved through the completion of observational notes, demographics form, medical scenarios and symptoms form, and semi-structured interviews which were tape recorded. The interviews focused on patients' definition of a medical emergency.
Findings: Overwhelmingly, patients related pain as a medical emergency though many different aspects of pain emerged such as severity, unrelenting, fear of serious illness, and immediate need for care. Additionally, patients responded with the following definitions of a medical emergency: something life threatening, the need for urgent or quick care, the need for medical assistance, and inability to see primary care provider.
Conclusions: Patients perceive a broad and ill-defined perception of a medical emergency, which has developed from patients' past medical and family experiences. Patients have a broad, colloquial understanding of a medical emergency and perceive an emergency based on their personal understanding of the medical condition present.
Patients seek ED care for health care providers' medical expertise and knowledge of treatment options. Patients must understand basic medical conditions and treatment options in order to decipher the correct use of the ED.

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Introduction

Discovering the Patient's Definition of a Medical Emergency

In 2004, the National Hospital Ambulatory Medical Care Survey (NHAMCS) reported an estimated 110.2 million annual emergency department (ED) visits, an 18% increase since 1994 (McCraig & Nawar, 2006). The increase usage of the ED has led to its overuse and misuse, where as many as 75% of patients present with non-urgent symptoms (Young, Wagner, Kellerman, Ellis, & Bouley, 1996; Billings, Parikh, & Mijanovich, 2000). The dramatic increase in ED utilization during the past decade is a complex issue with numerous contributing factors. A significant contributing factor is the convenience of ED care, including continuous hours of operation, geographical location and no appointment necessary for evaluation (Ragin et al., 2005). Additional reasons include access, need, referral, familiarity and trust, all which influence patients to choose emergency medicine (Afilalo et al., 2004).

The increase in ED use has led to ED overcrowding which has many negative effects

on the patients, health care providers, and hospitals. Overcrowding is an international concern that is common in North America, United Kingdom, and Australia (Sprivulis et al, 2006; Trzeciak & Rivers, 2003). Negative effects include: increased patient mortality (Sprivulis, Da Silva, Jacobs, Frazer, & Jelinek, 2006; Richardson, 2006), reduced quality of care (Trzeciak & Rivers, 2003), delay of necessary treatments such as pain medications (Derlet & Richards, 2000), antibiotic administration (Shah, Schmit, Croley, & Meltzer, 2003), and patients' unnecessary exposure to nosocomial infections (Shah et al., 2003).

Many programs and proactive measures have been developed in order to decrease patient usage of the ED such as patient education (Powell & Breedlove-Williams, 1995), telephone triage (LaFrance & Leduc, 2002), access to office appointments (Davidson, Giancola, Gast, Ho, & Wadell, 2003; Cunningham, 2006), pre-authorization (Franco, Mitchell, & Buzon, 1997; Young & Lowe, 1997) , and increased insurance co-payment (Cunningham, 2006), which have only produced short term results.

This study set out to discover what motivates patients to seek ED care through the patient's definition of a medical emergency. Current research supports the notion that patients choose ED treatment for multiple reasons. Therefore, a single intervention will not prevent all unnecessary use of the ED. Health care providers need to be aware that a patient's definition of a medical emergency may differ from the medical community's definition, suggesting that exploration of the patient's definition could provide supportive insight into their overuse and misuse of the ED (Afilalo et al., 2004). Therefore, future methods may be developed in order to educate patients on the proper use of the ED and to provide health care professionals the foundation to create programs to remedy the misuse and overuse of the ED.

Methods

This qualitative study took place at a large academic medical center, a small private hospital, and a moderate sized private hospital within a metropolitan, southeastern city. Institutional review board approval was obtained from all three hospitals and consent was obtained from all participants.

A total of 55 patients from all three hospitals completed the study. No predetermined demographic data, such as race or sex, was expected secondary to the unpredictability of patients who utilize the ED. Participants were limited to ED patients, whose age was greater than 18, and seeking care at the three metropolitan hospitals. Patients with an altered mental status such as dementia, intoxication, drug abuse, or severe medical conditions were excluded from the study.

Triangulation of data collection was conducted through the completion of observational notes, demographics form, medical scenarios and symptoms form, and semi-structured interviews which were tape recorded. Questions on the demographics form included age, race, gender, educational level, occupation, income, and source of ED payment. The second phase of the data collection consisted of a list of medical scenarios that the participants determined if the scenario was a medical emergency or not. Also, patients were given a list of signs and symptoms and asked to choose whether they believed the sign or symptom was an emergency and whether they would utilize the ED for the condition. Finally, patients underwent an in-depth, semi-structured interview. Interview questions focused on the patient's definition of a medical emergency.

General inductive approach of data analysis was utilized which allowed recurrent or significant themes from the data to emerge without strict constraints (Thomas, 2006). The following procedure was used for inductive analysis of the qualitative data: (1) preparation

of raw data files, (2) close reading of the text, (3) creation of categories, (4) overlapping coded and un-coded text, and (5) continuing revision and refinement of categories. The preparation of the raw data required formatting the data in a common format (Thomas, 2006). Interviews were voice recorded and transcribed to Microsoft Word documents with similar font and margins. Close reading of the transcripts was completed with multiple readings in order to identify themes and categories, and to consider possible relationships and differences among categories.

The creation of codes or categories emerged, but initially appeared general. Coding organized the data into conceptual categories, which were analyzed to create themes or concepts. Analysis of the main research study question was completed with a coding system, however, some data collected did not require coding for data interpretation. Continuation of revision and refinement of the category/code system was completed. Many categories that shared similar text were combined.

Trustworthiness was ensured by use of coding consistency check, triangulation of data collection, and a detailed audit trail. Inter-rater coder reliability was accomplished through a secondary coder. A reliability score of 96% was obtained. A detailed audit trail of all events that took place throughout the study was maintained.

FINDINGS

An array of definitions of a medical emergency emerged from the data, with pain being the number one response. Additionally, patients responded with the following definitions of a medical emergency: something life threatening, the need for urgent or quick care, the need for medical assistance, and inability to see primary care provider (PCP).

Pain

Overwhelmingly, patients correlated pain as a medical emergency. Sub-categories of pain emerged from the data to include severity, unrelenting, fear of a serious illness, and immediate need for care.

Severity of Pain

Patients had a wide range of symptoms they associated with pain including abdominal pain, headache and back pain. Patients viewed the intense level of pain as an emergency. For example, one patient provided the following description, “Stabbing, shooting, or me getting down like I did a while ago. Yes, pain where you almost pray you’re dead.”

Unrelenting Pain

Many patients related pain that was unrelieved with home therapy to require immediate medical attention. The following patient best describes this as “pain not going away and it being like a ten and it gradually gets worse and worse. Everything I take doesn’t make it feel better.” Another patient states, “when you have problems with aching and it’s going on and you feel like it affects your breathing even though you’ve taken medicine and stuff. That’s an emergency, isn’t it?” While some patients attempted to remedy the pain at home prior to seeking ED care, many patients came to the ED without trying any over the counter products to cease pain.

Fear of Serious Illness

Though patients may seek emergency care due to the severity or unrelenting nature of their pain, the fear of a serious or life threatening illness propels them to believe their pain is an emergency. An older gentleman relays this with the following statement: “My head was hurting real bad and I know I had high blood pressure and I really wanted to check, because it’s real dangerous when you have high blood pressure.” When asked if he considered his symptom of headache and history of high blood pressure as an emergency he responded, “yes, a stroke or anything could happen.”

Immediate Need for Care

Patients perceived pain very differently but many patients believed pain control should be addressed and treated quickly through the ED. Patients believed they required immediate attention because if their pain was not taken care of "quickly" then the symptoms would only "get worse and worse." The ED is considered the "only place that will relieve pain." One patient with sudden back pain described an emergency as "something that hurts like hell and it needs to be taken care of quickly." While another patient furthered this by saying, "you need to hurry up and go to the doctor, you need to go to the emergency room."

Life Threatening

Many patients described a medical emergency as life threatening. This would be anything that would put "someone's life in danger" or if they are "dying." Patients gave many examples of signs and symptoms they considered life threatening to include gun shot wounds, stabbing, stroke, heart attack, loss of consciousness, and broken bones.

Urgent Need

Patients perceived an emergency as something "drastic," serious," or "real bad." A patient with a seizure disorder described an emergency as "an injury or you get hurt that you have to be rushed to the hospital. Something dangerous." One patient related his urgency to be something "serious to the point that I can not wait to see a family doctor that day or serious enough for someone to be in tears, they are going to the hospital."

Quick Care

Patients associated a need for quick care or quick service when asked to define a medical emergency. Patients came to the ED believing their sign or symptom was severe enough to need "quick care." For example, patients described an emergency as "something that needs to be treated right away" and "anything that requires needing to see a doctor immediately."

Need for Medical Assistance

The need for immediate medical attention from healthcare professionals emerged from the interviews. Patients believed they needed someone with more medical expertise, therefore, choosing emergency care. Some patients sought emergency care due to their belief that the ED would not "turn them way" because "they are supposed to see you." The following patient provided the best narrative stating "a medical emergency would be something that you can't handle at home and that you would need someone with more experience to help you." Patients who were unable to identify their illness or could not explain their symptoms desired emergency care, as they feared the unknown.

Unable to see Primary Provider

Few patients attempted to contact their PCP to report their illness or medical condition. However, patients claimed if they were unable to contact their PCP, then they would seek emergency care. Patients did relay that the symptoms would have to be "serious" or "hurting and can't go anywhere," in order for them to seek emergency care. However, they believed they needed medical assistance regardless of where the medical care took place.

Discussion

The purpose of this study was to discover the patient's definition of a medical emergency as such information could facilitate healthcare professionals to understand patient motivation of ED use. Six themes emerged from the research study. Overwhelmingly, patients perceived pain as an emergency. Patients perceived pain differently and have different tolerance levels to pain. Patients believed if severe, unrelenting pain was present, then it was an emergent medical condition. Patients believed they needed the expertise of a

healthcare professional to decipher if pain was related to a medical emergency or not. Several patients admitted to not attempting pain remedy with over-the-counter treatments due to patients' lack of medical background or knowledge. Many patients reported they did not take medication due to the fact they were waiting for the ED's advice on which medications to take.

