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Swamp Rabbit (*Sylvilagus aquaticus*) Demographics, Morphometrics, and Reproductive Characteristics in Mississippi

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ABSTRACT

Wildlife agencies have been concerned about possible swamp rabbit (*Sylvilagus aquaticus*) declines, however swamp rabbits have tended to be one of the least studied members of *Sylvilagus*. During the 1997–98, 1998–99, and 1999–2000 harvest seasons, we characterized sex and age ratios, reproductive status, body mass, and hind foot length of harvested swamp rabbits on Trim Cane Wildlife Management Area, Mississippi, to better understand their demographics and morphometrics. Swamp rabbit sex ratios did not differ among years ($\chi^2_2 = 0.01$, $\underline{P} = 0.907$). Age ratios for swamp rabbits did differ marginally among years ($\chi^2_2 = 3.01$, $\underline{P} = 0.083$). Swamp rabbits exhibited pregnancy in January (6%) with greater evidence of pregnancy (46%) in February. We did not detect a difference in body mass ($F_{1,111} = 0.74$, $\underline{P} = 0.391$) or hindfoot length ($F_{1,111} = 0.89$, $\underline{P} = 0.349$) between the sexes for swamp rabbits. Although we did detect a marginal difference in hindfoot length ($F_{1,111} = 3.38$, $\underline{P} = 0.069$) between ages, we did detect a difference in body mass ($F_{1,144} = 107.51$, $\underline{P} < 0.001$). Swamp rabbit populations appeared to be sensitive to late season harvest, as measured by timing of conception, pregnancy, and changes in age ratio. States with swamp rabbits and rabbit harvest seasons that end in late winter should consider investigating effects of harvest season length on swamp rabbit population dynamics.

INTRODUCTION

Wildlife agencies have been concerned about possible swamp rabbit (*Sylvilagus aquaticus*) declines, however swamp rabbits have tended to be one of the least studied members of *Sylvilagus* (Martinson et al., 1961; Chapman and Feldhamer, 1981; Palmer et al., 1991; Dailey et al., 1993). Over the past several decades, swamp rabbit habitat has deteriorated leading to declines in many areas within their geographic range (Martinson et al., 1961; Terrel, 1972; Chapman and Feldhamer, 1981; Chapman et al., 1982; Palmer et al., 1991; Dailey et al., 1993). Swamp rabbits begin breeding in mid–February (Hill, 1967) until August, except for Texas (suggested year–round; Hunt, 1959) and Louisiana (observed pregnancies in all months except October; Svihla, 1929). Juvenile swamp rabbits are capable of breeding the year of their birth, but there are few reports of juveniles actually breeding (Chapman and Feldhamer, 1981). Therefore, there is

potential of harvesting swamp rabbits during their breeding season.

Considering the ecological importance of swamp rabbits and their status as a game animal in Mississippi, along with the general belief in their decline, it is of upmost importance to understand their population dynamics. Terrel (1972) commented that wildlife agencies were not able to collect pertinent data from trapping because of cost and labor consumed related to amount of data collected. Data with the least bias is from hunter bag checks (Chapman et al., 1982). Petrides (1951) reported the importance of sex and age ratios in providing valuable indications of population characteristics. Therefore, we collected swamp rabbit age and sex ratio, reproductive status, body mass, and hind foot lengths from mandatory hunter bag checks and examined them among years to better understand population demographics and morphometrics.

METHODS AND MATERIALS

Trim Cane Wildlife Management Area (TCWMA) is located approximately 10 kilometers north of Starkville in Oktibbeha County, Mississippi. Trim Cane Wildlife Management Area consists of 320 hectares that was converted from hardwood bottomland forest to agricultural fields during the early 1970s and was farmed until 1986 (Taylor, 1996); then, the area succeeded naturally into oldfield and hedgerow habitats.

