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REGIONAL CLIMATE VARIABILITY AND LONG-TERM TRENDS IN SOUTHERN CENTRAL STATES OF USA

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ABSTRACT

Recent climate model improvements have resulted in an enhanced ability to simulate many aspects of climate variability and extremes. However, they are still characterized by systematic errors and limitations in accurately simulating more precisely regional climate conditions. There is a need to develop a greater understanding of the synergistic impacts of environmental change, and improve development, testing and validation of integrated stress impacts through computer modeling as well as long term real time data. Earlier, we carried out study to understand the interplay of climate variability and air quality based on the data obtained from the NOAA Climate Diagnostic Center. As a part of the study, we investigated by statistical methods the temperature trends over Mississippi for the period 1871 to 2006. In this region, we noticed that the temperature variation during the period is split into three zones, a zone of negative trend with cooling in between two zones of positive trend with warming. The regional scale observations are in contrast to the monotonous global positive increasing trend. In the present study, we extend similar investigations in the neighboring southern central states such as Alabama, and Georgia to observe the regional climate variability long-term trends. The outcome of the study is discussed in lieu of the existing global warming changes as reported in IPCC, 2009.

INTRODUCTION

Climate variability and global warming have become of great concern because of their impacts directly or indirectly on the life of our planet and are presently the focus of major investigations on environmental issues. Global climate is sensitive to human activities, and the changes may lead to influencing the air quality among other effects.

A representative diagram summarizing the interplay among solar radiation, air quality, and the environment is shown in Figure 1 (NOAA-CREST, **2008).** A study of the climate variability is essential to develop a greater understanding on the role of disturbances in the environment and improve our ability to predict climate extremes and global trends. Such investigations facilitate a decision management for a better living by taking deterrent measures that reduce the extremes, or by adapting to the climate change impacts. A collaborative participation of the researchers of various National and International Universities/Institutions will also greatly help in improving the understanding of the dynamics behind climate changes globally and regionally and to assess their impacts.

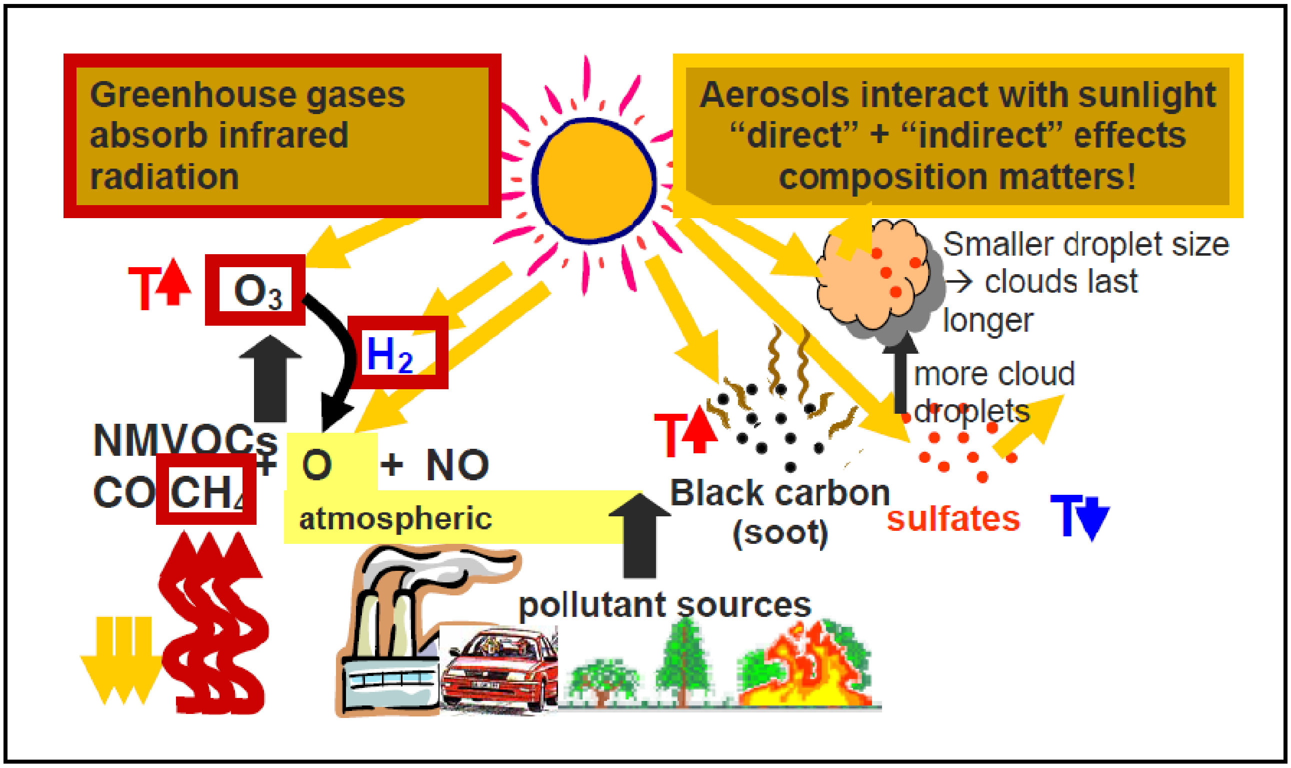

Figure . Factors Controlling Earth’s climate, and interaction of climate variability and air quality

Global warming – the increase in the average temperature of Earth, is a global phenomenon that is typical of a situation where the cause and effect are not simultaneous in space and time. The consequences of the effect are severe and require greater understanding of the cause and reduction of the global warming by a collective effort (Tuluri et al, 2009). Greenhouse gases are those gases that absorb and re-emit radiation at longer wavelengths and contribute to the warming by the greenhouse effect. Greenhouse gases like water vapor, carbon dioxide (CO2), methane and ozone are the cause of the observed surface temperature (Juerg Rohrer, 2007). It is presumed that man-made CO2 emissions and global warming are intricately connected. CO2 emissions are mostly put into the atmosphere due to the burning of fossil fuels – coal, oil and gas towards energy needs of the humankind (IPCC, 2009, Ch2). The CO2 once released into the atmosphere will remain for longer periods such as 100 to 200 years, Due to Greenhouse effect, the elevated levels of CO2 in the atmosphere will cause the temperature of the Earth to raise; see Figures 2 and 3(Giorgi et al, 2007; Robinson, 2007; Pier Tans, 2009, Keeling et al 1976; Thoning et al, 1989).

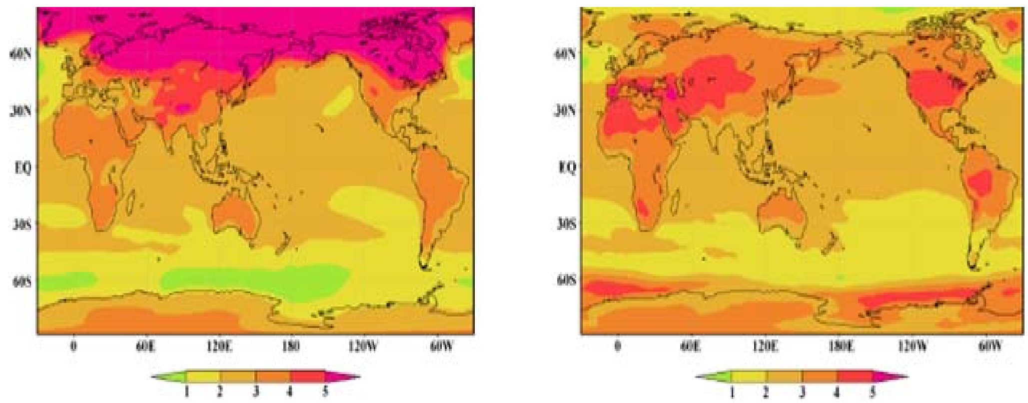

Figure 2: Carbon Flux from various Processes (Units: Billion metric Tons of Carbon/y)

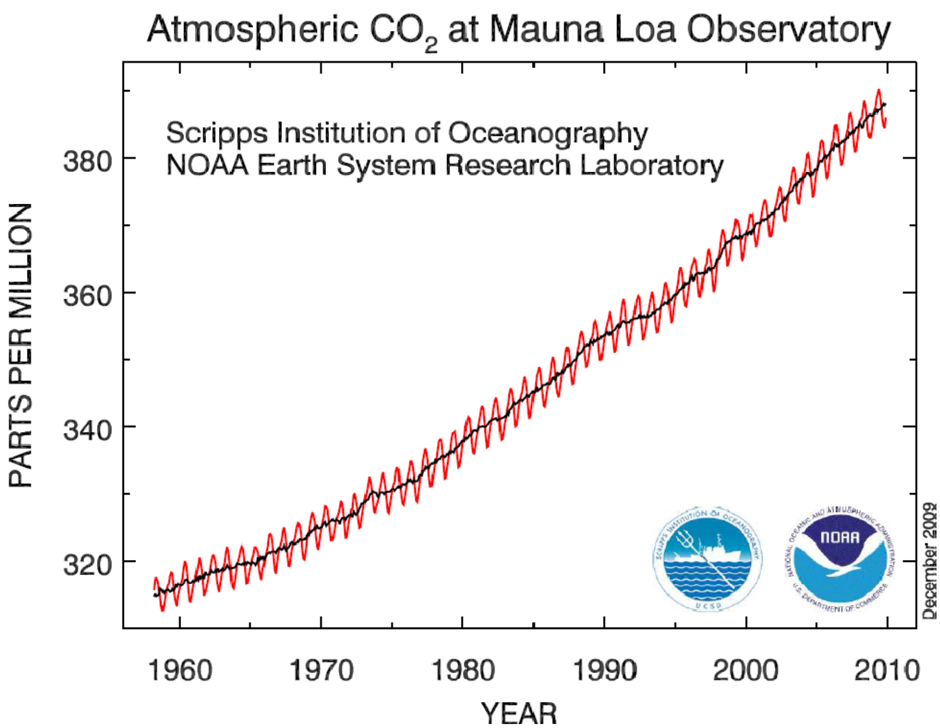

Figure 3: Change Air Surface Mean Temperatures (for 2071-2100 compared to1961-1990) (A) Dec-Jan-Feb, (B) June-July- August (Ref F. Giorgi, F. Meleux, Modelling the regional effects of climate change on air quality, as simulated by CMIP 3ensemble, Units are degrees

Not many studies have been reported in the literature on the regional climate variability in temperatures over the United States of America to address the global warming for effects of CO_2 in the light of the global scale trends observed (Hansen, 2007; Robinson, 2007). In the present preliminary study, we investigate these aspects in regional climate variability in temperatures over 100 year period using linear trend and multiple regressional statistical analyses, for the south central states (Mississippi, Alabama, and Georgia). We divide the total period into sub-periods in order to delineate global warming trends in the regional climate temperature data. These states are of importance because they experience distinct weather patterns due to the influence by the Atlantic and the Gulf of Mexico which is a really good moisture source for storm systems. We will also look into the regional scale characteristics of temperature variations for effects of greenhouse gases predominantly by CO_2.

MATERIALS AND METHODS

To see the temperature dependence on the climate variability, temperature data of south central states of USA – Mississippi, Alabama, and Georgia were collected for the period 1895 - 2008 from the NOAA climate Diagnostic Center (NCDC). We used linear trend and multiple regressional statistical tools to analyze the data. Temperature variation plots for each of the three states over the period 1895 – 2006 are drawn and shown in Figures 4 and 5 and the corresponding results are given in Table 1. Figure 4 shows liner trends of actual temperature in degrees Fahrenheit for three segments over the total period, and Figure 5 shows the linear trends of the corresponding temperature anomalies of Figure 4. To obtain the temperature anomalies variation, we used Hansen approach for multiple regression analysis (Hansen, 2007). The results of regressional analysis are shown in the Table 1.

RESULTS AND DISCUSSION

The time series 1895 to 2006 has shown three distinct climate intermediate trends with two positive and one intermittent negative temperature trends. Robinson has observed that US surface temperatures have increased about 0.5^0 C per century, with three distinct intermediate trends including a decreasing variation suggestive of 'global cooling' period. He also observed a positive correlation between solar activity and US surface temperatures (Robinson, 2007). Hansen also pointed out the global cooling by about 0.5^0C between 1940 and 10970s (Hansen, 1999). Our results also show that the temperature changes in the regional scale have similarities with the global warming temperature trends in US and the global mean. Effects of CO_2 are consistently observed globally, and regional. In our study we have noticed the large scale climate effects being manifested at local scales as well. The warming trends may be due to increase in CO_2 and the intermittent cooling trend may be predominantly due to other climate and radioactive forcings.