When comparing the patients' definition of a medical emergency to the Emergency Medical Treatment and Labor Act (EMTALA), a similar theme is evident. EMTALA defines a medical emergency as:

> "A medical condition manifesting itself by acute symptoms of sufficient severity (including severe pain) such that the absence of immediate medical attention could reasonably be expected to result in placing the health of the individual (or, with respect to a pregnant woman, the health of the woman or her unborn child) in serious jeopardy, serious impairment to bodily functions, or serious dysfunction of any bodily organ or part" (Centers for Medicare & Medicaid, 2006).

Patients reported pain and life threatening conditions as an emergency but seem to have a broad, colloquial understanding of a medical emergency as compared to the esoteric definition utilized by EMTALA. Patients perceived an emergency based on their personal understanding of the sign or symptom present. Past experiences and family input influenced their perception of their medical situation, therefore, leading the patient to examine their need for medical care. Patients believed their health was a primary concern and would do what is necessary to resolve their fear of the unknown.

Though EMTALA's definition mentioned pain as a medical emergency it is narrowed to "sufficient" severe pain, not a general, bothersome pain that many ED patients reported. Again, patients have an individual perception of a medical emergency and personal tolerance for pain. Therefore, patients' individualism impacts their decision of what constitutes an emergency.

Many patients believed they should receive quick care if they considered their sign or symptom an emergency, but would become frustrated if they were not seen by the ED provider in what they considered "quick" time. Patients had different perceptions of how timely care should be addressed.

Patient education is needed with a focus on management of chronic disease, preventive heath care, and basic treatment options. Patients need to be knowledgeable of their chronic diseases, therefore, patients may feel comfortable in recognizing health changes and treating basic heath needs. Walls, Rhodes, and Kennedy (2002) revealed patients considered the ED as not only a place for illness treatment but also for general and preventive services. The ED is not focused on wellness or preventive care and patients that use the ED as their primary source of healthcare are receiving inappropriate or incomplete care. However, patients should utilize the ED for emergent conditions.

Basic treatment options should be taught in community outreach programs, primary care clinics, and school health education courses. Patients need to be aware of over-the-counter medications such as for treatment of pain, fever, cough and constipation. Also, basic first aid knowledge could prevent or delay an ED visit. For example, if a patient twists their ankle, they could apply an ACE bandage, ice and elevate the ankle at home. A sprained ankle generally requires no immediate professional attention from the ED. While the sprained ankle maybe painful, the patient could take a pro-active approach to control the situation until their PCP is available.

Limitations of the study include the fact that patients were interviewed at three EDs within the same metropolitan city and state. Interviews took place during a one-month

period and in the afternoon and late evening, assuming patients had the opportunity to contact a primary provider or urgent care facility. Also, the study was limited to ED patients currently utilizing the ED. Patients' past personal or family experiences in the ED impacted their response to questions. Many friends and family members contributed to patient usage of the ED by encouraging the patient to seek care. Further investigation of family member influence for choosing ED care could be addressed in future research.

CONCLUSIONS

This study revealed patients' usage of the ED is driven by their broad and individualistic definition of a medical emergency, which is developed from numerous external sources and experiences. Patients have a broad, colloquial understanding of a medical emergency and perceive an emergency based on their personal understanding of the medical condition present.

Previous research and programs have tried to educate patients on what is an accepted medical emergency and this research study confirmed that the patient's definition of a medical emergency is individualistic. Therefore, this type of education will not change or affect patients' use of the ED if patients perceive their sign or symptom as an emergency. This study discovered many patients sought ED care for healthcare providers' medical expertise and knowledge of treatment options. Patients are not attempting home treatment options such as over-the-counter medications prior to seeking ED care. Basic home treatments should be taught to patients in order to prevent an ED visit or to delay care until their primary provider is available. In addition, patients need to be knowledgeable of their chronic medical conditions in order to attempt home treatment or to recognize symptoms that require immediate care.

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Leadership Institutes: Guiding Science and Mathematics Systemic Reform: Delta Rural Systemic Initiative (Delta RSI) One Decade Later

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ABSTRACT

The National Science Foundation (NSF) supported program, Delta Rural Systemic Initiative (Delta RSI), was designed to initiate and stimulate systemic reform in K-12 mathematics and science to children living in the most rural and low SES counties of Arkansas, Louisiana, and Mississippi. From 1997-2003, Delta RSI helped local districts to build and support a systemic and sustainable framework for grassroots leadership, policy development, improvement of K-12 science, mathematics, and technology learning environments and an enhanced capacity for local community involvement. Advisory councils and district leadership teams were established to work closely with others in Delta RSI to strengthen relationships in the educational system. Delta RSI Leadership Institutes were especially successful in creating the dynamic communities and interrelationships necessary for creating and implementing plans for sustainable growth.

The results of survey data completed by Delta RSI Leadership Institute participants provide valuable insight into what was perceived to be successful and what challenges remain in sustaining systemic reform in science, mathematics, and technology. Recommendations for future collaborations are discussed in light of Boyer's Leadership Models and current issues facing science and mathematics education in the K-12 educational system.

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Introduction

Mission and scope of the Delta Rural Systemic Initiative

According to the *National Science Education Standards* (NRC, 1996), an understanding of science and the processes of science are essential to creating a "scientifically literate" citizenry. In comparison with many other countries, students in the United States – and particularly students in rural, poor areas of the Delta -- score lower in science mathematics problem solving and reasoning skills despite several decades of education reform in this country and hundreds of millions of dollars spent on programs, kits, consultants, and the like. Sustainability of effective science and mathematics education is vital to the scientific and economic health of the individual and of society.

The Delta Rural Systemic Initiative (Delta RSI) was established in 1997 under a grant from the National Science Foundation. The purpose of the grant was to target the most rural and low SES counties in Arkansas, Louisiana, and Mississippi for regional and local systemic efforts. The project was designed to ensure that Delta children and youth acquire, and become proficient at, globally competitive levels in those skills and content related to science, math and technology. The program

targeted the key barriers to systemic reform in 64 counties and 106 K-12 schools.

Critical to systemic sustainability, local stakeholders in each community formed the basis for any meaningful improvement and that fundamental reform/change could only occur by mobilizing local groups of individual as change agents. The Delta RSI formed an over-arching umbrella for the participating counties, communities and schools.

Leadership Institutes: A Crucial Component of Delta RSI

One of the most pivotal and vital roles to creating sustainable systemic reform in K-12 science, mathematics, and technology rested with the formation and actions of the district leadership teams. Leadership teams at the school district level were established to address the scope of the grant activities in the K-12 system and, through teambuilding, to address and support high-quality research-based, standards-based science, mathematics, and technology curriculum, instruction, and assessment issues and decisions. Teams consisted of a district administrator (e.g. the curriculum coordinator and or director of federal programs), a science teacher, a mathematics teacher, a university faculty member, and other representatives from the community such as a business leader, parent coordinator, school board member, an influential member of the faith-based community, and the district superintendent who served as the official chairperson of the leadership team.

Once district leadership teams were formed, they were invited to apply to a week-long Delta RSI Leadership Institute modeled after the Arkansas Leadership Academy (ALA), a collaborative venture between the University of Arkansas, state government, and the private sector. The ALA was created in 1991 by the state legislature to provide leadership for systemic reform in Arkansas through team building, awareness of issues, and action. Leadership institutes for school districts focused on vital issues in education such as quality of educational programs, student, teacher and school accountability, funding and equity.

Through the leadership institutes, the ALA brought together teachers, principals, university faculty members, community members, counselors and others in school teams to focus on science and mathematics education. These workshops provided a means to educate, elucidate, and coordinate so that stakeholders could develop effective plans to drastically improve science, mathematics, and technology and to realize higher achievement test scores.

Implementing the Leadership Institutes: The Application Model

During the leadership institutes, teams participated in knowledge and skill-building sessions on research-based, standards-based science, mathematics, and technology curriculum, instruction, and assessment. Standards were modeled through engaging activities and participants were encouraged to better understand and experience standards-based curricula and observe teaching strategies representing "best practices." Each team received a copy of the *National Science Education Standards* (NRC, 1996) and the NCTM *Principles and Standards for School Mathematics* as well a copy of a leadership institute manual developed around research-based, standards-based curricular and instructional state frameworks.

Feedback from Leadership Institute participants

Upon completion of the leadership institutes, teams provided valuable feedback to evaluate the effectiveness of the week-long training. A survey was distributed a year after they attended the Leadership Institute to gather information about the nature of their ongoing efforts.

Independent evaluators--Kurt Minnick and

Associates evaluation team--collected, analyzed, and disseminated relevant data. These data provided a basis for stakeholders at local, state, and regional levels to plan and assess daily activities, guide strategic planning, and collect additional data to evaluate ongoing efforts.

Project members directly involved with leadership institutes – principal investigators, project director, and field coordinators – agreed that there was an overwhelmingly positive response to Institute workshops and team-building activities among participants. Members of leadership teams were motivated, dedicated, and driven to work together to facilitate systemic reform on the local level. Their values and commitment to support high quality science and mathematics education was equal to the level in which they communicated, shared, and created short-term and long-term plans for sustained growth.

Leadership Institute Surveys – A Year Later

Leadership participants' enthusiasm and effort is reflected in the survey results that

Minnick & Associates collected and tabulated from 1997 – 1999. Minnick & Associates sent out the Delta RSI Leadership Institute Team Survey: One Year Later in April 1999. They sent a cover letter, the survey, and postage-paid return envelopes. The surveys were sent to 166 Year 1 leadership institute participants. They received 34 surveys (21%) in response. Among the respondents, 44% were administrators, 29% were teachers, 9% were board members, 3% were parents, and 15% were other support personnel. This data provided information on participants' beliefs about how their leadership teams were functioning, what the usefulness of the leadership institute proved to be, and about leadership team accomplishments. The tabulated data are found in Figure 1 and Tables 1-5.

As survey responses indicate, an overwhelming majority of 82% participants rated the overall week's training as extremely useful. More detailed information was revealed through directed questions found in Table 1.