We examined swamp rabbit population demographics and morphometrics on TCWMA during the 1997–98, 1998–99, and 1999–2000 harvest seasons. Prior to the 1997–98 harvest season, swamp rabbits were not harvested for >8 years. There were 3, 2–day weekend hunts in November and 2, 2–day weekend hunts in October, December,

January, and February during each season. Two hunting parties were drawn for each weekend hunt. Each party consisting of ≤3 hunters was limited to a harvest of 6 swamp rabbits/day because of TCWMA's small size. During most hunts a biologist, technician, or graduate student observed the hunt to process rabbits and determine hours hunted. We recorded sex, body mass (g), and hind foot length (mm) for each harvested rabbit. Additionally, we noted if a male's testes were regressed or descended, and if females were anestrous or pregnant. We collected reproductive tracts from females and placed them in 10% formalin to determine fetus counts. We collected eye lenses from all rabbits to determine age. We soaked eyes in 10% formalin for two weeks, then extracted lenses and oven dried them at 80°C for 7 days, and weighed them to the nearest 0.0001 grams (Martinson et al., 1961). We used Hill's (1967) eye lens weights to distinguish adult and juvenile swamp rabbits. We predicted age based on morphometrics using logistic regression models developed by Bond et al. (2000) for swamp rabbits with damaged eyes due to harvest (n = 24, 20%). Bond et al. (2000) were able to accurately (81%) predict age of swamp rabbits using body mass and hind foot length together in logistic regression equations.

We investigated changes in population structure by comparing age and sex ratios among years. Since rabbits were not harvested for >8 years prior to implementation of experimental harvest, we assumed temporal changes in population age and sex ratios were attributed to harvest effects. We tested for population structure differences among years using a Mantel–Haenszel chi–square. We tested for body mass and hindfoot length differences between ages and sexes using a two–way analysis of variance, blocked by

year. All analyses were performed in SAS® with an alpha level of 0.10.

RESULTS AND DISCUSSION

Hunters harvested 123 rabbits during 244 hours of hunting. Rabbit harvest rate (harvest/hr) typically increased from October to February. Over 3 years, swamp rabbit harvest rate ranged from 0.31–0.92. Most rabbits were harvested in December (n = 37), January (n = 32) and February (n = 36), whereas fewer rabbits were harvested in October (n = 3) and November (n = 15). The harvest trend we observed most likely was from the fact that earlier in the season it is warmer and scenting conditions are worse for dogs to trail rabbits, while late in the season as temperatures drop scenting conditions become better for dogs to locate and trail rabbits. Also, earlier in the harvest season there is more vegetation for concealment which makes harvesting harder, while late in the harvest season escape cover and vegetation is less dense all making harvest of rabbits easier.

Swamp rabbit sex ratios did not differ among years (χ^2_2 = 0.01, P = 0.907; 1997–98 = 42% females, 1998–99 = 52%, and 1999–2000 = 44%). Previous research on swamp rabbits documented 44% (Mississippi; Palmer et al., 1991) to 57% female (Texas; Hunt, 1959) swamp rabbits in the harvest, which was similar to our results. Swamp rabbit age ratios varied by year (χ^2_2 = 3.01, P = 0.083; 1997–98 = 56% juveniles, 1998–99 = 75%, and 1999–2000 = 32%). Ranges of 32% (Texas; Hunt, 1959) to 61% (Missouri; Martinson et al., 1961) juvenile swamp rabbits in the harvest were previously reported, therefore our yearly estimates were similar to or greater than previously reported range. Swamp rabbits exhibited little evidence of breeding activity prior to February (pregnant: October–December = 0% and January = 6%;

testes descended: October = 0%, November = 11%, December = 28%, and January = 13%) with greater reproductive activity during February (pregnant = 46% and testes descended = 50%). Previously in Mississippi, Palmer et al. (1991) reported that 38% of swamp rabbits were pregnant in February but made no report of January breeding activity. Although swamp rabbits have been documented to breed year–round in Texas (Hunt, 1959), we did not observe any swamp rabbits pregnant in October–December. Currently, to our knowledge no one has researched the latitudinal effects on swamp rabbit breeding. However, the differences observed between our part of Mississippi and Hunt's (1959) part of Texas could be from differences in latitude that has previously been observed in cottontail rabbits (*Sylvilagus floridanus*) by Barkalow (1962). The observed mean litter size of 1.8 (n = 10, SE = 0.25, range 1–3) for pregnant swamp rabbits was the least reported compared to the previously reported range of 2.0 (Mississippi; Palmer et al., 1991) to 3.7 (Louisiana; Svihla, 1929).