Regionally, the south central states of USA are largely showing three intermediate temperature trends over the total period 1895 – 2006 with an intermittent cooling effect. For the periods 1895 – 1938, and 1968 – 2008, the temperature trend shows positive (at yearly rate of about 0.04^0 C) showing warming effect. While for the period 1938 – 1968 there is a shift in the trend (negative at yearly rate of 0.08^0C) showing cooling effect (Figure 4a, 4b and 4c). The temperature anomalies are also consistent with the actual temperature trends (Figures 5a, 5b, and 5c). The temperature anomalies appear to extend the cooling effect up to 1976, and have the highest decreasing rate for Mississippi and highest increasing rate for Georgia (Table 1). The results further show that the temperature trends for actual temperatures and temperature anomalies are consistent, however temperature anomalies has an advantage of stretching the intermediate trends. These findings are corroborating with the global scale trends studied by earlier investigators (Robinson, 2007; Hansen, 2007; IPCC, 2009).

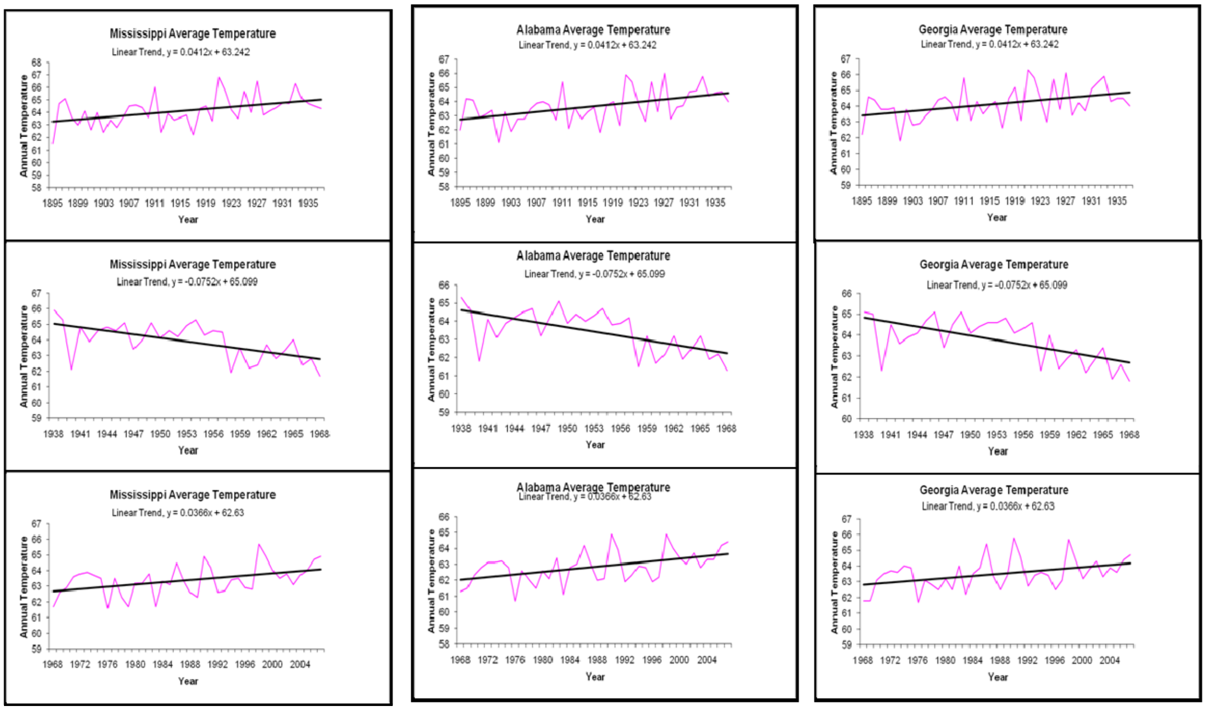

Figure 4: Mean yearly temperature variation for the period 1895 – 2008 split into three zones of the periods – 1895 – 1038, 1938 – 1968, and 1968 – 2008: a) Mississippi, b) Alabama, and C) Georgia

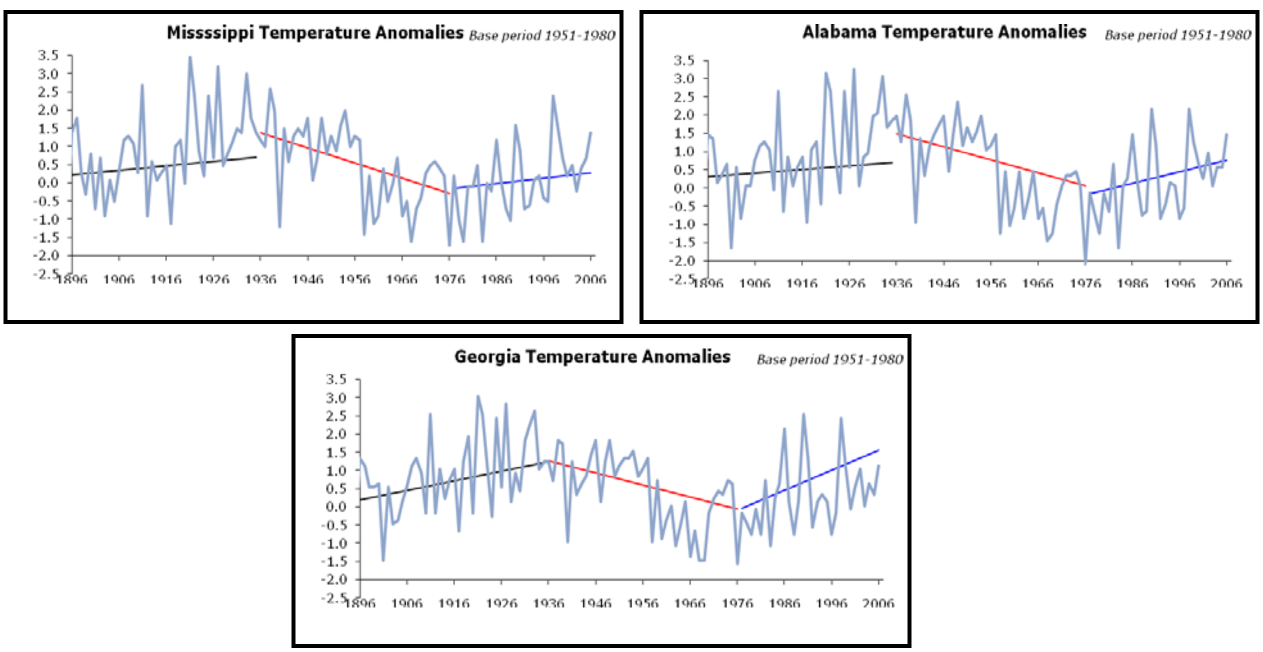

Figure 5: Temperature anomalies trends for the period 1895 – 2008 split into three zones of the periods – 1895 – 1038, 1938 – 1968, and 1968 – 2008: a) Mississippi, b) Alabama, and C) Georgia

Table 1: Temperature anomalies trends for the period 1895 – 2008 split into three zones of the periods – 1895 – 1038, 1938 – 1968, and 1968 – 2008: a) Mississippi, b) Alabama and C) Georgia. 'Int' is the intercept, 'slope' is the yearly rate of variation, and 'RSq' is the correlation coefficient corresponding to each of the linear fit

		Mississippi Results			
Line #	**From**	**To**	**Int**	**Slope**	**RSq**
1	1895	1935	-23.83	0.013	0.01
2	1936	1976	82.1898	-0.042	0.2101
3	1977	2006	-29.276	0.015	0.0233
		Alabama Results			
Line #	**From**	**To**	**Int**	**Slope**	**RSq**
1	1895	1935	-18.23	0.010	0.01
2	1936	1976	70.4554	-0.036	0.1527
3	1977	2006	-62.927	0.032	0.0921
		Georgia Results			
Line #	**From**	**To**	**Int**	**Slope**	**RSq**
1	1895	1935	-49.13	0.026	0.05
2	1936	1976	64.668	-0.033	0.1633
3	1977	2006	-108.18	0.055	0.2354

During the last 100 years for the period 1905 – 2005, a linear trend of global mean surface temperatures variation show a rise by 0.74 ^{0}C within 0.18 ^{0}C uncertainty. Though there are differences in the regional rates of surface ocean warming in the Atlantic, Pacific, and Indian Ocean regions that affect the atmospheric circulation, inter-hemispheric differences in warming in the Atlantic and Pacific oceans , the warming is shown at all latitudes (IPCC, 2009). It is clear from the observed record that there has been an increase in the global mean temperature of about 0.7°C since the start of the 20th century and that this increase is associated with a stronger warming in daily minimum temperatures than in maximums, leading to a reduction in the diurnal temperature range. Climate models predict a future climate with warming trends due to increasing greenhouse gases, and precipitation intensity due to energy budget constrains (IPCC 2009). The most recent runs of state-of-the-art computer models of the Earth's climate (general circulation models — GCMs) have projected a globally averaged warming ranging from almost 3 to10.7degrees F over the next 100 years, if greenhouse gases continue to accumulate in the atmosphere at the current rat (IPCC, 2009). A study of temperature anomalies relative to 1951 – 1980 climatology also shows current warming is nearly ubiquitous with larger variation over land than over ocean and largest at high latitudes in the Northern Hemisphere (Hensen, 2007).

In the industrial era since 1890, human activities has increased use fossil fuels to meet energy needs for transportation, residential or business units temperature maintenance, agriculture, and manufacture of goods among others. Consequently the levels of the emissions of four main greenhouse gases – CO2, methane, Nitrous oxide, and the halocarbons released are on the rise. The increased emissions will result in the increase of concentrations of radioactively active species in the atmosphere. The corresponding rise in the radioactive forcing and the climate response would be manifested as global warming. Effects of CO2 are consistently observed globally, regional. In our study we have noticed the large scale climate effects being manifested at local scales as well.

Our regional results are agreeing with that of the temperature trends at global and continental scale as pointed out by other investigators (Robinson, Hansen, and IPCC). Despite the continual increase of CO2, the emissions are not affecting the temperature trend for global warming, and it appears that during the period 1935 – 1976 there is onset of temperature reversal from warming to cooling effect. The cooling effect may be influenced by some other factors related to the human activities.

HYPOTHESIS

Solar warming of the earth is altered by the greenhouse effect. By human activities, greenhouse gases are released into the atmosphere and due to convective readjustments and the radioactive blanketing effect prevent the escape of terrestrial thermal infrared radiation. Increasing levels of CO2 contributes to the effective increase of radioactive energy in the Earth's atmosphere and hence warming.

The intermittent temperature fluctuations in the extremes may be due to natural dynamical variability coming from the contribution by the Southern Oscillation, the El Niño-La Niña cycle. The second factor may be due to the solar irradiance and the sunspots cycle. It is estimated that considering the large thermal inertia of the ocean, the surface temperature response to the decadal solar cycle lags the irradiance variation by about two years. Thus, relative to the mean, i.e., the hypothetical case in which the sun had a constant average irradiance, actual solar irradiance will continue to provide a negative anomaly for the next 2-3 years. The third fluctuation factor may be due to the volcanic aerosols. Especially, during the cooling period 1930 – 1075, there was much volcanic activity in New Mexico, Manitoba of Canada and elsewhere globally. The changing levels of anthropogenic Greenhouse gases like CO_2, and CH_4 also contribute to the temperature fluctuations. The negative trend may be due to:

- CO2 emissions not affecting the surface temperatures during the intermittent cooling period
- Aerosol loading of the atmosphere during the World War II
- Series of Volcanic activities during 1938 and later in New Mexico and west coast
- High levels of particulate matter and its stagnation due to high pressure system by the influence of Gulf of Mexico

CONCLUSIONS

The present preliminary study examines the regional climate variability in temperatures over 100 year period using linear trend and multiple regressional statistical analyses, for the south central states (Mississippi, Alabama, and Georgia), primarily of importance due to their vulnerability to the influence of storm systems the Atlantic or the Gulf. We also observed the regional scale characteristics of temperature variations for effects of CO2. Our regional results are agreeing with that of the temperature trends at global and continental scale as pointed out by other investigators (Robinson, Hansen, and IPCC). Despite the continual increase of CO_2, the emissions are not affecting the temperature trend for global warming, and it appears that during the period 1935 – 1976, there is onset of temperature reversal from warming to cooling effect. The cooling effect may be influenced by some other factors related to the human activities. The possibilities for the occurrence of temperature cooling effect amidst the temperature warming trends are accounted.

To extend the observed results of the temperature trends and to arrive at general deductions, further work will be carried out for similar studies in the other climate regions by grouping states that come under NOAA climate regions to see region-wise trends and collective trend in relation to USA sub-continent. To substantiate the results, we would carry out WRF regional climate modeling and obtain the temperature trends for a short period in each of the three segments of the total period.