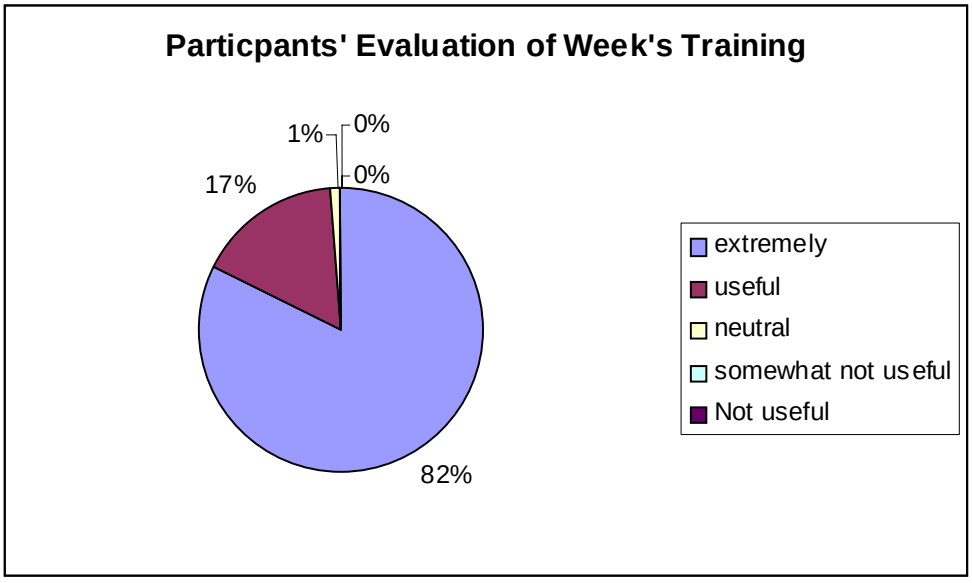

Figure 1 Leadership Institute Overall Evaluation 1999

Table 1 Leadership Institute Evaluation, 1999

Item	Response % Rating 1-5: 1 = extremely positive response				
	1	2	3	4	5
I feel empowered to implement the beliefs, mission, vision, and goals of my school district	65.3	34.3	2.2	0	0
The type of leadership addressed by this institute was practical	72.0	24.7	2.2	1.1	0
As a result of this institute, my awareness level of the resources available to Delta RSI math/science educators was heightened.	73.8	22.6	3.6	0	0
The institute addressed those areas of organizational and leadership reform that can accomplish school improvement in Delta RSI in a way that can be described as effective.	69.5	28.4	2.1	0	0

As seen in Table 1, approximately two-thirds of participants reported that, as a result of the leadership institute, they felt extremely empowered to implement the mission, vision, and goals of their school district and an additional 34% felt empowered. Greater than 95% percent of participants responded that the institute was practical or extremely practical. Approximately 75% of those believed that the Institutes were extremely practical. As a result of the institute, greater than 95% of participants reported that their awareness level of available resources was extremely heightened. Approximately 98% of participants believed that the institute addressed important areas of organizational and leadership reform that can accomplish effective school improvement.

A year later a survey was sent to Delta RSI Leadership Institute team members for additional feedback. Data were gathered to better understand how the leadership teams were functioning (see Table 2), the usefulness of the leadership institutes (see Table 3), and leadership team accomplishments (see Table 4).

Question/Statement	Responses	
	Has not met since Institute	6%
	Less than once a month	67%

1. How often has your leadership team met this year?	Once a month	12%
	Twice a month	9%
	Once a week	6%

Fewer than 10% of leadership teams did not meet since the Institute. Approximately 2/3 of leadership teams reported they met less than once a month and 12% reported that they met once a month. Only 9% reported meeting twice a month and 6% reported that they did meet once a week.

Table 3 The Usefulness of Leadership Institutes

Please rate how the description applies to you.	Less True	More True
1. I have a better understanding of systemic reform as a result of the leadership institute.	0%	85%
2. The leadership institute was relevant to my work in education.	6%	77%
3. The leadership institute was a good preparation for the work of systemic reform of math and science education.	3%	88%

Eighty-five percent of participants felt that that it was mostly true that they had a better understanding of systemic reform as a result of the leadership institute. Seventy-seven percent reported that the leadership institute was relevant to their work in education, and 6% reported that it was less true. The vast majority, 88% of participants reported that the institute was a good preparation for the work of systemic reform in science and math.

Participants were not as overwhelmingly positive about their leadership team accomplishments but the majority did report successful results. (Table 4)

Table 4 Leadership Team Accomplishments

Please rate how the following descriptions apply to you and your leadership institute team.	Less True	More True
1. Our leadership team has had a significant impact on local math and science education.	21%	56%
2. I have shared knowledge, experiences, and reactions from the leadership institute with others.	6%	82%

3. I have been successful in involving others in systemic reform of math and science education.	15%	58%
4. I have made significant changes in my approach to education reform since returning from the leadership institute.	12%	70%

Many participants believed that leadership teams had a significant impact on local math and science education. The relatively unremarkable percentage of participants (58%) revealed that they felt less certain about the positive broad local impact of institutes on science and math education. The overwhelming majority of participants reported that they had shared knowledge and experiences with others. Participants felt less certain of their success in involving others in systemic reform in science and math education. Almost three-fourths of participants felt that they had made significant changes in their own approaches to education reform since returning from the leadership institute.

In Their Own Words

Participants' thoughtful analytic comments revealed additional perceptions about the success of the leadership institutes. When asked to provide some insight into the functioning of the leadership teams, a recurrent theme was post leadership institute follow-up. One team wrote that (they) "need follow through." They stated that their team had not convened to discuss successes and remaining "hurdles that remain to be overcome." Another team believed that the institute was valuable in helping them better understand procedures and methods for change. They reported it was unfortunate that they "have not followed up as we should to really affect change." One group felt that a follow-up institute to discuss successes and failures of different leadership teams might help fine tune the process and create greater sustainability. One team wrote that, "The leadership institute was missing an immediate follow-up and periodic communication to monitor implementation efforts." Many participants believed that the leadership institute changed the way they perceived educational reform. They remarked that leadership institutes helped them "to be able to adapt to the ever changing world of math and science."

Survey data provided compelling evidence that participants gained a great deal from institutes including greater understanding of systemic reform and preparation for the work of systemic reform of math and science. Participants' reflections and insights revealed several important features that could help ensure systemic sustainability. Most agreed that teams needed to meet on a regular basis, follow-through with plans made at the institute, and routinely assess successes and areas needing improvement.

Direct observations of team dynamics, activities, and planning indicated principals and/other administrators experienced and realized the value of the nature of high-quality standards-based science and mathematics. As principals or superintendents worked with teachers and community members the atmosphere was informal, collegial, and extremely productive. To support such academic programmatic changes in schools, principals must be well informed to serve as instructional and institutional leaders. Through team interaction, they gained knowledge, experience, and insights to help facilitate effective instructional opportunities, provide necessary materials, and focused professional development.

Too many times elementary teachers lament that they are told *not* to teach science because it is not tested. Young students are naturally curious about the natural world -- science class should be a time for them to experience the richness and wonder around them and learn problem-solving skills.

Math class should not be a series of unrelated skills to be forever learned, forgotten, and relearned each year. Math teachers must provide opportunities for young students to flex their critical thinking muscles through engaging and realistic situations that will serve them well for learning higher mathematics and as the future work force. As teams used manipulatives to conceptualize abstract concepts, principals and teachers have exclaimed that, "Oh, now I understand about dividing fractions! I always wondered why 'flip and multiply' worked!"

Math and science is in Mississippi has a renewed emphasis in school curriculum, instruction and assessment. Science is now being tested as part of the No Child Left Behind (NCLB) Legislation. Even though science instruction is now on the educational front burner, it is important to avoid teaching with the main focus being a fact-driven curriculum. Standards-based science requires that students learn fewer concepts but in greater depth and learn how to think like real scientists. Inquiry-based science serves as a means to meaningfully merge content, process skills, and scientific dispositions. Problem-solving and using critical thinking skills is an important focus of math instruction and our students deserve challenging classroom opportunities that prepare them for Algebra, higher math, and real world situations.

The National Assessment of Educational Progress (NAEP) reports that math and science test scores in Mississippi consistently rank lowest of all the states. The NAEP test, given to 4th, 8th, and 12th grade students, places a greater emphasis on critical thinking scores as compared with the Mississippi Curriculum Test (MCT). Because expectations have been lower for our students, educators in Mississippi have stepped up their efforts to prepare students for more advanced courses in math and science, thus more competitive on the NAEP. The new State Mathematics Curriculum Framework provides a stronger emphasis on critical thinking and higher expectations for students as does the new Mississippi Curriculum Test (MCT 2). Aligning our goals with the National Council of Teachers of Mathematics (NCTM) and the National Science Education Standards (NSES) provides the much needed emphasis toward problem-solving and reasoning skills and ensure that our students have equal access to high quality math and science instruction.

Ms. Joyce McNair, superintendent of Humphreys County School District, was recently interviewed to provide additional information on the short and long term effects of Delta RSI in her school district. An exemplary superintendent, Ms. McNair played a prominent role in initiating and sustaining change in mathematics instruction through the programs and leadership focus of Delta RSI. She shared the positive systemic and sustainable programs and ongoing practices that stemmed from participating in Delta RSI Leadership Institutes. (J. McNair personal communication, September 12, 2007)

McNair reported that one continuing vital focus in the Humphreys County is the emphasis on departmental learning communities that function to keep current with research and standards-based best practices. These learning communities have their roots in the original Delta RSI Leadership Team. Peer-study groups are embedded within the departmental teams to ensure high-quality education for all students through sharing ideas, challenges, and effective classroom strategies. Communication through these peer-study groups helps ensure that all children receive a high-quality education and the additional support necessary to succeed in school and become productive citizens. Continued contact with community stakeholders and with university faculty has not been a strong part of

sustained reform in K-12 science and mathematics.

CONCLUSIONS AND RECOMMENDATOIONS

The intent of Delta RSI was to make standards-based science and mathematics education reform systemic and sustainable. It's encouraging to learn about Humphreys County schools' emphasis on research-based, high quality mathematics instruction; however, this is one example and would not be possible without Ms. Joyce McNair's vision and implementation of instructional excellence. Building new leadership teams and facilitating their sustainability is a daunting goal. Can we do this again? To help ensure that K-12 students receive high-quality science and mathematics education in the early grades, leadership teams can provide the means to share the vision of effective science and math curriculum, instruction, and assessment and strengthen the support system crucial for classroom teachers to sustain engaging and meaningful experiences for all children. It is never too late to rekindle or initiate leadership teams that bring together teachers, principals, university faculty members, board members, and other interested stakeholders for science and math instructional excellence.