We did not detect a difference in body mass (male: 1935 grams, SE = 42.8; female: 1828 grams, SE = 40.7; $F_{1,111}$ = 0.74, P = 0.391) between sexes swamp rabbits. Mean body masses observed for adult male (2214 grams) and female ($\bar{x}$ = 2117 grams) swamp rabbits were comparable to others in Mississippi (males $\bar{x}$ = 2236 grams, females $\bar{x}$ = 2229 grams; Palmer et al., 1991), Indiana (males $\bar{x}$ = 2254 grams, females $\bar{x}$ = 2217 grams; Terrel, 1972), and Missouri (males $\bar{x}$ = 2235 grams, females $\bar{x}$ = 2161 grams; Holten and Toll, 1960), but were larger than those observed in Louisiana (males $\bar{x}$ = 2013 grams, females $\bar{x}$ = 2076 grams; Mullin, 1982; all adults combined 1698 grams; Lowery, 1974),

and Alabama (males = 2059 grams, females = 2035 grams; Hill, 1967; Table 1). We detected a difference in body mass between ages (adult: 2179 grams, SE = 19.9; juvenile: 1689 grams, SE = 30.9; $F_{1,144}$ = 107.51, $\underline{P}$ <0.001). Our mean body mass observed for juvenile male (1682 grams) and female (1695 grams) swamp rabbits were smaller than those observed previously in Mississippi (males $\bar{x}$ = 2051 grams, females $\bar{x}$ = 1981 grams; Palmer et al., 1991) and Missouri (males $\bar{x}$ = 2022 grams, females $\bar{x}$ = 1954 grams; Holten and Toll, 1960), but comparable to juveniles in Indiana (1776 grams; Terrel, 1972; Table 1). We did not detect a difference in hindfoot length (male: 104 millimeters, SE = 0.7; female: 102 millimeters, SE = 0.7; $F_{1,111}$ = 0.89, $\underline{P}$ = 0.349) between sexes swamp rabbits. We detected a marginal difference in hindfoot length (adult: 104 millimeters, SE = 0.6; juvenile: 102 millimeters, SE = 0.7; $F_{1,111}$ = 3.38, $\underline{P}$ = 0.069) between ages. We observed mean hind foot lengths of 105 millimeters (adult males), 103 millimeters (adult females), 103 millimeters (juvenile males), and 102 millimeters (juvenile females) for swamp rabbits, which were slightly larger than the overall mean of 101 millimeters (90–113 millimeters) reported by Lowery (1974) in Louisiana and slightly smaller than reported by Nelson (1909) 106 millimeters (Table 1).

Table 1. Body mass (BM – grams) and hind foot length (HFL – millimeters) measurements and associated sample sizes (n) from swamp rabbits (*Sylvilagus aquaticus*).

- = Genders combined

Location	Measurement	Adult Female	Adult Male	Juvenile Female	Juvenile Male
Mississippi (our study)	BM	2117 (n=17)	2214 (n=30)	1695 (n=37)	1682 (n=33)
Mississippi (Palmer et al. 1991)	BM	2229 (n=11)	2236 (n=19)	1981 (n=16)	2051 (n=20)
Alabama (Hill 1967)	BM	2035 (n=180)	2059 (n=144)		
Louisiana (Mullin 1982)	BM	2076 (n=17)	2013 (n=15)		
Louisiana (Lowery 1974)	BM	1698* (n=7)			
Missouri (Holton and Toll 1960)	BM	2161 (n=35)	2235 (n=44)	1954 (n=49)	2022 (n=63)
Indiana (Terrel 1972)	BM	2217 (n=6)	2254 (n=7)	1776* (n=7)	
Mississippi (our study)	HFL	103 (n=17)	105 (n=30)	102 (n=37)	103 (n=33)
Louisiana (Lowery 1974)	HFL	101* (n=7)			
Geographic range-wide (Nelson 1909)	HFL	106* (n=10)			

CONCLUSIONS

In conclusion, most states (85%) with swamp rabbit harvest occurs during a portion of their breeding season, particularly February.

We observed approximately 50% of all swamp rabbits reproductively active during February. We also observed that after the first year of harvest, proportion of juvenile swamp rabbits increased then correspondingly decreased after the second year of harvest below the initial harvest regime levels. We postulate that continued hunting pressure

during the late–season through 2 years led to the decrease in the proportion of juveniles during 1999–2000 below that of the 1997–98 level. Martinson et al. (1961) and Palmer et al. (1991) suggested that swamp rabbit populations may be susceptible to over–harvest. Considering our reduced bag limit, our results are conservative. We recommend states with swamp rabbits more aggressively investigate effects of harvest on population dynamics because of the decline in swamp rabbit habitat, the considerable amount of harvest during February among states, and the lack of published data on harvest effects on swamp rabbit population status.