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SYNTHESIS OF FUNCTIONALIZED DISUBSTITUTED ISOXAZOLINES

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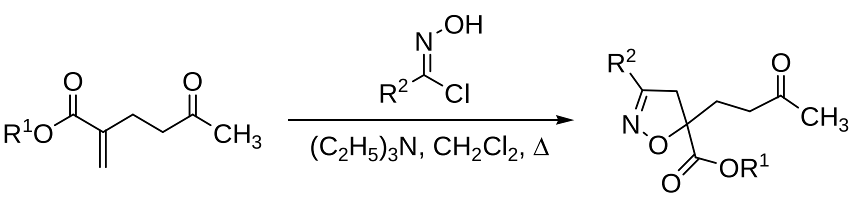
ABSTRACT

The synthesis of geminally disubstituted isoxazolines was achieved through the 1,3-dipolar cycloaddition of 1,1-disubstituted alkenes with nitrile oxides with varying functional groups. These isoxazolines could potentially be used as precursors toward the syntheses of spiroisoxazoline natural products.

Graphical Abstract



1 $R^1 = CH_2CH_3$
2 $R^1 = CH_3$

A $R^2 = Ph$
B $R^2 = CO_2CH_2CH_3$
C $R^2 = 3\text{-}NO_2C_6H_4$
D $R^2 = 4\text{-}OCH_3C_6H_4$
E $R^2 = 2,6\text{-}Cl_2C_6H_3$

(43-76%)
3 $R^1 = CH_2CH_3$
4 $R^1 = CH_3$

INTRODUCTION

A number of spiroisoxazoline containing natural products possess biological activity against cancer[1] as well as microorganisms.[2] Because of the interesting biological profile of spiroisoxazoline natural products, the synthesis of the spiroisoxazoline family of natural products continues to attract the interest of synthetic organic chemists.[3-7] Even though a number of methods to synthesize spiroisoxazolines exist,[3-7] synthetic methodologies that quickly afford the synthesis of a variety of spiroisoxazolines would be useful for the biological evaluation of biologically active spiroisoxazoline analogues. An example of a spiroisoxazoline synthetic methodology that allows for the synthesis of spiroisoxazolines involves a 5,5-disubstituted isoxazoline[8] precursor which undergoes an intramolecular cyclization/methylation to afford the corresponding spiroisoxazoline. (Scheme 1) 5,5-Disubstututed isoxazolines also exhibit biological activity against pest insects and fungi.[9] Herein we report the synthesis of geminally disubstituted isoxazolines from the 1,3-dipolar cycloaddition of nitrile oxides and the corresponding 1,1- disubstituted akene

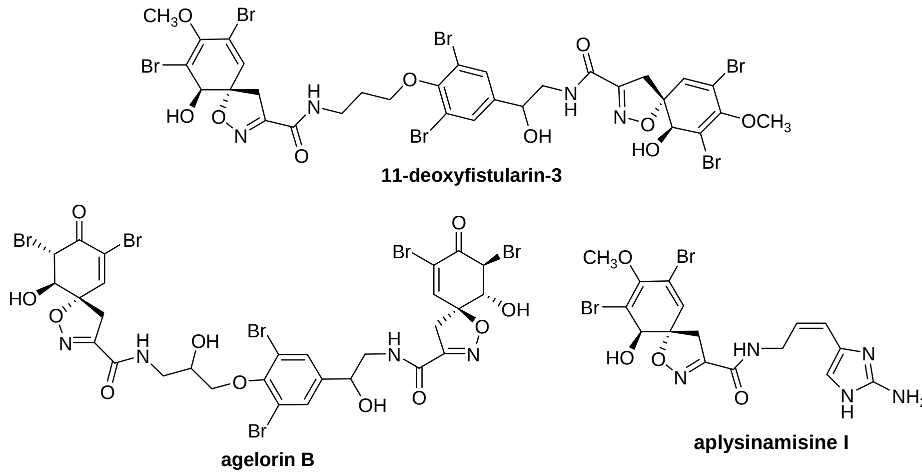
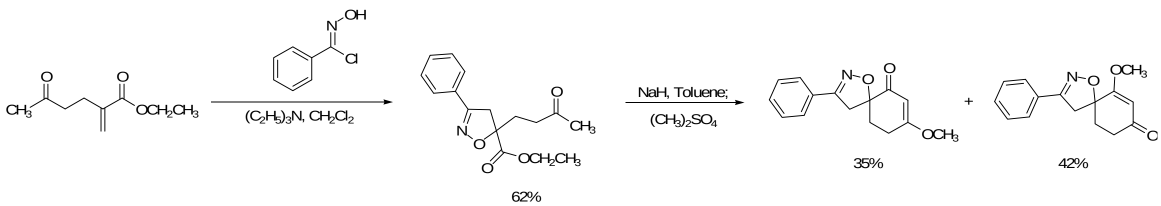


Figure 1. Biologically active spiroisoxazoline natural products.



Scheme 1. Two step spiroisoxazoline synthesis from a 5,5-disubstituted isoxazoline.

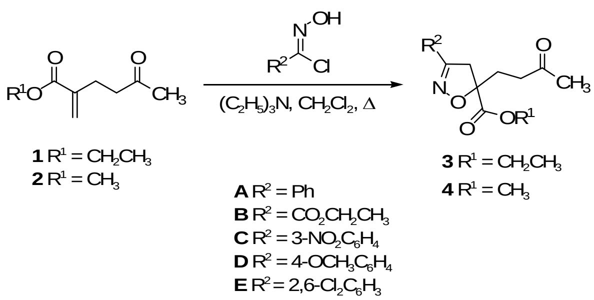
MATERIALS AND METHODS

All chemicals were purchased from commercial vendors and used without purification. Analytical TLC was performed on precoated aluminum plates (Merck silica gel 60, F254) and was visualized with UV light. Products of reactions were purified by flash column chromatography over Merck Silica Gel 60 (230-400 mesh), and ethyl acetate/hexane was used as eluant. NMR spectra (^{1}H at 250 MHz, 300MHz, or 500MHz, ^{13}C at 62.9 MHz, 75 MHz, or 125MHz) were recorded in $CDCl_3$, and chemical shifts are reported in parts per million relative to internal solvent signal. IR spectra were taken on a Nicolet Model Nexus 670 FTIR spectrophotometer with $CHCl_3$.

General Procedure for the Preparation of the isoxazolines by 1,3-dipolar cycloaddition: A solution of the alkene (3.0 mmol) and the hydroximoyl chloride (3.0 mmol) in 4 mL of dichloromethane was heated to 50 ^{o}C for 10 minutes. Triethylamine (0.46 mL, 3.3 mmol) was then added dropwise, and the resulting reaction mixture was heated for an additional 5 minutes at 50 ^{o}C. The reaction mixture was stirred at rt until the disappearance of the starting materials, as evidenced by TLC. After the reaction was complete, the reaction mixture was washed with water (3 x 4 mL) and brine (4 mL). The organic layer was dried over anhydrous magnesium sulfate, filtered, and the solvent was evaporated under reduced pressure. Purification was achieved via column chromatography with a 2:1 hexane/ethyl acetate eluant system.

RESULTS AND DISCUSSION

Before we could apply the synthetic methodology shown in Scheme 1[3a] toward the synthesis of a variety of spiroisoxazoline derivatives, the synthesis of 5,5-disubstituted isoxazolines with a variety of substituents at the 3-position of the isoxazoline was investigated. Syntheses of isoxazolines with either a methyl ester or an ethyl ester was also explored for future studies relating to the most effective ester required for the intramolecular spirocyclization/methylation strategy toward spiroisoxazolines. From alkenes **1** and **2**,[10] the synthesis of various isoxazolines was achieved from the 1,3-dipolar cycloaddition of an in situ generated nitrile oxide from the corresponding α-chlorooxime.[11] The data from Scheme 2 shows that the cycloaddition occurred in moderate to good isolated yields. The regiochemistry of the cycloaddition proceeded such that the oxygen of the nitrile oxide bonds exclusively to the most substituted carbon of the dipolarophile.



Entry	Isoxazoline	R^1	R^2	% Yield
1	**3a**	CH_2CH_3	Ph	62
2	**3b**	CH_2CH_3	$CO_2CH_2CH_3$	46
3	**3c**	CH_2CH_3	$3\text{-}NO_2C_6H_4$	49
4	**3d**	CH_2CH_3	$4\text{-}OCH_3C_6H_4$	73
5	**3e**	CH_2CH_3	$2,6\text{-}Cl_2C_6H_3$	70
6	**4a**	CH_3	Ph	43
7	**4b**	CH_3	$CO_2CH_2CH_3$	53
8	**4c**	CH_3	$3\text{-}NO_2C_6H_4$	54
9	**4d**	CH_3	$4\text{-}OCH_3C_6H_4$	65
10	**4e**	CH_3	$2,6\text{-}Cl_2C_6H_3$	76

Scheme 2. Syntheses of 5,5-disubstituted isoxazolines **3** and **4**.

DISCUSSION

High regioselectivity of 1,3-dipolar cycloaddition reactions of nitrile oxides with geminally disubstituted alkenes is often observed due to both steric and frontier molecular orbital interactions of the 1,3-dipole and the alkene.[12] We postulate that during the cycloaddition reaction, the nitrile oxide approaches the 1,1-disubstituted alkene in a manner such that the aromatic ring of the nitrile oxide skirts the steric bulk of the two substituents which leads to the observed regioselectivity. Elucidation of the substitution pattern for the isoxazolines was realized through ^{1}H and ^{13}C NMR chemical shifts of the methylene protons of the isoxazoline ring, HETCOR analysis, and literature precedent.[13]

CONCLUSION

In conclusion, a number of different 5,5-disubstituted isoxazolines were synthesized via the 1,3-dipolar cycloaddition of nitrile oxides with geminally disubstituted alkenes. The isolated yields for the cycloaddition reactions were moderate to good, and the cycloaddition occurred with complete regiochemical integrity. These isoxazolines are potentially useful as precursors for the syntheses of spiroisoxazolines through an intramolecular cyclization/ methylation methodology.

ACKNOWLEDGEMENTS

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REFINING THE DIGITAL FORENSICS HIERARCHY

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Abstract

Smartphones are increasing in popularity due to functionality, portability, convenience and affordability. Because of this, examiners must acquire and analyze these devices when criminal activity is suspected to have occurred. In order to obtain this information, it has to be extracted in a way that is repeatable and testable. There are several process models available for use, but the ad-hoc approach is on the rise. The dilemmas are that ad-hoc approaches and the forensic investigative process models available are not well suited for the examination of such devices. These approaches may cause the validity of investigator skill and methods to fall under scrutiny. To address this, there is a need for an investigative framework tailored to the unique qualities of smartphones. To accomplish this, the hierarchy of digital forensics should be understood. "Computer forensics" and "digital forensics" are used synonymously in literature, but wrongfully so. This paper highlights the differences in computer forensics, digital forensics, computer crime, and digital crime while proposing a revised hierarchy of the forensics discipline.

INTRODUCTION

Due to the increase in the use of smartphones, the need has arisen to be able to examine these devices forensically and accurately. In order to accomplish this task, a thorough understanding of the functionality of the devices as well as the methods and tools used is necessary. Before this can be achieved, the forensics community must evaluate the current state of the discipline. The authors believe that this re-evaluation begins with definitively identifying important terms that will assist in understanding where smartphones lie in the hierarchy of the discipline.

Computer Forensics vs. Digital Forensics

Computer forensics is an innovative area of computer science that is also referred to as digital forensics in various literatures. Due to its infancy, researchers, law enforcement, and those tenured in the field have faced significant issues developing standards and methodologies that are sufficient. One of those struggles has been the development of a standard vocabulary. As a result, we find that "computer forensics" and "digital forensics" are often used synonymously due to their similar definitions. The authors believe that this is done in error because by definition, as well as they are alike, they are dissimilar. Kruse and Heiser define computer forensics as

> " involving the preservation, identification, extraction, documentation, and interpretation of computer data" (Kruse II and Heiser, 2001).

Digital forensics is defined by Palmer as

> "the use of scientifically derived and proven methods toward the preservation, collection, validation, identification, analysis, interpretation, documentation, and presentation of digital evidence derived from digital sources for the purpose of facilitation or furthering the

reconstruction of events found to be criminal, or helping to anticipate unauthorized actions shown to be disruptive to planned operations" (Palmer, 2001).