University-K-12 Partnerships

A vital component of effective, research-based K-12 science and mathematics is sustainable and mutually beneficial interaction between science, mathematics and science/mathematics university faculty and K-12 teachers and administrators. When university faculty members were invited to provide professional development workshops at leadership institutes, many expressed reluctance to devote time and energy to working with K-12 leadership teams. The prevailing thought was that this endeavor wasn't valued as much as research and that promotion and tenure largely depended on publication in peer-reviewed journals. Traditionally, university faculty members are judged for tenure and promotion on teaching, research, and service. Although a well-balanced approach is desirable, it is generally understood that scholarship -- synonymous with a rigorous publication record -- is most crucial to success at the university level. The old adage "publish or perish" is alive and well.

Boyer (1997) argues that the definition of scholarship can be expanded to include: discovery (conduct 'traditional' research); integration (elucidate interdisciplinary aspect of knowledge); application (address problems to assist society and professional organizations); and teaching (implement curriculum, instruction, and assessment practices to maximize learning). Boyer recommends that the focus of scholarship within his model should be based upon the individual's interests, talents, and desire and that all types of scholarship should be valued and rewarded as a flexible model for administrators in setting policy and gaining tenure and promotion.

Boyer's model can serve as a basis for ongoing collaborative efforts between university math, science, and education faculty members and the K-12 system. This flexible model can allow faculty members to focus on the element through which their greatest contribution might be made. A supportive environment for all types of scholarship encourages and validates faculty involvement in the schools through professional development and collaboration. In this system, everyone contributes toward the rigor and vitality of K-12 science and mathematics programs and both the K-12 and the university systems realize the benefits of such collaboration. Learning-teams that include university faculty encourages sustainability as well as the study and consideration of effective research-based curriculum, instruction, and assessment to elevate American science and mathematics students to the level of competency that is enjoyed by other

countries in the world. The application and teaching elements of Boyer's model provide excellent examples of the implementation of his expanded and flexible definition of 'scholarship'.

Application

In Boyer's model, the element of application is an excellent example of scholarship as addressing issues and problems in their professional organizations and society. A faculty member's research is viewed in the context of the broader knowledge base and across disciplines. The *National Science Education Standards* and the *National Council of Teachers of Mathematics* support this view as a means to integrate content areas and integrate knowledge within the disciplines to understand the "big ideas" of science and mathematics. As a valuable member of a leadership team, university faculty could help clarify the unifying concepts and processes of their discipline to help K-12 educators and administrators strengthen their content knowledge and possibly offer the use of equipment to enhance instruction – especially in the rural, poor areas where schools typically lack materials and resources. Student teachers in science and mathematics are required to use the community and universities as valuable resources to bridge classroom learning with real life application and foster appreciation for possible careers in science and math.

Teaching

According to Borra (2001), many university professors feel that teaching is not valued as highly as research and publication in peer-reviewed journals and that there is little reward for excellence in teaching. Boyer views teaching as a vital aspect of scholarship and, as such, should be recognized and rewarded with greater weight and consideration for tenure. As part of excellence in teaching, university faculty members can play important roles in K-12 leadership teams by interpreting current research in effective teaching models, providing professional development for school districts, and serving as a partner in developing and testing instructional materials. University education faculty members should spend time in K-12 classrooms and interact with teachers and students to maintain a realistic understanding of the current problems and issues teachers face daily – this "reality check" is vital to productive and progressive partnerships. Faculty may partner with K-12 educators in designing and conducting meaningful action research projects to inform teaching and curriculum planning with a focus on problem-solving and critical thinking applications that connect classroom learning with real-life skills. University faculty, as positive role models, may influence students' career decisions in science and mathematics disciplines and motivate young students to become life-long learners and scientifically literate citizens as adults.

The National Science Foundation program, GK-12, serves as an excellent example for collaboration between university faculty and K-8 science and math classrooms. This program provides funding for graduate students in science, technology, engineering, and mathematics (STEM) disciplines to interact and partner with teachers and students in K-8 schools, other graduate fellows, and faculty from STEM disciplines. GK-12 fellows prepare units of study, offer teaching assistance in their field, and provide science and math materials to enhance learning. While graduate students and university faculty positively impact STEM learning and instruction in K-8 classrooms, they also develop greater depth of understanding in their field. In local schools, K-8 teachers have been very enthusiastic and receptive to the many excellent professional development opportunities; opportunities for enriched learning for K-12 students; and strengthened and sustained partnerships in STEM between institutions of higher education and their school district.

Sustainable, systemic reform in science and mathematics means focused involvement of all stakeholders in education.

Tomanek (2005) states that, "successful partnerships involve university faculty members asking how involvement with K-12 schools and teachers can enhance the education of their own students". Dynamic partnerships between university faculty and K-12 educators can provide meaningful rewards for everyone involved – young students benefit from high-quality standards-based instruction in science and math; teachers and administrators can update their content knowledge, keep current with research and issues that impact science and mathematics education; and university faculty may enjoy the rewards of collegiality and contact with teachers and their students to gain greater insights into workings of the system that will produce their future students and colleagues.

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Geographic Distribution of *Hemidactylus turcicus* (Reptilia: Squamata: Gekkonidae) in Mississippi

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ABSTRACT

Recently collected specimens, literature records, and unpublished museum records were used to evaluate the current distribution of the exotic Mediterranean Gecko (*Hemidactylus turcicus*) in Mississippi. Geckos were often found in association with 24-h facilities (e.g., casino, gas stations, hotels, welcome center), or large retail stores that had an adjoining exterior lawn and garden center. Over the past 31 years, the known geographic range of this species has expanded from 1 to 16 counties and new colonies will probably be discovered throughout the state in the future. Individuals who find geckos in counties other than those reported herein are encouraged to publish their findings or submit a voucher specimen to an appropriate institution

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Introduction

The Mediterranean Gecko (*Hemidactylus turcicus*), a small lizard native to southwestern Eurasia, north and east Africa, was first reported in the United States in 1910 from Key West, Florida (Fowler 1915, as *H. mabouia*; McCoy 1970) (Figure 1). Since that time, the species' range has expanded to include most of the southeastern United States (Conant and Collins 1998; Meshaka et al. 2006). The rapid increase in the geographic range of the species over such a short time period appears to be a result of repeated jump dispersal events which are often facilitated by humans (Rose and Barbour 1968; Davis 1974; Selcer 1986). The rate at which diffusion dispersal takes place is slow, and likely contributes little in the expansion of the species' range (Locey and Stone 2006). The geckos small body size, calcareous eggs, nocturnal lifestyle, high population densities, limited number of predators and a predilection for human habitats make the species well suited for jump dispersal in cargo transported by humans (Barbour 1968; Davis 1974; Rose and Selcer 1986). While some non-native (exotic invasive) species can cause tremendous damage to ecological systems, economic well-being, and human health (e.g., Vitousek et al. 1997; Rodda et al. 1999; Pimentel et al. 2000), the threats *H. turcicus* pose (if any) are unknown. However, speculations have been made that the species may compete with native Hylid treefrogs where syntopic (Meshaka et al. 2006; Tom Mann, Mississippi Natural Heritage Program, personal communication). The species appears to be declining in Florida and Texas, possibly as a result of recently introduced and competitively superior geckos (i.e., *H. garnotii*, *H. frenatus*, and *H. mabouia*) (Meshaka et al. 2004; Meshaka et al. 2006). Conversely, the known geographic range of *H. turcicus* in Louisiana has expanded by nearly 8 fold since 1989 (Meshaka et al. 2006).

The first report of *H. turcicus* in Mississippi was from Oxford (Lafayette Co.) in 1976 (Keiser 1984). These individuals (n = 6) were originally captured in Lafayette, Lafayette Parish, Louisiana, transported to Oxford, and accidently released that same year (Keiser 1984). A small breeding colony developed and hatchlings, subadults and adults were observed each year until the colony apparently died out following an unseasonably warm winter in 1986-87 (Keiser 1984; E. Keiser, Ecological Consulting, personal communication). The geographic range map presented by Conant and Collins (1998; p. 203) includes five counties in Mississippi; three coastal (Hancock, Harrison, and Jackson) and two interior (Lafayette and Montgomery). It should be noted that this "general range" (see Conant and Collins 1998; p. 4) for *H. turcicus* in Mississippi was based upon voucher specimens or reports from four counties (Harrison, Jackson, Lafayette and Montgomery) (J. Collins, Kansas Biological Survey, personal communication); no Hancock county record was available to the authors. Nonetheless, their range map represents the most recent summary of the species geographic distribution for the state.

While conducting surveys (primarily south of interstate highway 20) it became apparent that *H. turcicus* is more widespread throughout the state than the current literature suggests. Herein, I document an updated geographic distribution of this exotic species in Mississippi.

Figure 1. Adult Mediterranean Gecko (*Hemidactylus turcicus*) Captured in Forrest County Mississippi; 31 October 2006.

MATERIALS AND METHODS

Specimens were collected arbitrarily from 18 May 2005 to 14 October 2007 while conducting various activities throughout the state. Voucher specimens were deposited into the Mississippi Museum of Natural Sciences (MMNS) collection. Additionally, I obtained records from the literature and systematic collections throughout the United States. Systematic collections were searched using an online database (i.e. HerpNET; http://www.herpnet.org/) on 7 November 2007; I also requested *H. turcicus* records for the state of Mississippi from10 institutions (museums, universities, and other appropriate organizations) which were not associated with the online database

RESULTS AND DISCUSSION

In total, twelve new county records were identified (Figure 2). Seven records were collected during my surveys: Adams (MMNS 15991), Hancock (MMNS 15995), Lamar (MMNS 15992-93), Lauderdale (MMNS 15998), Pearl River (MMNS 15994), Perry (MMNS 15997), and Stone (MMNS 15996) counties. A search of the systematic collections revealed an additional five previously unreported county records, including, Forrest (MMNS 14084-86), Hinds (MMNS 5412, 5514-18, 13023, 13468, 14034), Madison (MMNS 13476), Warren (MMNS 2585-89), and Wayne (MMNS 13582) counties. No new county records for Mississippi were found in the literature.