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Notes on Food Habits of Swamp Rabbits (*Sylvilagus aquaticus*) in the Atchafalaya Basin, Louisiana

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ABSTRACT

Plants cut by wild swamp rabbits (*Sylvilagus aquaticus*) were noted in the Atchafalaya Basin, Louisiana during summer 1994 and winter 1995. Food preferences were apparent. Woody vegetation was frequently used during both summer and winter, but more so during winter.

INTRODUCTION AND STUDY AREA

Plants cut by wild swamp rabbits (*Sylvilagus aquaticus*) were noted as part of a study aimed to assess swamp rabbit habitat in the Atchafalaya Basin, Louisiana after Hurricane Andrew struck in August 1992 (Helm 1995). Food habits of swamp rabbits vary regionally and have been studied in Louisiana on captive rabbits fed selected plants (Richardson 1963; Sullivan 1966), free ranging rabbits using food plots (Croft 1961), and penned rabbits using natural habitat modified by timber thinning (Garner 1969).

The study area occurs at elevations less than 3.0 m msl (U.S.D.I. Geol. Surv. 1953a and 1953b) within a very gentle ridge-swale complex in a swamp environment. The study area was characterized by varying degrees of hurricane damage (designated as low, moderate, and high), two forest types [bottomland hardwood ridges and slightly lower baldcypress (*Taxodium distichum*)-tupelogum (*Nyssa aquatica*) swales], and two tree sizes (pulpwood and sawtimber) (see Helm 1995; Salyer 1995) and located south of Interstate 10 between the Atchafalaya and Mississippi Rivers in Iberville Parish, Louisiana. Thirty-three study plots were located approximately 10 km south of Ramah in sections 59 and 61 (T8S-R10E) on property used by the Red Diamond Hunting Club. Fifteen plots were located approximately 10 km west of Plaquemine and about 15 km east of the above-mentioned plots in section 9 (T9S-R11E) on property used by the Shell Road Hunting Club.

Common trees on ridges included boxelder (*Acer negundo*), red maple (*Acer rubrum*), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and American elm (*Ulmus americana*). Baldcypress and tupelogum were dominant in swales. Understory vegetation was diverse and frequencies of all recorded understory plants are appended in Helm (1995). Small elevation differences greatly impact durations of flooding within the study area. Swales generally support at least some standing water most of the year while ridges typically support standing water only after heavy rainfall.

METHODS

Plots were established during summer 1993. Four subplots were randomly located within each of 48, 0.1 ha plots and subplots were divided into 1 m^2 quadrats, resulting in 768

quadrats. Equal numbers of plots were established in each combination of hurricane damage, forest type, and tree size. Presence of all understory plant taxa and the number and taxa of stems cut by swamp rabbits, as indicated by a smooth 45° angle cut (Garner 1969), were recorded in each quadrat during August 1994 and January 1995. Timber harvesting on 8 of the 0.1 ha plots resulted in 640 quadrats sampled during January 1995. Understory vegetation was defined as plants occurring to a maximum height of 1 m. Plants were required to be rooted in a quadrat to be considered present.

Eastern cottontails (*Sylvilagus floridanus*) were observed on the open grounds around the Red Diamond Hunting Club lodge but never on the study plots, while swamp rabbits were observed on the study plots. Discussions with hunters substantiated these observations. The eastern cottontail is typically found in fairly open country, pastures, and grassy areas and is replaced by the swamp rabbit in swamps and marshes (Lowery 1974). All observed smooth 45° angle cuts were considered to be from swamp rabbits.

RESULTS AND DISCUSSION

Woody and herbaceous vegetation cut by swamp rabbits within quadrats was noted during summer 1994 (Table 1) and winter 1995 (Table 2). Most cuttings were within 20 cm of the ground and none were higher than 45 cm.