As can be seen, the definition for digital forensics has advanced over time to include potential evidentiary data from all technological devices, not just computers. Scientific proven methods are also an important part of the process because the integrity of the digital data extracted may be questioned due to its volatile nature as well as the validity of the results of the investigation (Kruse II and Heiser, 2001).. It is also noticed that the activities involved in conducting a digital forensic investigation have been expanded to include key processes that were not included in Kruse's definition of computer forensics such as collection, validation, analysis, and presentation which are all imperative components of the forensics progression. For these reasons, "computer forensics" should be a category of forensics encompassed by "digital forensics".

The authors agree with Carrier and Spafford (Carrier, 2006) on how the area of digital forensics should be divided with one exception, the addition of Small Scale Digital Device Forensics (SSDDF). Digital forensics includes any investigative technique applied to any technology and is therefore divided into four major areas:

- Computer forensics: Collecting, analyzing, and preserving evidence on computers, laptops, notebooks, etc.
- Small Scale Digital Device Forensics: Collecting, analyzing, and preserving evidence on small digital devices
- Network forensics: Collecting, analyzing, and preserving evidence that is spread throughout a network
- Software forensics: Linking software or malicious code to its author.

The addition of SSDDF is vital and the significance of its addition is detailed in the section on: **Small Scale Digital Forensics (SSDF)**.

Computer Crime vs. Digital Crime

Just as "digital forensics" and "computer forensics" are used interchangeably throughout forensics literature, "digital crime" and "computer crime" are as well. The authors believe that these words, although similar, are not synonymous. There has been debate over the definition of "computer crime". The Department of Justice (DOJ) defines computer crime as:

> "any violation of criminal law that involved the knowledge of computer technology for its perpetration, investigation, or prosecution" (Goodman, 2001).

Some see this definition as too abstract because it could potentially include crimes that have nothing to do with computers being used or targeted for the commission of a crime. As an example, a criminal could use the computer to assist in locating potential victims with the intention of committing a heinous act against them. Under the DOJ definition, this crime would be categorized as a computer crime whether it is a terrorist bombing, stalking, or assault. But this classification would not be accurate because neither of the crimes mentioned above uses a computer to commit the act. In this situation, the computer would contain vital evidentiary data that would assist in proving that the suspected party had specific knowledge of the location of each victim. So this definition of computer crime is not as thorough as is needed for this discipline.

Kruse and Heiser defined computer crime by categorizing it in two different classes, either the computer itself is the object of the offense, or the computer is used to commit the offense. If the computer is the object of the offense, it is the target of the aggressor. Examples of this would be a user deliberately destroying the monitor by defacing it, pouring liquid in the chassis, physically misusing the peripherals, or physically taking a weapon and damaging it. The destruction of the computer does not always have to be physical in nature. One could embed malicious code on the computer with the intentions of causing some unexpected action to occur.

When a computer is used to commit an offense, then the target is one other than that physical computer itself. Because of this, various legal issues may arise. For instance, one could use the computer to launder money, spread viruses, commit software piracy, blackmail victims, sabotage individuals, or recreate legal documents which are all illegal activities. No matter what resources are used to accomplish these tasks, they are illegal. As an example, one can send a threatening email over the network using a specific computer which is against the law. But it would still be illegal if the same person was to write the threatening note and personally deliver it to the intended victim. Although there are no laws pertaining to computers in place to assist in deterring these types of crimes, there are punishments in place for the illegal actions committed using computers such as blackmail, money laundering, and forging documents.

There are instances where the computer is used as an avenue to gain information that will assist the suspect in the commission of a crime. Although it is not against the law to conduct research via the Internet, a well developed forensic investigation can uncover these actions and extract evidence that can support or refute the position of the prosecutor. Following are several cases involving the use of computers to assist in committing a criminal act (Department of Justice). One will notice that the charges against each suspect are not considered computer crimes, but a computer assisted each in the commission of their crimes.

On September 26, 2007, Lan Lee and Yuefi Ge were indicted on charges of conspiracy to commit economic espionage. Their plan was to steal trade secrets related to computer chip design from their employer and pass them off as their own creations. The two formed a company called SICO Microsystems in order to develop the products and market them to other companies for compensation. Neither suspect has been prosecuted, but they both face up to 15 years in prison and a fine of $500,000.

Mark Wayne Miller faces a minimum of 35 years to life in prison for one count of the Sexual Exploitation of Children in Dayton, OH. Miller successfully persuaded minors to conduct themselves inappropriately on a webcam for his viewing pleasure. Without the knowledge of the minors, Miller would also eavesdrop on them by obtaining their passwords through phishing and then using the password to access their webcam through special software. In order to lure the girls, he would assume the identity of a teenage male in chat rooms and engage them in conversation. He was arrested on November 28, 2005 by the U.S. Marshals and remains in their custody.

In 2004, Larry Lee Ropp was indicted on charges of federal wiretapping for installing an electronic device on a company computer that recorded every key stroke taken by an employee. This was the first of such a case in the United States. Ropp faced a maximum of 5 years in federal prison.

Although these crimes are not considered computer crimes, they are still a part of the digital forensic process because evidence was located on a computer that supported the indictment of each suspect. With that, the authors believe that there are three types of computer crime: crimes against computers, crimes committed using computers, and crimes committed with the assistance of computers. The definition of a computer-assisted crime is when a computer is used to aide in the commission of a crime by performing information searches and storing information pertinent to the crime in memory either actively or passively. The idea of computer-assisted crimes is vital to this research mainly because of the technology chosen as the focus.

"Digital crime" is not as often used in literature as "computer crime", but the authors feel this is due to the non-standard vocabulary. At its infancy, researchers in this area of computer science developed preliminary definitions that did not keep pace with the evolving technologies. As technology advances, these definitions must be altered to accommodate those changes. Surprisingly, in the systematic review process, the authors found no sufficient definition for "digital crime", so an attempt to provide clarity is as follows:

Digital crime

- Involves the use of any digital technology to commit a criminal offense.
- Involves any digital technology that is the target of a crime.
- Involves the use of any digital technology to obtain or store information for the exclusive purpose of committing a crime.
- Involves the unauthorized access, unauthorized use, dishonest manipulation or theft of information from any digital technology.

Following the same logic used when comparing definitions of "computer forensics" and "digital forensics", "digital crime" would encompass "computer crime" because the first three statements are derived from the definition of "computer forensics". The difference is the word "computer" is changed to "digital technology" in order to encompass *all* technologies whether past, present, or future.

Small Scale Digital Forensics (SSDF)

Due to the vast number of digital devices with the ability to perform various functionalities, digital forensics further categorizes devices by their physical size and operability as follows: computers, storage devices, and obscure devices. Examples of devices that are classified as computers are laptops, tablet PCs, desktop computers, and notebooks. A storage device would be a peripheral that stores digital data such as a flash drive, iPod, or external hard drive. An obscure device would be a Play Station Portable (PSP), Nintendo Gameboy, and any other portable gaming device (Kruse II and Heiser, 2001).

Mislan refined the device categories above by introducing the SSDD category described as

> "a small form factor device which utilizes permanent or temporary memory in conjunction with embedded chips to perform a variety of tasks" (Harrill and Mislan, 2007).

He established that the SSDD category would contain five sub-categories assisting in determining which device belonged in which category. The five sub-categories are Embedded Chip Devices, PDAs, Cellular Telephones, Audio/Video Devices, and Gaming Devices. These devices are all small and dynamic in nature which has made them difficult to evaluate and examine. From this category comes a sub-area of digital forensics called Small Scale Digital Device Forensics (SSDDF), which was established in order to provide the examiner with the capability to investigate technologies developed after the invention of the computer and future devices. This area focuses on the five sub-categories of SSDD. To provide a starting point for investigations, the devices in each category have to be classified with respect to the internal components of each.

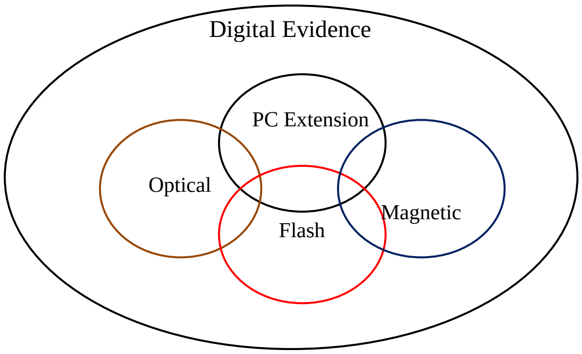

Figure 1. SSDD Framework and devices by type

Figure 1 is a revised version of the Harrill et al. classification of the SSDD Framework showing how devices store information. The difference is that based upon device breakdown, PC extension devices, flash devices, and magnetic drives can overlap. In the illustration by Harrill et al., the device categories only overlap with PC Extension devices (Harrill and Mislan, 2007). The authors would also like to point out that Harrill et. al. classifies notebook computers and tablet computers as SSDD. The digital forensic framework suggested in this research by definition does not contain any devices that are considered computers, as can be seen in Figure 2. A computer can be categorized in all four groups: magnetic, PC extension, flash, and optical. This would mean that all four categories would overlap each other. However, the illustration depicts PC extension and flash devices overlapping while magnetic and optical devices never relate. This is not to say that the topology of the framework will remain the same. Allowances for future devices will have to be considered.

Harrill and Mislan, (2007) states that in order to be effective, the field of SSDDF will have to be handled depending upon the internal components of each device. These devices can then be categorized and the type of forensics applied to each device depends upon how it is grouped. From this, it is obvious that a separate category for small scale digital devices is necessary due to the unique attributes of each. If separation from computers and the creation of a unique category was necessary for these types of devices, then a different framework for investigating them must be necessary as well. The key processes that define a digital investigation will still have to be present in the process model, but approached in a different manner.

Figure 2 depicts the digital forensic hierarchy as proposed by the author. The sub-disciplines are depicted in the rounded rectangles and the devices belonging to each are shown in the ovals. Software and network forensics are defined as sub-disciplines of digital forensics, however, defining any devices or processes belonging to each lies outside the scope of this research. Because there are aspects of each that may be categorized as part of another discipline, these rounded ovals are not fully contained by the digital forensic discipline.

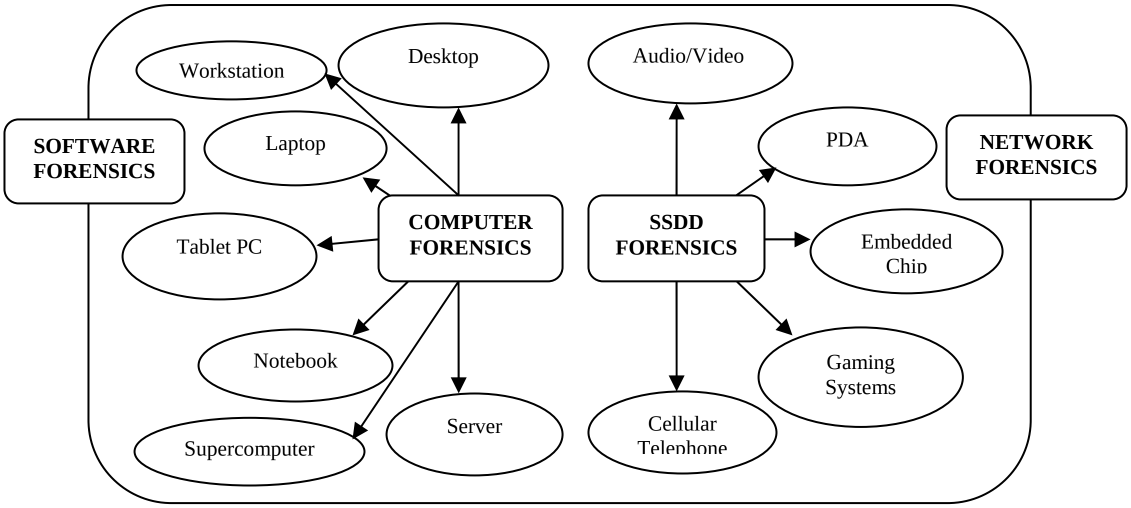

Figure 2. Digital Forensic Hierarchy and Devices

CONCLUSION

A standard terminology in the field of digital forensics is necessary in order for the successful continuation of digital research. The terms "computer forensics" and "digital forensics" are used synonymously and will continue to be used that way until further research eliminates this usage. "Computer forensics" was sufficiently used at the infancy of the discipline because computers were the target device in examinations, however, the term should now be a sub-discipline. Today, interests have expanded to include SSDDs and other types of technologies. SSDDs cannot be categorized as computers and therefore cannot belong to a discipline entitled "Computer Forensics". Simultaneously, all of the devices in question can be categorized as digital devices so the proper name for this field would be "Digital Forensics". The authors are conducting further research in the field of SSDDs targeting the smartphone. A forensic process model is being developed that deals specifically with smartphones due to issues distinct to that device.