While the first *H. turcicus* colony in Mississippi has apparently gone extinct (See Introduction above), a single specimen was observed on the University of Mississippi Oxford Campus in Lafayette County in 2007, (E. Keiser, Ecological Consulting, personal communication). If this individual represents a member of an established colony or a recent introduction is unknown. Nevertheless, *H. turcicus* is frequently associated with cities and universities throughout the southeastern United States (Meshaka et al 2006; and references therein), and Mississippi is no exception.

The distribution of *H. turcicus* in Mississippi appears to follow major highways (Fig. 1), a trend also noted in Florida (Meshaka 1995), Louisiana (Meshaka et al. 2006) and Texas (Davis 1974), and is reflective of a human-mediated dispersal pattern. Most of the individuals that I found were associated with 24-hour facilities (e.g., casino, gas stations, hotels, welcome center), or large retail stores that had an adjoining exterior lawn and garden center. In fact, on 1 August 2007, a communal nest of six unhatched *H. turcicus* eggs were found in the soil of a potted Yellow Allamanda (*Allamanda cathartica*) which was purchased from one such large retail store in Lamar County; an adult female (MMNS 15992) and a juvenile (MNNS 15993) were subsequently captured at this location. It is unknown whether this observation constitutes an isolated incident, or if large retail stores with exterior lawn and garden centers in Mississippi serve as egg distribution centers through the sale of potted plants. Selcer (1986) stated that communal *H. turcicus* nests are often found in boxes of old paper, drawers of cabinets, and piles of old clothing; he postulated that because of low individual vagility, eggs may be the species primary form of dispersal. In Gainesville, Florida, eggs are usually laid from April to August (King 1958), and the incubation period is known to last from 37 to 45 days (Rose and Barbour 1968). It therefore seems quite probable that a number of communal nests (mini colonies) could have been distributed throughout the state (and possibly the country) when thousands of people in southern Mississippi packed up their belongings and

evacuated prior to Hurricane Katrina (August 29 2005).

Over the past 31 years, the range of *H. turcicus* in Mississippi has expanded from 1 to 16 counties and new colonies will probably be found throughout the state in the future. Individuals who find geckos in counties other than those reported herein are encouraged to publish their findings or submit a voucher specimen to an appropriate institution.

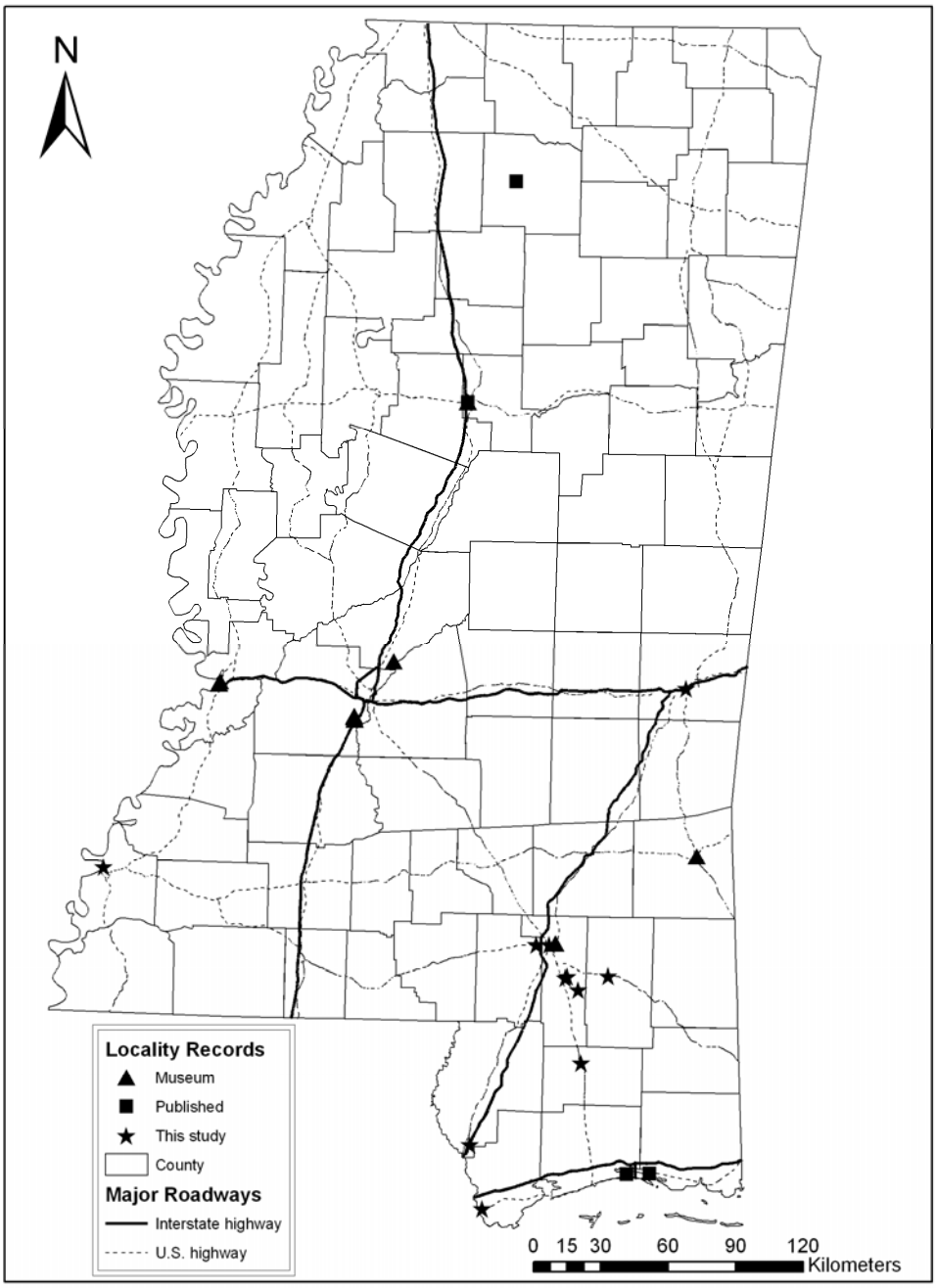

Figure 2. Geographic distribution of the Mediterranean gecko (*Hemidactylus turcicus*) in Mississippi.

ACKNOWLEDGEMENTS

I would like to thank the staff of the Nature Conservancy's Camp Shelby Field Office, Tom Mann and Tom Radizo for their constructive comments on this manuscript.

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MISSISSIPPI ACADEMY OF SCIENCES
Seventy-Second Annual Meeting – Program Corrections

HEALTH SCIENCES

FRIDAY AFTERNOON, FEBRUARY 23
New Posters, Friday, 3:00p.

CHARACTERIZATION OF OXIDATION PRODUCTS FROM CATFISH OIL AND BIODIESEL

Supanee Danviriyakul[1], Ashli E. Brown[2]*, William E. Holmes[3], Elizabeth C. Rogers[3], and Juan L. Silva[2], [1]Chandrakasem Rajabhat University. Bangkok, Thailand; [2]Mississippi State University, and [3]Mississippi State Chemical Laboratory, Mississippi State, MS 39762.

The stability of biodiesel depends on the quality of the feedstock, transesterification process, environmental conditions, and other factors. Oxidation of biodiesel can lead to lower engine performance and shorter life. Oil breakdown can occur through hydrolysis of triglycerides and through oxidation of fatty acid methyl esters (FAMEs), resulting in low molecular weight FAs and/or polymerized molecules of very high MW. Polymerization can result in increased viscosity of the biodiesel and failure to meet ASTM standards. Catfish oil was trasesterified with excess methanol and sodium hydroxide and refined. The resulting product was heated to 80 and 110°C, with and without air. The oxidation products were analyzed using GC/MS and LC/MS. These highly selective analytical techniques allow identification and monitoring of these products. Samples stored without available oxygen did not produce significant ROOH or conjugated dienes, and the acid number remained low. When the samples were stored open to air, ROOH and conjugated dienes both increased. The acid number and viscosity increased more in samples exposed to air than for samples not exposed to air

UTILIZING ZEBRAFISH AS A MODEL FOR FISH DISEASES.

L. Petrie-Hanson, P. Khosravi, C.M. Hohn and L. Hanson. Mississippi State University, Mississippi State, MS 39762.

Aquaculture, or the production and rearing of aquatic animal species, is rapidly growing throughout the world to replace dwindling natural resources. Channel catfish production is the largest aquaculture enterprise in the United States. The leading cause of loss in channel catfish (*Ictalurus punctatus*) production is disease, with very high losses occurring at the fry stocking to fingerling stage. The leading cause of fry/fingerling loss is Enteric Septicemia of Catfish (ESC), with 57.8% of fry/fingerling producers reporting losses. Providing broad protection against multiple pathogens at an early developmental stage is especially critical in extensive aquaculture because very young fish are placed in extremely vulnerable situations. Research investigating disease progression in channel catfish fry is difficult because channel catfish take 3 years to mature, and spawn once a year, so the availability of fry for developmental immunology studies is limited. Additionally, the genome of this species has not been sequenced, and micro array reagents are limited. These factors negatively impact developmental immunology and infectious disease research of this commercially important fish. Alternatively, zebrafish reproduce by three months of age, spawn weekly, are hardy and easy to maintain. The zebrafish genome has recently been sequenced; so characterizing the interaction of zebrafish and pathogens can be more readily investigated at the molecular level. We are investigating disease progression of several fish pathogens utilizing the zebrafish model.

CELLULAR, MOLECULAR AND DEVELOPMENTAL BIOLOGY

THURSDAY AFTERNOON, FEBRUARY 22
Moved Lecture, 2:00p. Moved to Health Sciences, Poster, Friday, 9:30a.
DELETION AND EPITOPE-TAGGING OF CELL CYCLE GENES USING UNCLONED PCR FUSION PRODUCTS AND HOMOLOGOUS RECOMBINATION IN *ASPERGILLUS NIDULANS*
Moved Lecture, 3:30p. Moved to Lecture, Friday, 10:15a.
EXPRESSION ANALYSIS OF THE MOLD-SPECIFIC M46 GENE IN FIVE STRAINS OF THE PATHOGENIC FUNGUS *HISTOPLASMA CAPSULATUM*
Moved Lecture, 3:45p. Moved to Lecture, Friday, 10:30a.