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AQUATIC PLANTS OF MISSISSIPPI COASTAL RIVER SYSTEMS

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ABSTRACT

Shallow waters in main river channels and adjoining bayous, streams, inlets, lagoons, and bays of the Pascagoula River, Back Bay of Biloxi, and Pearl River systems were surveyed for aquatic plants from May 2008 to May 2010. The location of species of submerged aquatic vegetation (SAV), floating aquatic plants, and the shore emergent plants are presented in this paper. Photos of most of the plants that are mentioned in this paper are available at the website, jcho.masgc.org. The survey area for each system extended from the river mouth to upstream areas where stream width became narrow and shore vegetation became tall trees which restricted SAV growth due to canopy shading. This paper was prepared as a rapid response to requests to provide the SAV species and their locations in coastal river systems, particularly in relation to the current BP oil spill incident and disaster in Gulf of Mexico.

INTRODUCTION

Aquatic plants, also called hydrophytes, refer to plants that are adapted to life in or on water. They can occur in a range of growing forms: free-floating on the water surface, rooted with floating leaves, completely submerged, or emergent with roots in standing water or permanently water logged soil (Cronk and Fennessy 2001). Aquatic vascular plants help improve water quality, stabilize sediment, and provide nursery habitats for aquatic life. On the other hand, fast growing aquatics especially freshwater submerged or floating plants can produce noxious conditions by forming surface canopies that interfere with gas exchange, light penetration, navigation, and commercial/recreational activities. In either case, identification and locating of the native, favorable species or the invasive, noxious species are: 1) required to understand species richness/dominance/diversity which can be used as an indicator of the habitat's health, complexity, stability, and status; and 2) the first step in habitat assessment for proper conservation and management.

Submerged aquatic vegetation (SAV) has received much less media, funding, and research attention compared to the other major coastal ecosystems. In addition, much of the SAV research and funding efforts have been focusing on locating, characterizing, and restoring marine seagrass habitats while it is well-known that the SAV beds in the brackish and intermediate coastal waters provide the equivalent ecosystem services as well as additional unique functions to those environments and the associated fisheries (Castellanos and Rozas 2001; Strayer and Malcom 2007).

The majority of publications on coastal Mississippi SAV also have focused on barrier islands and estuarine seagrass beds (Eleuterius 1971; Eleuterius 1973; Eleuterius 1975; Moncreiff et al. 1998; Moncreiff 2006; Cho and May 2008; Cho et al. 2009; Cho and Nica 2009); and there is almost a dearth of published information on brackish and freshwater species that occur along the Mississippi mainland coast (Weiland 1994). This paper was prepared as a rapid response to numerous requests to provide the SAV species and their locations in coastal river systems, particularly in relation to the current BP oil spill incident and disaster in Gulf of Mexico.

Coastal Mississippi has various aquatic plant habitats along the four major river systems: Pearl River, St. Louis Bay, Biloxi Bay, and Pascagoula River, which empty into the coastal estuaries. According to Eleuterius (1975), the Pearl and Pascagoula Rivers drain part of the North Central Plateau, the Jackson Prairie Belt, and Long-leaf Pine Regions and the Coastal Pine Meadows, while the St. Louis Bay and the Biloxi Bay Systems drain only the Longleaf Pine and Coastal Pine Meadows. Information on SAV species and their locations that are presented in this paper is based on field surveys from spring 2008 through spring 2010 conducted in various areas in Pascagoula River, Pearl River, and Back Bay of Biloxi.

In addition to SAV species, we documented the free-floating and floating-leaved aquatic plants and also the dominant emergent plants along the surrounding shore. Photos of most of the plants that are mentioned in this paper are available at the website, jcho.masgc.org. While we are confident that our list contains all significant SAV species that occur in the Mississippi coastal river systems, it should not be considered as an exhaustive list. More importantly, the SAV bed locations and their exact species compositions should not be used as an absolute guide because SAV species exhibit substantial seasonal and annual variations in their growth and extent.

MATERIAL AND METHODS

We surveyed shallow waters in main river channels and adjoining bayous, streams, inlets, lagoons, and bays of the Pascagoula River, Back Bay of Biloxi, and Pearl River systems for aquatic plants from May 2008 to May 2010. The survey area for each system extended from the river mouth to upstream areas where stream width became narrow and shore vegetation became tall trees which restricted SAV growth due to canopy shading. The survey locations were selected based on previous experiences of the authors, personal communication with JD Caldwell at Gulf Coast Research Lab, and careful topographic assessments of the candidate SAV habitat areas using 1:25,000 and 1:50,000 USGS topographic maps and the Google Earth™ mapping service. Survey methods included raking from a boat and wading in the water, after SAV were observed to occur in a given location. In addition to SAV species and bed location, dominant shore vegetation and GPS coordinates were recorded using a Trimble™ GeoXH handheld GPS unit and TerraSync™ software. The survey locations were added onto base GIS (Geographic Information System) maps as point data by National Center for Biodefense Communications of Jackson State University (JSU).

RESULTS

The locations for the SAV beds and other information including site name, survey period, GPS coordinates, SAV species, other aquatic plants, and dominant shore vegetation are presented in Figs. 1, 2, 3, and 4 and in Tables 1, 2, and 3. Dominant SAV species included *Ruppia maritima* L (Wigeongrass), *Vallisneria americana* Michx (Wildcelery), *Najas guadalupensis* (Spreng.) Magnus (Southern Naiad), *Zannichellia palustris* L (Horned Pondweed), *Potamogeton pusillus* L (Small Pondweed), and *Ceratophyllum demersum* L (Coontail). Emergent plants that are often submerged were *Eleocharis parvula* Link (Dwarf Spikerush) and *Zizania aquatica* L (Annual Wildrice). Macrophytic algae that can easily be confused with vascular SAV were *Nitella* sp. (Brittlewort) and *Chara* sp (Muskgrass). Some species such as

Myriophyllum aquaticum (Vell.) Verdc (Parrot Feather), *Myriophyllum spicatum* L (Eurasian Watermilfoil), and *Callitriche heterophylla* Pursh (Water Starwort) were found in isolated locations. Submerged *Eleocharis* species included *E. baldwinii* (Torr.) Chapm (Baldwin's Spikerush) and *E. robbinsii* Oakes (Robbin's Spikerush). Floating leaved or free-floating plants included *Nuphar lutea* (L.) Sibth. & Sm (Yellow Pondlily), *Nymphaea odorata* Soland *ex* Ait (American Waterlily), *Utricularia* sp. (Bladderwort), and *Eichhornia crassipes* (Mart.) Solms (Waterhyacinth).

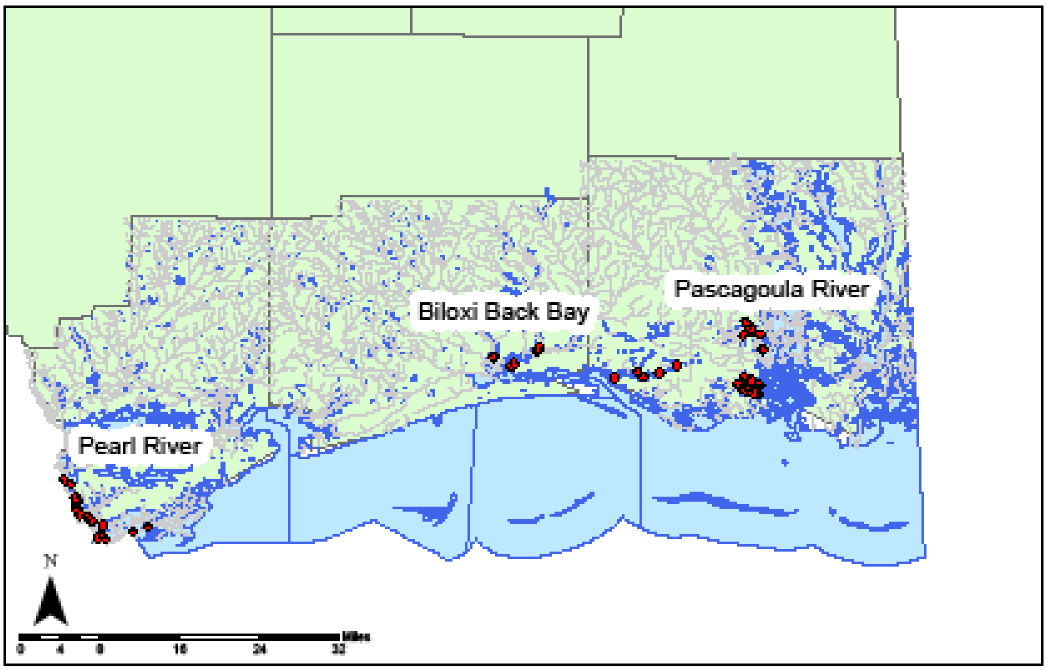

Figure 1. Survey locations along the Mississippi coast

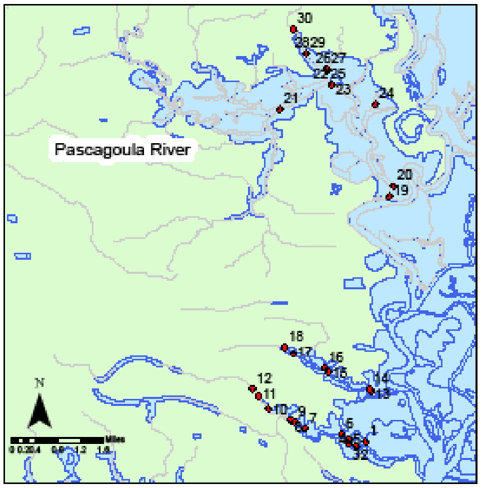

Figure 2. Survey locations in the Pascagoula River system

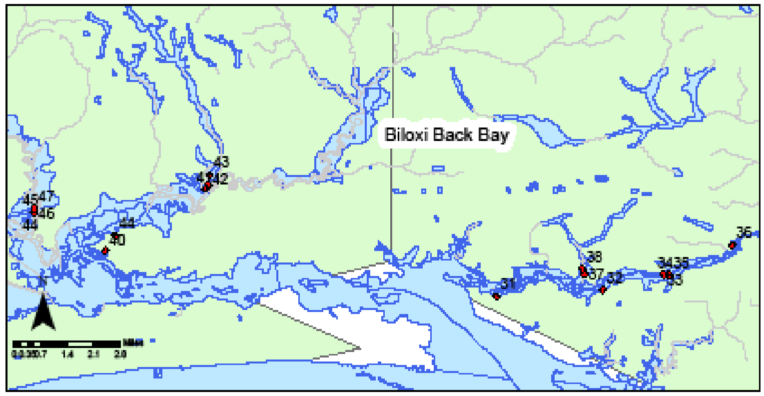

Figure 3. Survey locations in the Back Bay of Biloxi system

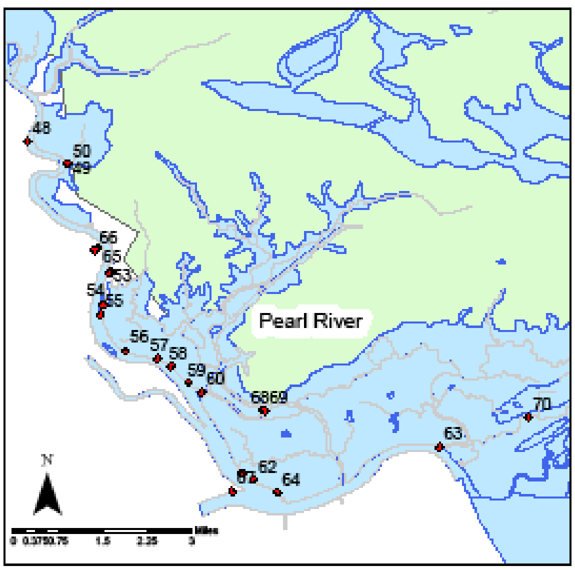

Figure 4. Survey locations in the Pearl River system

Table 1. The survey locations, survey periods, and aquatic plants found during study period (May 2008 – May 2010) in lower Pascagoula River, Mississippi.

PASCAGOULA RIVER SYSTEM

Location	Survey Period	Site ID	Latitude	Longitude	Plants Found Growing in and on Water	Dominant Shore Vegetation
Mary Walker Bayou	May-08	1	30°23'42"N	88°37'27"W	*Najas guadalupensis*, *Potamogeton pusillus*	*Juncus roemerianus*, *Sagittaria lancifolia*, *Spartina cynosuroides*
Mary Walker Bayou	May-08	2	30°23'37"N	88°37'36"W	*Vallisneria americana*, *Najas guadalupensis*, *Myriophyllum spicatum*, *Zannichellia palustris*, *Nitella* sp.	*Juncus roemerianus*, *Sagittaria lancifolia*, *Spartina cynosuroides*
Mary Walker Bayou	May-08	3	30°23'40"N	88°37'43"W	*Ruppia maritima*	*Juncus roemerianus*, *Sagittaria lancifolia*, *Spartina cynosuroides*
Mary Walker Bayou	Mar-10	4	30°23'43"N	88°37'42"W	*Ruppia maritima*, *Vallisneria americana*	*Juncus roemerianus*, *Sagittaria lancifolia*, *Spartina cynosuroides*
Mary Walker Bayou	May-10	5	30°23'44"N	88°37'42"W	*Najas guadalupensis*, *Zannichellia palustris*, *Vallisneria americana*, *Ruppia maritima*	*Juncus roemerianus*, *Schoenoplectus tabernaemontani*, *Schoenoplectus robustus*
Mary Walker Bayou	May-08	6	30°23'48"N	88°37'49"W	*Vallisneria americana*, *Zannichellia palustris*	*Juncus roemerianus*, *Schoenoplectus tabernaemontani*, *Schoenoplectus robustus*
Mary Walker Bayou	Mar-10	7	30°23'54"N	88°38'22"W	*Vallisneria americana*	*Juncus roemerianus*
Mary Walker Bayou	May-10	8	30°24'1"N	88°38'36"W	*Vallisneria americana*, *Najas guadalupensis*	*Juncus roemerianus*, *Sagittaria lancifolia*
Mary Walker Bayou	May-10	9	30°24'0"N	88°38'32"W	*Vallisneria americana*, *Najas guadalupensis*	*Juncus roemerianus*, *Sagittaria lancifolia*
Mary Walker Bayou	May-10	10	30°24'12"N	88°38'56"W	*Vallisneria americana*, *Najas guadalupensis*, *Nitella* sp.	*Sagittaria lancifolia*, *Juncus roemerianus*, *Cladium jamaicense*
Mary Walker Bayou	Mar-10	11	30°24'23"N	88°39'5"W	*Vallisneria americana*	*Cladium jamaicense*
Mary Walker Bayou	May-10	12	30°24'30"N	88°39'11"W	*Najas guadalupensis*	*Sagittaria lancifolia*, *Baccharis halimifolia*, *Ilex* sp., *Pontederia cordata*, *Acer rubrum*, *Juncus roemerianus*
Sioux Bayou	Mar-10	13	30°24'28"N	88°37'22"W	*Vallisneria americana*, *Ruppia maritima*	*Schoenoplectus tabernaemontani*, *Spartina cynosuroides*, *Sagittaria lancifolia*, *Cladium jamaicense*,

						Juncus roemerianus
Sioux Bayou	May-10	14	30°24'30"N	88°37'23"W	*Vallisneria americana, Najas guadalupensis, Potamogeton pusillus, Zannichellia palustris, Nitella* sp.	*Schoenoplectus tabernaemontani, Spartina cynosuroides, Sagittaria lancifolia, Cladium jamaicense, Juncus roemerianus*
Sioux Bayou	Mar-10	15	30°24'45"N	88°38'1"W	*Vallisneria americana*	*Schoenoplectus tabernaemontani, Spartina cynosuroides, Sagittaria lancifolia, Cladium jamaicense, Juncus roemerianus*
Sioux Bayou	May-10	16	30°24'49"N	88°38'5"W	*Vallisneria americana, Zannichellia palustris*	*Juncus roemerianus, Sagittaria lancifolia, Anthemis* sp.
Sioux Bayou	Mar-10	17	30°25'2"N	88°38'33"W	*Vallisneria americana*	*Juncus roemerianus, Sagittaria lancifolia*
Sioux Bayou	May-10	18	30°25'7"N	88°38'41"W	*Najas guadalupensis, Zizania aquatica*	*Juncus effusus, Sagittaria lancifolia, Juncus roemerianus, Cladium jamaicense, Distichlis spicata*
Bluff Creek	May-10	19	30°27'25"N	88°37'5"W	*Potamogeton pusillus, Utricularia* sp.	*Phragmites australis, Schoenoplectus robustus, Sagittaria lancifolia*
Bluff Creek	May-08	20	30°27'35"N	88°37'2"W	*Nuphar lutea, Utricularia* sp., *Eichhornica crassipes, Alternanthera philoxeroides*	*Zizania aquatica, Taxodium distichum*
Bluff Creek	May-08	21	30°28'45"N	88°38'46"W	*Vallisneria americana, Nitella* sp., *Utricularia* sp., *Myriophyllum aquaticum, Eleocharis parvula*	*Taxodium distichum*
Bluff Creek	Mar-10	22	30°29'8"N	88°37'58"W	*Callitriche heterophylla*	*Juncus roemerianus, Spartina cynosuroides*
Bluff Creek	May-10	23	30°29'7"N	88°37'58"W	*Vallisneria americana*	*Campsis radicans, Sagittaria lancifolia, Peltandra virginica, Smilax* sp., *Osmunda regalis, Palmetto* sp., *Cladium jamaicense*
Catch-Um All Bayou	May-10	24	30°28'50"N	88°37'18"W	*Potamogeton pusillus, Nitella* sp., *Najas guadalupensis, Myriophyllum aquaticum*	*Cladium jamaicense*
John's Bayou	May-10	25	30°29'20"N	88°38'3"W	*Nitella* sp., *Najas guadalupensis, Ceratophyllum demersum, Potamogeton pusillus, Zannichellia palustris, Vallisneria americana,*	*Sagittaria lancifolia, Smilax* sp. *Cladium jamaicense, Juncus roemerianus*

					Utricularia sp.	
John's Bayou	Mar-10	26	30°29'22"N	88°38'3"W	*Vallisneria americana*, *Callitriche heterophylla*	*Cladium jamaicense*, *Spartina patens*, *Juncus roemerianus*
John's Bayou	Mar-10	27	30°29'22"N	88°38'2"W	*Vallisneria americana*, *Callitriche heterophylla*	*Cladium jamaicense*
John's Bayou	Mar-10	28	30°29'36"N	88°38'21"W	*Vallisneria americana*, *Callitriche heterophylla*	*Cladium jamaicense*, *Juncus roemerianus*
John's Bayou	May-10	29	30°29'36"N	88°38'21"W	*Vallisneria americana*	*Juncus romerianus*, *Cladium jamaicense*, *Sagittaria lancifolia*, *Hibiscous* sp., *Smilax* sp., *Peltandra virginica*
John's Bayou	May-10	30	30°29'58"N	88°38'33"W	*Eleocharis baldwinii*	*Juncus polycephalus*, *Zizania aquatica*

Table 2. The survey locations, survey periods, and aquatic plants found during study period (May 2008 – May 2010) in the Back Bay of Biloxi area, Mississippi.

BACK BAY of BILOXI AREA						
Location	**Survey Period**	**Site ID**	**Latitude**	**Longitude**	**Plants Found Growing in and on Water**	**Dominant Shore Vegetation**
Old Fort Bayou	Mar-10	31	30°25'1"N	88°50'0"W	*Vallisneria americana*, *Ruppia maritima*	*Juncus roemerianus* *Spartina alterniflora*
Old Fort Bayou	May-10	32	30°25'10"N	88°47'34"W	*Ruppia maritima*, *Zannichellia palustris*, *Vallisneria americana*	*Juncus roemerianus* *Spartina alterniflora* *Spartina patens* *Distichlis spicata*
Old Fort Bayou	May-10	33	30°25'29"N	88°46'10"W	*Zannichellia palustris*, *Chara* sp.	*Juncus roemerianus* *Cladium jamaicense* *Spartina patens*
Old Fort Bayou	Mar-10	34	30°25'29"N	88°46'3"W	*Zannichellia palustris*	*Juncus roemerianus* *Spartina cynosuroides*
Old Fort Bayou	Mar-10	35	30°25'29"N	88°46'2"W	*Zannichellia palustris*	*Juncus roemerianus* *Spartina cynosuroides*
Old Fort Bayou	May-10	36	30°26'8"N	88°44'36"W	*Vallisneria americana*, *Eleocharis parvula*	*Baccharis halimifolia* *Juncus roemerianus* *Pinus* sp.
Bayou Talla	May-10	37	30°25'30"N	88°47'59"W	*Najas guadalupensis*, *Zannichellia palustris*, *Chara* sp.	*Spartina patens*, *Juncus roemerianus*, *Pinus* sp.
Bayou Talla	May-10	38	30°25'37"N	88°48'2"W	*Zannichellia palustris*	*Juncus roemerianus*
Tchoutacabouffa River	Apr-10	39	30°26'21"N	88°58'45"W	*Zannichellia palustris*	*Juncus roemerianus*
Tchoutacabouffa River	Apr-10	40	30°26'1"N	88°58'58"W	*Zannichellia palustris*	*Juncus roemerianus*
Cedar Lake	May-	44	30°26'21"	88°58'45"	*Zannichellia*	*Sapium sebiferum*,

	10		N	W	*palustris, Chara* sp., *Potamogeton pusillus*	*Sagittaria lancifolia, Juncus roemerianus, Smilax* sp.
Cedar Lake	Apr-10	41	30°27'22" N	88°56'40" W	*Vallisneria americana*	*Juncus roemerianus*
Cedar Lake	May-10	42	30°27'27" N	88°56'37" W	*Vallisneria americana, Eleocharis parvula*	*Juncus roemerianus, Peltandra virginica, Sagittaria lancifolia*
Cedar Lake	May-10	43	30°27'40" N	88°56'35" W	*Zannichellia palustris, Najas guadalupensis, Chara* sp., *Potamogeton pusillus, Vallisneria americana*	*Sagittaria lancifolia, Juncus roemerianus, Crinum thaianum*
Biloxi River	Apr-10	44	30°26'51" N	89° 0'38"W	*Zannichellia palustris, Najas guadalupensis, Vallisneria americana*	*Juncus roemerianus, Eleocharis* sp.
Biloxi River	May-10	45	30°26'51" N	89° 0'38"W	*Najas guadalupensis, Vallisneria americana, Eleocharis parvula*	*Sagittaria lancifolia, Juncus roemerianus, Silver Magnolia, Myrica cerifera, Acer rubrum, Peltandra virginica, Cladium jamaicense*
Biloxi River	Apr-10	46	30°26'56" N	89° 0'36"W	*Vallisneria americana, Zannichellia palustris*	*Eleocharis* sp.
Biloxi River	May-10	47	30°26'56" N	89° 0'36"W	*Vallisneria americana*	*Sagittaria lancifolia, Eleocharis sp. Pontenderia cordata, Juncus roemerianus,* surrounded by trees

Table 3. The survey locations, survey periods, and aquatic plants found during study period (May 2008 – May 2010) in Pearl River, Mississippi.

PEARL RIVER						
Location	**Survey Period**	**Site ID**	**Latitude**	**Longitude**	**Plants Found Growing in and on Water**	**Dominant Shore Vegetation**
Pearl River	Mar-10	48	30°16'11'N	89°38'0"W	*Zizania aquatica*	*Zizania aquatica, surrounded by woody bushes and trees*
Pearl River	May-10	49	30°15'52"N	89°37'24"W	*Potamogeton pusillus, Najas*	*Schoenoplectus tabernaemontani, Juncus effusus*

					guadalupensis, Zanichellia palustris Ceratophyllum demersum, Nuphar lutea, Zizania aquatica	
Pearl River	Mar-10	50	30°15'52"N	89°37'24"W	*Zizania aquatica*	*Sable minor*
Pearl River	May-08	51	30°14'17"N	89°36'47"W	*Vallisneria americana, Ceratophyllum demersum, Najas guadalupensis, Lemna minor, Nuphar lutea*	
Pearl River	Mar-10	52	30°14'17"N	89°36'46"W	*Najas guadalupensis, Potamogeton pusillus*	*Phragmites australis, Baccharis halimifolia, Cladium jamaicense*
Pearl River	May-10	53	30°14'16"N	89°36'49"W	*Zizania aquatica, Potamogeton pusillus Ceratophyllum demersum*	*Sagittaria lancifolia, Schoenoplectus tabernaemontani, Sapium sebiferum*
Pearl River	May-10	54	30°13'48"N	89°36'53"W	*Eleocharis parvula Zanichellia aquatica, Potamogeton pusillus*	*Sagittaria lancifolia, Schoenoplectus tabernaemontani*
Pearl River	Mar-10	55	30°13'39"N	89°36'56"W	*Zannichellia palustris, Vallisneria americana, Nitella sp.*	*Eleocharis parvula, Phragmites australis*
Pearl River	May-08	56	30°13'7"N	89°36'34"W	*Nitella sp.*	
Pearl River	May-10	57	30°13'0"N	89°36'6"W	*Vallisneria americana*	*Spartina cynosuroides, Schoenoplectus tabernaemontani, Spartina alterniflora*
Pearl River	May-08	58	30°12'54"N	89°35'54"W	*Vallisneria americana, Potamogeton pusillus, Najas guadalupensis*	*Spartina cynosuroides, Schoenoplectus tabernaemontani, Spartina alterniflora*
Pearl River	Mar-10	59	30°12'39"N	89°35'38"W	*Vallisneria americana*	*Phragmites australis, Spartina alterniflora*
Pearl River	May-08	60	30°12'31"N	89°35'27"W	*Najas gualdalupensis, Vallisneria americana, Zannichellia palustris,*	*Phragmites australis, Spartina alterniflora*