THE CO-EXPRESSION OF AMPKA, AMPKB, AND AMPK" FROM *TRYPANOSOMA BRUCEI*

FRIDAY MORNING, FEBRUARY 23
New Lecture, 10:45a.
A NOVEL APPROACH FOR IDENTIFYING POLYMORPHIC SIMPLE SEQUENCE REPEAT MARKERS IN GOSSYPIUM USING GENE-ENRICHED DNA SEQUENCES
Linda Ballard[1]*, Abigail Newsome[2], and Brian E. Scheffler[1], [1]USDA-ARS-MSA Genomics Laboratory, Stoneville, MS 38776, [2]Mississippi Valley State University, Itta Bena, MS 38941

Over the last decade, the use of simple sequence repeats (SSRs) has greatly advanced the development of molecular markers. However, many of these SSRs are not proximal to genes even though many are derived from genomic DNA and can be linked to genes of interest. In addition, they can be related to potentially less desirable repetitive DNA regions from which to develop markers. Efforts to use expressed sequence tag sequences (ESTs) derived from coding DNA have provided a number of SSRs, but they are typically not polymorphic due to strong selection pressure to preserve the coding region. Polymorphism between parental lines or within a population are desirable characteristics of SSRs. The USDA MSA Genomics Laboratory generated 27,186 sequences from a pilot methylation filtration project involving four species of *Gossypium*. A novel technique was developed to screen this data for non-coding regions which contain SSRs associated with genes. Primers were designed for the selected SSRs. A *Gossypium* panel was genotyped using these primers and polymorphic SSRs were determined and categorized. within *G. hirsutum* and between five other *Gossypium* species of the Cotton Microsatellite Database panel.

New Lecture, 11:00a.
ROS INDUCED GERM LINE GENOMIC INSTABILITY (GI) IN THE HUMAN TESTIS
Megid, W[2,3], Bacher, J[3] ,Bedran, W[1]., Prolla, T.[4], Menendez, C.[1] Lucena, E[5]. and Kent-First, M.G[1,2] [1]Mississippi State University, [2]University of Wisconsin, Madison, WI; [3]Promega Madison, WI; [4]University of Wisconsin, Madison, WI, [5]CECOLFES, Bogota, Columbia.

The male germline is susceptible to damage that result from pro-mutagenic changes having the potential to generate mutations, including defects in mismatch repair (MMR), recombination errors, and DNA or chromatin fragmentation, specifically DNA strand breaks. Pro-mutagenic changes may be induced, for example, in the abortive apoptosis pathway, by deficiencies in natural processes such as recombination and chromatin packaging that involve the induction of DNA strand breaks, and by oxidative stress. Single and double DNA strand breaks are particularly frequent in DNA isolated from the ejaculates of sub-fertile men, as is aneuploidy and other indicators of genomic instability (GI). Men with this type of testis profile are at risk of developing testicular tumors.

There exists a need in the art for improved methods of evaluating germline specific genomic instability and to define the mechanism that leads to DNA strand breaks and/or chromosome instability. Detection of microsatellite and chromosomal instability will allow assessment of risk for testicular cancer, detection of acute exposure to ROS or mutagens, and monitoring of exposure over time. In our studies we have identified specific microsatellite repeats that are sensitive to ROS exposure in human and mouse cells. We have determined that these microsatellites are highly unstable in the germ line (sperm) of infertile men. We have shown that a significant subset of these infertile men followed over time develop germ cell tumors (testicular cancer). Results demonstrate that this genomic instability is a part of a ROS induced mutator phenotype in the testis that leads to tumorogenesis. ROS induced DNA strand breaks lead to progressive alterations in the testis including MSI and CIS. Though the normal DNA repair mechanisms are unaffected, ROS induced damage overrides the cells ability to repair DNA strand breaks leading to progressive alterations in the testis including MSI and CIS and tumor formation. The completion of this project provides a valuable clinical research tool to identify men at risk of testicular cancer and to track tumor progression.

FRIDAY AFTERNOON, FEBRUARY 23
Canceled Poster, 3:00p
EFFECT OF HETEROTROPHY ON OXIDATIVE STRESS IN THE HERMATYPIC CORAL *CAULASTREA ECHINULATA*
Canceled Poster, 3:00p
CULTURE MAKES A DIFFERENCE IN DEVELOPMENT AND MOLECULAR BIOLOGY OF PORCINE PREIMPLANTATION EMBRYOS

IN VITRO
Moved Poster, 3:00p. Moved to Health Sciences, Poster, Friday, 10:30a.
EFFECTS OF VALPROATE AND ALCOHOL ON CADHERIN EXPRESSION

HEALTH SCIENCES

THURSDAY MORNING, FEBRUARY 22
Moved Lecture, 9:00a. Moved to Poster, Friday, 10:30a
COMPARISON OF GENE EXPRESSION IN MALIGNANT GASTRIC AND ENDOMETRIAL TUMORS
Moved Poster, 9:30a. Moved to Lecture, Thursday, 11:00a
CHARACTERIZATION OF PEDIATRIC PNEUMOCOCCAL OTITIS MEDIA ISOLATES
New Poster, 9:30a. Moved from Cellular, Molecular and Developmental Biology Lecture, Thursday, 2:00p.
DELETION AND EPITOPE-TAGGING OF CELL CYCLE GENES USING UNCLONED PCR FUSION PRODUCTS AND HOMOLOGOUS RECOMBINATION IN *ASPERGILLUS NIDULANS*
Canceled Lecture, 11:00a
GENERATIONAL AGE DIFFERENCES IMPACT THE COLLEGE CLASSROOM

THURSDAY AFTERNOON, FEBRUARY 22
Moved Lecture, 3:00p. Moved to Friday, 10:30a poster session
BLOOD PRESSURE IS NOT SALT SENSITIVE IN OBESE DOGS
Canceled Lecture, 3:30p
THE EFFECT OF ELLAGIC ACID ADMINISTERED INTRAPERITONEALLY AND ORALLY IN *TRYPANOSOMA LEWISI* INFECTED RATS
FRIDAY MORNING, FEBRUARY 23
New Poster, 10:30a. Moved from Cellular, Molecular, and Developmental Biology, Poster, Friday, 3:00p.
EFFECTS OF VALPROATE AND ALCOHOL ON CADHERIN EXPRESSION

New Posters, 10:30a

CHOLESTEROL PRODUCTION INHIBITOR (STATIN) INCREASED BONE HEALING IN SURGICALLY CREATED FEMORAL DEFECT IN AN ANIMAL MODEL

Felix Adah[1], Hamed Benghuzzi[1], Michelle Tucci[1], George Russell[1], and Barry England[2]. [1]University of Mississippi Medical Center, Jackson, MS and [2]University of Michigan Medical School, Ann Arbor, MI

This study investigated the effects of dual delivery of statin and vancomycin on the healing process of a femoral defect injury using tricalcium phosphate lysine (TCPL) delivery system in an animal model. The experimental design consisted of 14 rats divided into the following three groups: Group I animals (n=5) served as the intact control without treatment. Group II animals (n=5) were subjected to a surgically induced defect (2 mm, midshaft of the right femur) and implanted (IM) with TCPL capsules loaded with vancomycin (20mg) (TCPL-AB). Group III animals (n=4) were operated on in a similar fashion as Group II, and subsequently implanted with TCPL capsules loaded vancomycin (20 mg) plus statin (5 mg). The animals were euthanized at 30 days post-implantation using overdose of isoflourane. The right femurs were then harvested in addition to the vital organs, the reproductive organs, and sample of the adjacent skeletal muscles. The hard and soft tissues were evaluated histopathologically by following laboratory standard techniques. The results of this study indicated that statin plus vancomycin treated animals healed in a greater magnitude than the sham group (independent evaluators ($p<0.001$)). Histomorphometric analysis demonstrated that exposure to sustained delivery of statin resulted in increased in cortical width and periosteal area compared to the sham group ($p<0.05$). In conclusion, data obtained from this study demonstrated that sustained delivery of statin resulted in a remarkable increase in osteogenic activity.

BETA-2-MICROGLOBULIN COMPARED WITH SIX OTHER ANTIGENS FOR THE DETECTION OF HUMAN REPRODUCTIVE CANCERS

Mary J. Guo*, Michelle Branson, Sabrina Bryant, Margaret Jackson, James T. Johnson, and Margot Hall, University of Southern Mississippi, Hattiesburg, MS 39406

Human reproductive cancers are a major problem in the United States. In 2006, there were ~475,810 new cases (breast 212,920, ovarian

20,180, testicular 8, 250, prostate 234,460) and ~84,000 deaths (breast 40,970, ovarian 15,310, testicular 370, prostate 27,350) from reproductive cancers in the US. Tumor antigens are used for therapeutic monitoring and have been used in combination with other methods for the diagnosis of cancer. In this continuing study, our new goal was to compare the diagnostic potential of beta-2-microglobulin ($2M) with that of six other tumor antigens for breast, ovarian, testicular and prostate cancers. Sera from 554 patients (87 breast cancer, 6 ovarian cancer, 20 testicular cancer, 17 prostate cancer, 229 other cancers, and 195 non-cancer) were assayed for the presence of tumor antigens and the results correlated with diagnoses established pathologically. Immunoassay test kits from Diagnostic Automation ($2M, Ferritin), Hybritech (CEA), Centocor/Fugirebio Diagnostics (CA125, CA15-3, CA27.29), and Abbott (AFP) were used to test for the concentration of these antigens. Using the manufacturers= decision values the following diagnostic sensitivities were obtained: (Breast CA) $2M 77.3%, Ferritin 40.0%, CA 15-3 63.4%, CA27.29 39.3%, CEA 22.4%, CA125 12.1%, AFP 21.8%, (Ovarian CA) $2M: 50.0%, Ferritin 25.0%, CA 15-3 0.0%, CA27.29 0.0%, CEA 0.0%, CA125 16.7%, AFP 0.0%, (Testicular CA) $2M: 50.0%, Ferritin 31.3%, CA 15-3 30.0%, CA27.29 15.8%, CEA 20.0%, CA125 0.0%, AFP 23.5%. (Prostate CA) $2M: 57.1%, Ferritin 17.7%, CA 15-3 11.8%, CA27.29 17.7%, CEA 11.8%, CA125 5.9%, AFP 20.0%. We hypothesized that $2M would prove superior to the other markers and this hypothesis was accepted for all of the cancers.