					Nitella sp.	
Pearl River	May-08	61	30°11'20"N	89°34'51"W	*Vallisneria americana*	
Pearl River	May-08	62	30°11'14"N	89°34'41"W	*Ruppia maritima*	
Pearl River	May-08	63	30°11'43"N	89°31'58"W	*Ceratophyllum demersum*	
Pearl River	May-10	64	30°11'3"N	89°34'21"W	*Ceratophyllum demersum*	*Schoenoplectus tabernaemontani, Spartina alterniflora*
Poitevants Ditch	Mar-10	65	30°14'38"N	89°36'58"W	*Zannichellia palustris*	*Panicum virgatum Phragmites australis*
Poitevants Ditch	May-10	66	30°14'36"N	89°37'1"W	*Eleocharis parvula, Najas guadalupensis, Potamogeton pusillus, Vallisneria americana, Chara sp.*	*Sagittaria lancifolia, Juncus roemerianus*
Little Lake	May-10	67	30°11'4"N	89°35'0"W	*Ruppia maritima, Potamogeton pusillus, Zannichellia palustris*	*Phragmites australis, Juncus roemerianus, Spartina alterniflora*
Cross Bayou	May-10	68	30°12'16"N	89°34'34"W	*Zannichellia palustris, Vallisneria americana*	*Schoenoplectus tabernaemontani, Juncus roemerianus, Spartina alterniflora*
Mulato Bayou	May-08	69	30°12'15"N	89°34'31"W	*Myriophyllum spicatum, Ceratophyllum demersum, Zannichellia palustris, Najas guadalupensis*	*Phragmites australis, Spartina cynosuroides*

DISCUSSION

The plant communities within the coastal river systems encompass tidal saltwater marshes, tidal oligohaline marshes, tidal freshwater marshes, and freshwater swamps (Wieland 1994). SAV habitat in the saltwater marsh areas near the Gulf such as Biloxi Bay and the lower regions of Pearl River are mainly vegetated by *R. maritima* that tolerates a wide range of salinities (Kantrud 1991); the *Ruppia* beds often occur along *Spartina alterniflora* Loisel (Smooth Cordgrass) shores. However, these areas experience significant temporal fluctuations in presence and abundance of SAV since *R. maritima* growth and abundance is substantially influenced by the amount/timing of precipitation, winter/early spring temperatures, wind direction, and storms during a period precedent to the growing season.

The next most salt tolerant freshwater species that can live in brackish waters (mean salinity < 4 ppt) are *V. americana* and *M. spicatum*. In brackish areas along *Juncus roemerianus* Scheele (Black Needlerush), *Spartina cynosuroides* (L.) Roth (Big

Cordgrass), and *Schoenoplectus tabernaemontani* Gmelin (Softstem bulrush) marsh shores, *V. americana* often grows along with *R. maritima*. The size of *V. americana* in the rivers varies greatly with blade lengths ranging from 3 cm to longer than 1.2 m. *Myriophyllum spicatum*, known to be invasive in other Gulf states, did not appear to overgrow or be invasive in the Mississippi river systems.

Freshwater species that are easily confused with *R. maritima* such as *N. guadalupensis*, *P. pusillus*, and *Z. palustris* often grow together densely. We have observed that SAV tends to be abundant and diverse in brackish portions (mean salinities of 0.5 -3 ppt) of the coastal Mississippi river systems where the emergent vegetation in this salinity regime is characterized as brackish and intermediate marsh types (Eleuterius 1973). Relative abundance between *Ruppia*/*Vallisneria* and *Najas*/*Potamogeton*/*Zannichellia* in the same locations changes with season and also depends on the amount of freshwater inputs (i.e. rainfall). The freshwater species that tolerate mild brackish conditions occur primarily along the shores dominated by *Sagittaria lancifolia* L (Bulltongue Arrowhead), *Cladium jamaicense* Crantz (Sawgrass), *Schoenoplectus* spp. (Bulrushes) and *J. roemerianus*. While the dominant high marsh vegetation was *J. roemerianus* and *S. cynosuroides* in Pascagoula River and Back Bay of Biloxi, *Phragmites australis* (Cav.) Trin. *ex* Steud (Common Reed) was predominant in many areas in Pearl River.

Callitriche heterophylla occurred with *Vallisneria* in upstream areas where salinity is strictly fresh; *C. heterophylla* grew abundantly and formed thick surface canopies in cooler water during March, but disappeared by May as the water temperature increased. *Eleocharis baldwinii* was found in a highly colored, acidic, upstream black water system surrounded by trees.

CONCLUSIONS

This study compared benthic communities of three Mississippi Gulf Coast bayous Casotte, Cumbest and Heron, located within Grand Bay NERR where residential, industrial, and recreational activities occur. Annelids were the dominant phylum consisting of 68% of the total abundance. On Average, the highest value of total invertebrate density was found in Bayou Cumbest (168.73m^{-2}). For the entire study, the diversity of taxa as indicated by the Simpson Index varied between 1.00 and 2.1 bits. There was no significant difference in diversity between Bayou Heron (1.79 bits) and Bayou Cumbest (1.77 bits). Multiple regression analysis indicated that many water quality parameters could not be used in this study to explain the variations in the density and diversity of the macrobenthic communities. In order to better understand why macro benthic invertebrate counts differ among Bayous, Casotte, Heron, and Cumbest, physicochemical parameters alone cannot be used as they did little to distinguish one site from the other. A more exhaustive approach must be taken. A sediment analysis must be performed to determine the type and abundance of heavy metals, pollutants contaminants, and perhaps other xenobiotic substances that may have entered the Grand Bay NERR ecosystem. Regarding the density and diversity of macro benthic invertebrates, relative biomass measurements will need to accompany the samples.

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MIND OVER MATTER: ACADEMIC SUCCESS FOR ASSOCIATE DEGREE NURSING PROGRAMS

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ABSTRACT

Prediction of variables for academic success in associate degree nursing programs has intrigued nurse educators for decades. Compounding this issue is the urgency for producing more than one million registered nurses by the year 2010. The identification of these variables would enable nursing admission committees to formulate relevant admission criteria, identify and develop programs for failing students, as well as implement advisory and academic support programs to increase the probability of passing the National Council Licensure Examination-Registered Nurse (NCLEX-RN). This study examined both academic and non-academic variables. Study variables included American College Testing (ACT) composite scores, ACT sub-math scores, ACT sub-English scores, ACT sub-reading scores, NCLEX-RN successful passage scores NCLEX-RN of students' age, race, gender, nursing school prior failures, Grade point average (GPA) and NUR 2119, as well as NUR 2123 test scores. Although many of these variables have been explored in past studies the majority of the studies only examined baccalaureate of science nursing (BSN) populations. Currently, there is a lack of studies of associate degree nursing program (ADN) populations. The purpose of this study was to examine previous study variables identified in the literature and determine if these variables have relevance or predictability of success or failure among ADN students NCLEX-RN pass rates. Data were obtained from a convenience sample of 35 graduates from an urban public community college ADN program. Results from the study indicated that ACT composite and sub scores had significant relationships on NCLEX-RN passage rates ($p<0.05$).

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INTRODUCTION

By 2010, more than one million new and replacement nurses will be needed. Therefore identifying predictors of nursing program success is essential to produce the extraordinary numbers of nurses needed for future healthcare needs. As nursing educators increasingly focus on retention of nursing students, they need to identify variables that would predict successful completion of ADN programs. Following graduation from an accredited community college ADN program, students must pass the (NCLEX) to practice as registered nurses. The faculty was interested in identifying variables that could predict successful completion of an ADN program, as well as success on the certifying NCLEX examination. Although predicting failure is an unpleasant thought for faculty, this information would be valuable because such information would allow faculty to identify students at risk, and most importantly, develop a program for early intervention?

The U.S. Department of Labor has identified nursing as the fastest growing occupation in terms of growth through 2012. Over one million new and replacement nurses will be needed to fill the healthcare needs of our nation over the next several years. Although community colleges are designing new and innovative means of delivering nursing education, retention of nursing students remains at the forefront of academic concerns. Some nursing faculties contend that lowering admission standards create undue hardships on students and faculty. The admission standards are sometimes waived to ensure that the limited number of openings in nursing programs would be equally available to all students, thus averting discrimination complaints. College officials have been reluctant to expand nursing programs because such classes are more expensive to operate than other academic courses.

Retention of students, in schools of nursing, is a problem that persists in most institutions of higher learning and is pervasive in both the associate degree and baccalaureate degree format. Because attrition is costly to an institution, educators need to be aware of factors that can predict the academic performance potential of students admitted into a program of study so that the greatest number of students can be retained. Since the nursing shortage affects not only healthcare institutions, and the very safety and well-being of the population at large, schools of nursing administration need to understand the importance of admitting students who can successfully complete the course of study, pass the NCLEX-RN for licensure, and enter the work force in a timely manner. This can only be accomplished when nursing educators recognize the factors that lend to successful completion of programs of study. Conversely, a high rate of attrition among nursing students does not evaluate nor consider the students' personality traits and compatibility with the rigors of the nursing program.

Individual tests such as ACT and nurse entrance test (NET) are administered in high school and community colleges for evaluation to enter both baccalaureate and associate degree nursing programs. There is controversy regarding the bias and accuracy of the ACT test scores. According to the literature [1], a student who retakes the ACT would have about a two-thirds chance the score would be 1.55 points higher or lower on the English test than on a previous administration of the test. Thus if a student retakes the ACT more than two to three times in order to enhance their chances of scoring high enough to meet minimum requirements; there is a one-third chance the score difference would be even larger. The margins of error, while appearing to be small at 1.43 - 2.20, can actually have significant consequences for applicants when admissions offices or financial aid programs require minimum (or "cut-off") scores. Theoretically if a potential student took the ACT numerous times the chances for enhancement based on coaching and statistical odds would increase incrementally with each testing. For a student retaking the ACT to meet minimal entrance requirements of 18 or higher is this score reflective of the student's ability to be successful in a nursing program?

Historically, the model for admission to an associate degree-nursing program has not evolved with the technological informational base demanded by today's healthcare responsibilities. With the advent of highly sophisticated computerized charting systems and increasing patient acuity levels perhaps associate degree nursing programs are admitting students that do not have the building blocks needed to be successful in today's healthcare system. Attrition or retention is also driven by administrative and faculty concerns for student success however administration and faculty may not be aware the students are missing the building blocks needed to be successful in today's nursing program. Typically, baccalaureate-nursing programs required multiple pre-requisites before admission to a nursing program. The baccalaureate program also requires students to maintain course hour loads ranging from 17-21 hours each semester. In contrast, associate degree nursing programs may only require eight hours of anatomy and physiology based science courses before admission to their programs. Interestingly associate degree nursing graduates write the same NCLEX as baccalaureate nursing graduates Many ADN students complained of the rigor of the academic requirements while enrolled in the nursing program. The question is why BSN students manage 17 or more hours in a baccalaureate program; whereas, associate degree nursing students struggle with 12 credit hours. Perhaps the model for associate degree nursing programs has not evolved with the requirements of the highly technological and acuteness needs of today's healthcare clients'. In addition, the core required courses for a student to graduate with a bachelor's degree in nursing are saturated with an emphasis on literature, English, science, and humanities courses. Whereas the associate degree of nursing is limited by seventy-two hours of course work to complete the program of study. Perhaps the four-year university-based nursing programs pre-requisites and graduation requirements establish the building blocks necessary for a student to be successful in the school of nursing.

PURPOSE OF STUDY

The purpose of this study was to evaluate the relationship of admissions criteria and the retention of students to determine which variables have a positive or negative influence on successful completion of the Associate Degree Nursing program and passage of NCLEX-RN. In addition, ACT composite and sub scores may establish relevance and predictability for successful completion of an associate degree-nursing program. We hypothesis, a student's ACT composite and ACT sub-scores will have a positive correlation on passage of the required nursing courses and the NCLEX-RN exam.

REVIEW OF LITERATURE

In an age where there is a push to admit more students to fill a void of nurses, and more applicants are applying for a limited number of positions, it is vital that applicants are evaluated; whereby, the applicants with the most potential for success are admitted into the nursing programs. An extensive review of the literature was undertaken to demonstrate documented variables that are known to influence attrition and retention in associate degree schools of nursing. While many investigators have correlated the relationships of varying factors to success on the NCLEX-RN, few have set out to determine the factors that lend to successful completion of the associate degree-nursing programs of study. Because the literature is meager on the subject, the literature review was expanded to include predictors of success in comparable programs of study such as baccalaureate nursing, dental hygiene, physical therapy, and medical school.

Many variables affect the degree of success encountered by students in completing any educational program and in remaining in that career [2]. Several studies [3-9] indicated the importance of early identification of student characteristics that could be used in predicting success in nursing programs. Identification of these characteristics can assist faculty in nursing programs to admit students who will be successful in their nursing programs and passage of NCLEX-RN examinations. Although most nursing programs admission policies are driven by composite and sub-ACT scores, GPA, and Nurse Entrance Tests as well as other variables such as age, gender, employment (i.e., full or part-time) and social support or lack thereof may directly influence a student's ability to be successful in a nursing program. According to Polizzi and Ethington [10] study measured responses of 2,000 students from four groups of vocational programs. The researchers found there were differences in amount of effort exerted by the student to be successful in the program compared to the perception of career preparation. Polizzi & Ethington study found that students who were older and mostly female spent more time studying, exerted greater effort, and perceived the greatest gains in career preparation.

The variables that were documented throughout the literature vary greatly, depending especially upon whether the investigator was looking for cognitive or non-cognitive variables. DeAngelis [11], concluded that the addition of non-cognitive, or psychosocial variables, increased the predictive capacity of the cognitive measures including both didactic and clinical grades for those entering into schools of medicine. Houltram [12] demonstrated that age plays a significant role in future academic success, noting that students age 22 and older performed significantly better than younger students (ages 17-21). However, these ages were not correlated to other entry-level qualifications but did allude that prior academic success was a variable for future success. One of the early leaders in the study of academic success in nursing was Grant, [13] who concluded, as early as 1986, that the best predictor of future success is past success.

Utilizing Grant's findings, Fowles [14] further investigated independent cognitive variables including the ACT score, GPA, prerequisite course grades, science grades, and the Mosby Assessment Test and determined the best predictors of final college GPA were (a) nursing prerequisite GPA, (b) percentile on the Mosby Test, (c) anatomy and physiology grades, and (d) ACT social science or composite score.

In planning for entry level qualifications, Potolsky, Cohen and Saylor [15] suggested that prerequisite science course performance is a reliable predictor of academic success and to reduce attrition and increase overall performance of first semester nursing students, programs may consider setting a required GPA on science courses to a B as well as denying admission to students who have failed and repeated a science course.

Tests are used today for the selection of people for different professions. In Mississippi, associate degree nursing programs use a variety of entrance examinations to assess the student's suitability for admission. For example, some community colleges administer the NET or Health Education Systems, Inc. (HESI). More than a million high school students take the ACT (formerly known as the American College Testing Program Assessment) each year. Like the SAT, the ACT is a standardized multiple-choice test meant to predict first-year college grades. While the SAT predominates on the East and West Coasts, the ACT is more common in the Midwest, Southwest, and Deep South. Administration of these tests is based on a number of assumptions. Assumptions such as student's test scores will indicate their suitability for the intended program or profession or applicants with higher test scores are suitable for more important and sensitive positions. Because applicants participate in tests and the choice of program is voluntary, the assumption is that the successful applicants will be highly motivated and will be successful in the nursing program. Furthermore, reports from various community colleges indicated that this is not always the case. Although several studies [16-22] identified college GPA and ACT scores may be a predictor for general studies success but not for academic success in nursing programs.

A review of admission procedures for nursing students in different schools showed that admission and retention issues are not unique to any one program. In certain European countries, only a high school diploma is required for admission into nursing schools [23]. Whereas, Ehrenfeld and associates as well as the National League for Nursing (NLN) argued that admission to nursing schools is based on tests similar to other programs, such as aptitude tests or teacher made achievement tests [24, 25]. Identifying valid variables to predict success of nursing students on the NCLEX-RN has captivated the interest of nursing educators for decades. The determination of such variables would enable nursing programs to devise pertinent admission criteria, identify and intervene with students at risk of failing, and provide needed advisement and academic supports to increase the likelihood of passing the NCLEX-RN. This study examined academic variables and non-academic variables. Study variables included the following: (a) GPA preadmission scores, (b) age, (c) NET test scores, (d) ACT composite score, (e) ACT sub scores, and (f) race. Multiple variables have been explored in past studies to predict success on the NCLEX-RN. However, the majority of studies examined these variables only in BSN student populations. Conversely, there are no studies to validate one important variable, the human spirit. While most studies attempt to quantify predictors of success such as ACT scores, GPA, NET exams, HESI exit exams and pre-requisite course grades one cannot quantify the human spirit.

MATERIALS AND METHOD

This study was conducted in a community college ADN nursing program in urban Mississippi. A convenience sample of 35 students was used no exclusion criteria; so, all of the freshmen nursing students entering fall 2006 and graduating May 2008 were considered as potential candidates. The academic variables used in the study were ACT composite scores including math, English, and reading sub scores. Non-academic variables such as gender, generic, or previous healthcare experience were compared for statistical significance related to successful passage of NCLEX. SPSS and SigmaStat software was used for statistical analysis and charts were constructed using SlideWrite software.

RESULTS AND DISCUSSION

Successful passage of NCLEX-RN included four (n=4) males and 31 (n=31) females (97%). At the conclusion of the study, one (n=1) student had not taken the NCLEX-RN and one (n=1) student was unsuccessful on the first NCLEX-RN attempt (2.7%). Sixteen percent (n=6) of the graduates were licensed practical nurses (LPNs), which could skew the results. Thus for the validity of the study these students were expected to pass boards on first attempt because of prior experience in the healthcare field. Thus, of the five LPNs (n=5) who attempted NCLEX 100% has passed NCLEX-RN. One LPN (n=1) had not signed up to take the NCLEX-RN. The sum total of students taking the NCLEX-RN was n = 34 or 97% pass on first attempt. There was no significant difference between gender and successful passage of NCLEX-RN and ACT composite scores ($p<0.049$). The mean ACT composite scores were 21.4 +/- SD 3.2 for all the 2008 graduates, which is important to note. However, there was no statistical significance between ACT composite scores and passage of NCLEX-RN. These results validate previous studies which ACT composite scores may not be an accurate assessment of NCLEX-RN success. There was however a statistical difference (**Table 1**) between ACT sciences sub-scores (**Figure 1**) and passage of NCLEX-RN ($p=0.036$). At the conclusion of the study, 34 students had taken the NCLEX-RN with 100% pass rate although one student was unsuccessful on the first attempt (2.7%) but passed NCLEX-RN on their second attempt. Variables such as ACT composite; sub-scores, NCLEX, and non-academic variables such as gender were compared for statistical significance (**Table 2**). There was a statistical significance between ACT math and ACT composite scores ($p<0.05$), ACT reading versus ACT composite scores ($p<0.05$), ACT science scores and ACT composite scores ($p<0.05$) and ACT English sub-scores versus ACT composite ($p<0.05$).

Table 1: Analysis of Academic Variables

Comparison of academic variables revealed a statistically significant difference for all variables ($p < 0.05$) except ACT reading and math sub-scores ($p > 0.05$). There was a statistically significant difference between the HESI Exit Exam and successful NCLEX passage ($p < 0.05$), ACT math sub scores, science sub scores, ACT composite and English subscores ($p < 0.05$).

TABLE 1: ACADEMIC VARIABLES			
Comparison	**Diff of Ranks**	**Q**	**P<0.05**
HESI vs NCLEX	217.608	12.457	Yes
HESI vs Math	139.865	8.006	Yes
HESI vs Science	113.297	6.485	Yes (p=0.036)
HESI vs Comp	104.676	5.992	Yes
HESI vs English	103.095	5.901	Yes
HESI vs Read	95.459	5.464	Yes
NCLEX vs Read	122.149	7.041	Yes
NCLEX vs Eng	114.514	6.600	Yes
Read vs Math	122.149	7.041	No

Table 2: Comparison of Academic and non-academic variables

A strong positive relationship was observed between pairs I, II, III, and IV. Whereas there was a negative correlation between pair V: ACT Composite and NCLEX-RN. ACT Science composite scores versus ACT composite revealed a positive correlation ($p < 0.0001$). **Correlation is significant at the 0.01 levels. To isolate the groups that were different a Kruskal-Wallis One Way Analysis was analyzed to compare NCLEX passage, HESI Exit Exam scores, ACT scores, respectively math, science, English, reading and composite scores.

TABLE 2: SAMPLE PAIRS	**N**	*CORRELATION*	*SIGNIFICANCE*
Pair I: ACT Math & ACT Comp	35	0.699	**0.000****
Pair II: ACT Read & ACT Comp	35	0.800	**0.000****
Pair III: ACT Sci & ACT Comp	35	0.544	**0.001****
Pair IV: ACT Eng & ACT Comp	35	0.858	**0.000****
Pair V: ACT Comp & NCLEX-RN	35	-0.189	0.279
Pair VI: ACT Comp & LPN/Generic	35	0.182	0.296
Pair VII: NCLEX & Gender	35	0.098	0.569
Pair VIII: ACT Comp & Gender	35	-0.285	0.098

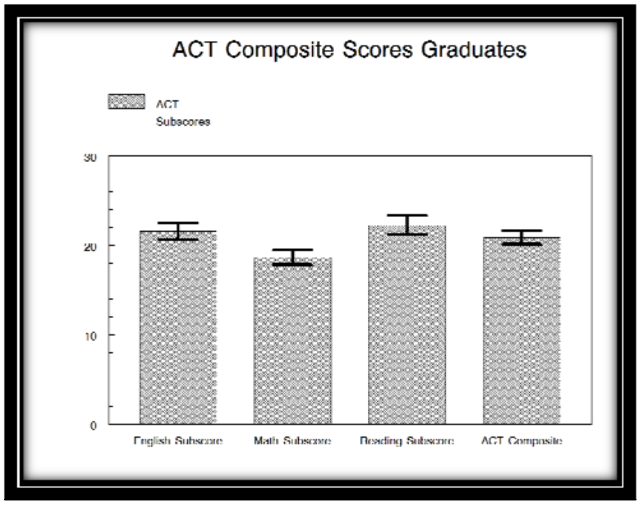

Figure 1: ACT Composite Scores 2008 Graduates
Descriptive statistics displaying ACT composite and math, English, Science and reading sub-scores for 2008 graduates. ACT sub-scores 21, 18, 22, and 20 English, Math, Reading, and ACT composite, respectively. There was a statistical difference between ACT science and NCLEX-RN pass rate.

CONCLUSIONS

Many factors including demographic variables, college grade point average (GPA), and ACT scores may affect academic success in associate degree nursing programs. The literature suggested that the art of study plays a key role in achieving academic success. Numerous studies validated ACT composite scores as predictors whereas conversely other studies identified no statistical significance between higher ACT scores and passage of NCLEX-RN. In this study ACT composite as well as ACT sub-scores were strong indicators of NCLEX-RN passage. In addition, non-academic variables such as gender were not a predictor of success for NCLEX-RN pass rates on first attempt. Therefore, hypothetically ACT composite and ACT sub-scores such as science, English, reading and math may be predictors of success in a nursing program provided the mean ACT scores are greater than 21. Fifty eight students were admitted to the fall 2004 class however only thirty five students (60 %) completed the program. It is interesting to note that the ACT of the students (40%) that were unsuccessful was less than 20. Many factors contributed to the lack of success for the students including illness, finances, work related issues and role strain. In addition, one variable that has not been quantified is the human spirit. Because the human spirit cannot be measure quantifiably predictors or numerical data remain just numbers. However, this study has brought numerous issues to the forefront including the significance of ACT composite, ACT sub-scores, and the spirit of the human heart. Although nurse educators continuously strive for the magic formula to retain students and remain aware that retention of students is not just a combination of academic grades, clinical skills, and the students' perception these variables are of value for students to obtain a nursing degree and passage of NCLEX-RN. In conclusion, this study begins to identify predictors relevant to students' success in an associate degree-nursing program. These predictors can be utilized to enhance and increase the general success rates of the associate degree-nursing student. However, one cannot measure the human spirit and the determination to be successful. Continuing research is needed to explore factors effecting student success in associate degree nursing programs.

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