BETA-2-MICROGLOBULIN COMPARED WITH SIX OTHER TUMOR ANTIGENS FOR THE SERODIAGNOSIS OF PANCREATIC, GASTRIC, AND COLORECTAL CANCER

Michelle Branson*, Mary Guo, Sabrina Bryant, Margaret Jackson, James T. Johnson, and Margot Hall, University of Southern Mississippi, Hattiesburg, MS 39406.

With 33,730 (pancreatic), 22,280 (gastric), and 106,680 (colorectal) new cases and 32,300 (pancreatic), 11,430 (gastric), and 55,170 (colorectal) deaths estimated during 2006, pancreatic, gastric, and colorectal cancers are important pathologies in the USA. Tumor antigens have been used in combination with other methods for diagnosis. The objective of this study was the comparison of beta-2-microglobulin ($2M) with six other tumor antigens for diagnostic efficacy in pancreatic, gastric, and colorectal cancer. We hypothesized that $2M would be the best tumor marker for these cancers. Sera from 554 patients (16 pancreatic cancer, 12 gastric cancer, 101 colorectal cancer, 230 other cancers, and 195 non-cancer) were assayed for the presence of tumor antigens and the results correlated with diagnoses established pathologically. Immunoassay test kits from Diagnostic Automation ($2M, CA242), Hybritech (CEA, CA195), Centocor/Fugirebio Diagnostics (CA19-9, CA72-4), and CIS Biointernational (CA50) were used to test for the concentration of these antigens. Using the manufacturers' decision values the following diagnostic sensitivities were obtained: Pancreatic CA: $2M 58.3%, CEA 37.5%, CA19-9 66.7%, CA195 100.0%, CA50 66.7%, CA242 66.7% ,CA72-4 31.3% ; Gastric CA: $2M 80.0%, CEA 50.0% , CA19-9 63.6%, CA195 58.3%, CA50 70.0%, CA242 70.0% , CA72-4 27.3%; Colorectal CA: $2M 28.4%, CEA 26.7% , CA19-9 18.8%, CA195 36.6%, CA50 18.2%, CA242 16.7%, CA72-4 17.0%. Diagnostic specificities were >75%. From these data we conclude that $2M was the best marker for gastric cancer supporting our hypothesis but that CA195 was superior for pancreatic cancer and colorectal cancer rejecting our hypothesis.

FRIDAY AFTERNOON, FEBRUARY 23

Moved Poster, 1:15p. Moved to Lecture, Thursday, 9:15a

SEASONAL VARIATION IN ANTI-CCV SERUM ACTIVITY IN CHANNEL CATFISH: IMPLICATION FOR BROODSTOCK SCREENING

Moved Poster, 1:15p. Moved to Lecture, Thursday, 11:00a

SELECTIVE HUMAN MELANIN-CONCENTRATING HORMONE RECEPTOR 1 AND MELANIN-CONCENTRATING HORMONE RECEPTOR 2 ANTAGONISTS FOR THE TREATMENT OF METABOLIC DISEASES

Moved Poster, 1:15p. Moved to Lecture,

IMMUNIZATION WITH PSPA INCORPORATED INTO A POLY(ETHYLENE OXIDE) MATRIX ELICITS PROTECTIVE IMMUNITY AGAINST *STREPTOCOCCUS PNEUMONIAE*

Moved Poster, 1:15. Moved to Lecture,

Thursday 2:30p
DOES YOUR IMMUNE SYSTEM HAVE STRIPES? INVESTIGATING THE SIMILARITIES AND DIFFERENCES BETWEEN THE IMMUNE SYSTEM OF MAN AND ZEBRAFISH
Moved Poster, 1:15. Moved to Lecture, Thursday 3:00p
BUTORPHANOL-INDUCED NEURONAL ACTIVATION WITHIN THE PARAVENTRICULAR NUCLEUS (PVN) OF THE HYPOTHALAMUS AND RESULTING ACTIVATION OF THE HYPOTHALAMIC-PITUITARYADRENAL (HPA) AXIS

MATHEMATICS, COMPUTER SCIENCE AND STATISTICS

THURSDAY AFTERNOON, FEBRUARY 22
New Poster, 6:00p

A COMPARATIVE STUDY OF NORMALIZATION METHODS USED IN STATISTICAL ANALYSIS OF CDNA MICROARRAY DATA

Dharmendra K. Singh, Deborah L. Boykin, Abigail S. Newsom, Mississippi Valley State University, Itta Bena, MS 38941

Normalization methods used in the statistical analysis of cDNA microarray data are evaluated. The cDNA microarray is considered an efficient analytical tool for analyzing thousands of genes simultaneously in a single experiment. However, systematic variation in microarray, originating from various sources, affects the measurement of gene expression levels. The purpose of normalization methods is to identify and eliminate any systematic variance in the measurements. Several normalization methods, such as total intensity normalization, intensity-dependent normalization, and global normalization are studied. Our choice for the normalization method would depend on the nature of experiments, and the type of data set being used. Different normalization methods are compared to determine the most suitable method for achieving greatest precision and eliminate spatially dependent variability. Precision will be evaluated using analysis of variance procedure and measuring the rate of erroneous decisions. A Type I error occurs when significance is falsely declared and a Type II error occurs when important differences are not detected. Decreasing variability using these normalization and statistical analysis methods will decrease Type I and Type II error rates. Minimization in Type II error signifies grater precision or higher power of study. A lower Type I error, in the microarray case, results in a lower false discovery rate of responsible genes. Spatial patterns in variability will be detected by plotting residuals from analysis of variance using the x,y coordinates from the microarray slide. Our method will be focused on a maize research project to look at gene expression related to disease resistance.

PSYCHOLOGY AND SOCIAL SCIENCES

THURSDAY MORNING, FEBRUARY 22
New Presenter
Dr. Shaila Kahn's lectures will be given by Dr. Abu Khan.

THURSDAY AFTERNOON, FEBRUARY 22
Division Business Meeting, New Time, 3:15p
Division Poster Session, moved from Thursday, 3:20p to Thursday 6:00p in Bost Auditorium
New Posters, 6:00p.

ELMO EATS BROCCOLI: A COMPARISON OF ACTUAL VERSUS REPORTED FOOD CHOICES

Christy Jayne* & Karen Christoff*, University of Mississippi, University, MS 38677

The prevalence of childhood obesity has continued to grow over past decades and is reaching epidemic proportions. While decreasing the prevalence of overweight children is important, prevention is essential. Understanding ways that children develop eating habits is crucial to prevention efforts. Children can be picky eaters and reluctant to try new foods. However, there are ways to impact on food choices. Birch and Fisher (1997) found that children base their food decisions on someone that is in a similar or more powerful position to them. Others have found that exposing children to food advertisements can impact later food choices (e.g., Halford et al., 2004; Borzekowski & Robinson, 2001). The present study examined children's beliefs about healthy eating as well as factors that impact children's food choices. We looked at the impact of pairing foods with familiar images on children's reported and actual food choices. Food choices were recorded over three sessions. In the first session, food choices were not

paired with images. In the second two sessions the food choices were paired with either a Muppet character or a shape. Examining frequencies of food choices showed that for children that picked the Muppet character as their favorite, pairing a food with a Muppet character increased the likelihood that those children would report that food as the favorite of a pair in a forced-choice protocol. However, the relationship was less strong when children actually got to eat the food they picked. Additional results and implications of the findings will be discussed. With special thanks to David Cohen and Jennifer Kotler of the Sesame Street Workshop

AN EXAMINATION OF THE RELATIONSHIPS AMONG GREEK STATUS, SOCIAL BEHAVIOR, ALCOHOL/SUBSTANCE USE, AND ASSOCIATED RISK BEHAVIOR

Kristen Sellers*, Carly Green*, and Karen Christoff, University of Mississippi, University, MS 38677

The current study examined the relationship between social Greek organization membership, risk behavior, and a variety of social variables known to be associated with substance use. Approximately 300 undergraduate students at the University of Mississippi were administered the Texas Social Behavior Inventory, the UCLA Loneliness Scale, CDC's Youth's Risk Behavioral Surveillance Survey, a risk behavior checklist, and a demographic questionnaire. Our sample consisted of 161 Greek students and 139 non-Greeks. A series of ANOVA's were computed to assess between group differences. Data indicate that non-Greek students report having significantly fewer friends than Greeks ($F=11.7987$, $p=.001$) and experiencing significantly greater loneliness than Greek students ($F=4.972$, $p=.027$). However, there were no differences in their self-perceived social competence. Therefore, their perceived ability to establish social relationships may not account for the differences in their actual social involvement. In addition, Greek students reported significantly more overall substance use ($F=5.373$, $p=.021$), in particular, alcohol ($F=25.33$, $p=.000$) and amphetamine ($F=9.16$, $p=.003$) use. Greeks also reported having engaged in risk behaviors associated with alcohol and substance use significantly more often than non-Greeks ($F=30.191$, $p=.000$). The data are consistent with the literature suggesting that students who are members of social Greek organizations engage in alcohol/substance use, as well as their associated risk behaviors, more often than non-Greeks. Risk behaviors may be seen as social in nature and depicting more social students as more likely to engage in more frequent risk behavior.

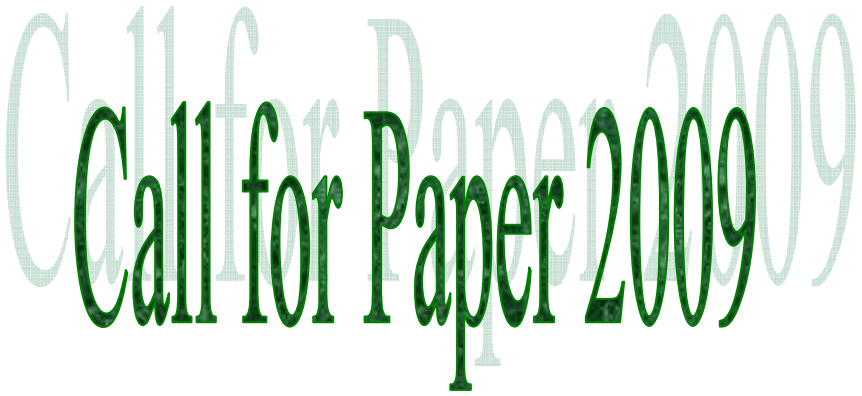
INTEGRATED FRUIT PRODUCTION IN BRAZIL

Paulo R. C. Lopes* and Juan L. Silva, Embrapa Semi-Arido, Petrolina, PE 56300-000, Brazil and Mississippi State University, Mississippi State, MS 39762

Integrated (fruit) production, IFP is defined by the International Organization for Biological Control as a "farming system that produces high quality food and other products by using natural resources and regulating mechanisms to replace polluting inputs and to secure sustainable farming." Emphasis is placed on a holistic systems approach involving the entire farm as the basic unit, on the central role of agro-ecosystems, on balanced nutrient cycles, on the welfare of all species in animal husbandry, on the safety of the product, and the economic feasibility. Brazil optimized this system and has been able to apply it to more than 20 fruit crops and other agricultural commodities. The system is implemented by developing and adapting technologies needed, selecting production/packing facilities, changing the conventional practices into this system's approach, training of technicians and growers/packers. IFP includes the adaptation of Integrated Pest Management practices, use of GPS technology, monitoring and records, and continuous evaluation to improve and insure that the system is working. This system has resulted in over 80% reduction in chemical usage and a significant decrease in costs of production, development of guides specific to each fruit (product), and a stamp to identify the product satisfies IFP guidelines. This system also satisfies the new traceability requirements placed by buyers and regulators around the world. Today there are over 13,000 ha of mangoes and 6,000 ha of grapes under IFP.

DIVISIONAL REPORTS

The divisional reports will be featured in the October issue of the journal. If you are divisional chair, and have not sent in your conference report you have until the August 23, 2007 to e-mail mtucci@orthopedics.umsmed.edu to be included.



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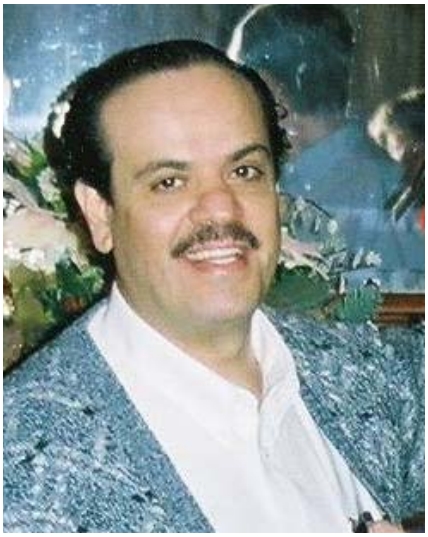
Hilda Wells, Co-coordinator
Hinds Community College Jackson, MS — **(601) 987-8174**

Jackson State University recruits, admits and provide services, financial aid and instructions to all students without regard to race, religion, sex, age, color or national origin.



Executive Director Column

by

Dr. Ham Benghuzzi

Our Academy of Science is making tremendous progress in terms of participation and interest as we head into 2009. Over the past year Dr. Joseph A. Cameron has provided us with excellent leadership and we were encouraged by the number of attendees and presenters at the annual meeting. We saw many new faces along with our strong steadfast members. It was also encouraging to see so many people attending and participating in the plenary and keynote lectures. This suggests a desire to learn and our underlying need to build on what is known and set the next hypothesis for testing.

During the upcoming year, there is a lot of work to be done. **It is important that our members become more active in the Academy to increase our strength and voice. We want to hear from you!!!!** To be a successful organization we need your help and input. There are so many ways to become involved. It can be something as simple as convincing a colleague to attend the annual meeting and submit an abstract, or it can be more substantial by agreeing to serve as a chair of a committee or volunteering to review manuscripts in your area of expertise. We need to show the next generation of students the experiment doesn't end with data collection. **That is the point where it begins**. We need to encourage our students to share their work and open the doors for additional ideas.

We need to work together to change the stigmatism associated with our state. We are known to lead the nation in terms of poverty, poor education, obesity, and access to care, but what about our efforts over the years in science? We are not recognized by the efforts of so many distinguished scientists and medical personnel like Arthur C. Guyton or James D. Hardy. I now challenge you, my friends and colleagues, to put forth the efforts to become involved and increase awareness in the positive aspects of our state. Each of us has much to offer, and it should be our duty and responsibility to serve as leaders in the Academy. I leave you with a quote from -- **Edward Teller**. The science of today is the technology of tomorrow.

Mississippi Academy of Sciences 2009

Whispering Woods Hotel and Conference Center
February 26-27, 2009

11200 East Goodman Road
Olive Branch, MS 38654

Telephone: (662) 895-2941
Fax: (662) 895-1590

More Information will be available in the October issue

CALL FOR ABSTRACTS

MISSISSIPPI ACADEMY OF SCIENCES ABSTRACT FORM/MEMBERSHIP FORM

ABSTRACT INFORMATION

Abstract title:_____
Name of Presenting Author(s): _____
(Presenter must be current (i.e., 2007 membership dues must be paid), student member, regular member or life member of the MAS)

Telephone_____Email_____

Check the division in which you are presenting

__ Agriculture and Plant Science
__ Cellular, Molecular, and Dev. Biol
__ Chemistry and Chem. Engineering
__ Ecology and Evolutionary Biology
__ Geology and Geography
__ Health Sciences
__ History and Philosphy of Sciences
__ Math., Computer Sci and Statistics
__ Marine and Atmospheric Sciences
__ Physics and Engineering
__ Psychology and Social Sciences
__ Science Education
__ Zoology and Entomology

Type of presentation
__ Poster presentation __ Workshop __ Lecture presentation __ Invited Symposium
If the presenting author for this paper will also present in another division, please list the other division_____

Audiovisual Equipment needs:
__ 2" X 2" slide projector __ Powerpoint __ Overhead projector

MEMBERSHIP INFORMATION
New ___ Renewal___
Mr. Ms. Dr._____
Address _____
City, State, Zip _____
School or Firm _____
Telephone_____ Email_____

PLEASE INDICATE DIVISION YOU WISH TO BE AFFILIATED _____
Regular Member $25 **Student Member $5** **Life Member $250**
Educational Member $150 **Corporate Patron $1000** **Corporate Donor $500**

CHECKLIST
Please complete the following:
__ Enclose copy of abstract (even if abstract has been submitted electronically)
__ Complete and enclose abstract/membership form (this form)
__ Enclose the following payments (Make checks payable to Mississippi Academy of Sciences)
__ $25 per abstract
__ $25 regular membership fee OR $5 student membership fee (2007 membership must be paid for abstract to be accepted)
__ You must supply a check #_____ or P.O. #_____ (credit cards are not accepted)

In addition, you MAY preregister at this time to take advantage of the saving
__ Enclose the following payments:
__ $80 regular member (after 23 Jan)
__ $40 student member (after 23 Jan)
__ $105 nonmember (after 23 Jan)
__ $55 regular member (Preregistration before Jan 23)
__ $25 student member (Preregistration before Jan 23)
__ $85 nonmember (Preregistration before Jan 23)

Note: Abstracts that are resubmitted for changes will incur a $10 resubmission fee. Late abstracts will be accepted with a $10 late fee during November increased to $25 after that. Late abstracts will be accepted only if there is room in the appropriate division. They will be published in the April issue of the MAS JOURNAL.

MISSISSIPPI ACADEMY OF SCIENCES—ABSTRACT INSTRUCTIONS
PLEASE READ ALL INSTRUCTIONS BEFORE YOU SUBMIT YOUR ABSTRACT ON-LINE

- Your paper may be presented orally or as a poster. Oral presentations are generally 15 minutes. The speaker should limit the presentation to 10-12 minutes to allow time for discussion; longer presentations should be limited accordingly. Instructions for poster presentations are linked here.
- Enclose a personal check, money order, institutional check, or purchase order for $25 publication charge for each abstract to be published, payable to the Mississippi Academy of Sciences. The publication charge will be refunded if the abstract is not accepted.
- The presenting author must be a member of the Academy at the time the paper/poster is presented. Payment for membership of one author must be sent for the abstract to be accepted.
- Attendance and participation at all sessions requires payment of registration.
- Note that three separate fees are associated with submitting and presenting a paper at the annual meeting of the Mississippi Academy of Sciences.
    1. An abstract fee is assessed to defray the cost of publishing abstracts and
    2. a membership fee is assessed to defray the costs of running the Academy.
    3. Preregistration payment ($20 regular; $10 student) may accompany the abstract, or you may elect to pay this fee before February 1, or pay full registration fees at the meeting.
- Abstracts may **only** be submitted on line via a link through the MAS website. The URL is http://www.msacad.org/index.html (case sensitive). The appropriate abstract fees can be paid via Paypal or sent via mail to Cynthia Huff at the Academy address .
- **Abstracts that are resubmitted for changes will incur a $10 resubmission fee.**
- **Late abstracts will be accepted with a $10 late fee during November increased to $25 after that. Late abstracts will be accepted only if there is room in the appropriate division. They will be published in the April issue of the MAS JOURNAL.**
- Submit your appropriate fees t NO LATER THAN NOVEMBER 1, 2008.

Ms. Cynthia Huff
Mississippi Academy of Sciences
Post Office Box 55907
Jackson, MS 39296-5907

msacad@bellsouth.net

GUIDELINES FOR POSTER PRESENTATIONS

- The Academy provides poster backboards. Each backboard is 34" high by 5' wide. Mount the poster on the board assigned to you by your Division Chairperson. Please do not draw, write, or use adhesive material on the boards. You must provide your own thumb tacks.
- Lettering for your poster title should be at least 1" high and follow the format for your abstract. Lettering for your poster text should be at least 3/8" high.
- Posters should be on display during the entire day during which their divisional poster session is scheduled. They must be removed at the end of that day.
- Authors must be present with their poster to discuss their work at the time indicated in the program.