Woody plants comprised 49.1% of all identified swamp rabbit cuttings during summer 1994 and 85.4% during winter 1995. Cuttings on stems with diameters to 0.6 cm at the cut were observed. Woody vegetation has previously been identified as an important constituent of the swamp rabbit diet only in northern parts of the rabbit's range including Missouri (Toll et al. 1960), Oklahoma (Smith 1940), Indiana (Terrel 1972), and Tennessee

(Calhoun 1941). No other studies on food habits of swamp rabbits have been conducted in the Atchafalaya Basin but Garner (1969) investigated swamp rabbit food habits in a similar bottomland hardwood forest subject to periodic inundation in LaSalle Parish, Louisiana, approximately 120 km north of the study area. Although woody plants were common in the understory, no woody plants were observed to be cut by swamp rabbits during summer 1968 and only sparse use of woody plants (13.3% of total) was noted during winter 1969.

Understory cover was related to hurricane damage (summer 1994), forest type (summer 1993, summer 1994, and winter 1995), and combinations of forest type and tree size (summer 1993, summer 1994, and winter 1995) and is discussed in Helm (1995) and Helm and Chabreck (2004). Number of cuttings by swamp rabbits, however, was not related to understory cover but was greater on ridges than in swales during winter 1995 (see Helm 1995), likely because of drier conditions on ridges.

Savannah panicgrass (*Phanopyrum gymnocarpon*) during summer and greenbrier (*Smilax* spp.) during summer and winter appear to be preferred foods, given the relatively large number of cuttings on these plants and their low frequencies of occurrence. Dewberry (*Rubus* spp.) was abundant and commonly used in summer and winter. While woody understory plants were common in Garner's LaSalle Parish study, greenbrier and dewberry were not; perhaps summer use of woody plants in Louisiana swamps occurs when specific favored plants are present. Palatable herbaceous forage may be limited during winter in the Atchafalaya Basin as indicated by a marked decrease in use from summer to winter. A less dramatic shift to woody plant use from summer to winter occurred in the LaSalle Parish study. Food

availability has generally not been considered a limiting factor for swamp rabbit populations but Sims (1956) indicated that herbaceous forage may be scarce in Louisiana during winter. A total of 46 plant taxa during summer 1994 and 54 plant taxa during winter 1995 in the Atchafalaya Basin showed no evidence of cutting by swamp rabbits.

Table 1. Plant abundance (frequency per m²) and number of cuttings by swamp rabbits, Atchafalaya Basin, Louisiana, summer 1994.

Taxon[1]	Habit	Frequency	Number Cuttings
Dewberry (*Rubus* spp.)	Woody	43.1	24
Savannah panicgrass			
(*Phanopyrum gymnocarpon*)	Herbaceous	5.6	20
Greenbrier (*Smilax* spp.)	Woody	4.4	14
False nettle (*Boehmeria cylindrica*)	Herbaceous	43.6	8
Smartweed (*Polygonum* spp.)	Herbaceous	17.1	5
Sugarberry (*Celtis laevigata*)	Woody	18.4	5
Green ash (*Fraxinus pennsylvanica*)	Woody	13.0	4
Thistle (*Cirsium* spp.)	Herbaceous	4.2	3
Thoroughwort (*Eupatorium semiserratum*)	Herbaceous	8.9	3
Waterwillow (*Justicia ovata*)	Herbaceous	19.3	3
Japanese honeysuckle (*Lonicera japonica*)	Herbaceous	6.5	2
Sedge (Cyperaceae)	Herbaceous	21.0	2
Peppervine (*Ampelopsis arborea*)	Herbaceous	27.5	2
Heart-leaf peppervine (*Ampelopsis cordata*)	Herbaceous	0.5	1
Deciduous holly (*Ilex decidua*)	Woody	1.3	1
Trumpet creeper (*Campsis radicans*)	Herbaceous	1.6	1
Seedbox (*Ludwigia* spp.)	Herbaceous	1.7	1
Swamp privit (*Forestiera acuminata*)	Woody	1.8	1
Elephant's-foot (*Elephantopus tomentosus*)	Herbaceous	2.6	1
Creeping cucumber (*Melothria pendula*)	Herbaceous	3.9	1
Swamp dogwood (*Cornus drummondii*)	Woody	6.0	1
Elm (Ulmaceae)	Woody	8.1	1
Virginia knotweed (*Polygonum virginianum*)	Herbaceous	11.7	1
Poison ivy (*Toxicodendron radicans*)	Woody	49.2	1
Unknown	NA	NA	11

[1]Scientific names in accord with Kartesz (1994).

Table 2. Plant abundance (frequency per m^2) and number of cuttings by swamp rabbits, Atchafalaya Basin, Louisiana, winter 1995.

Taxon[1]	Habit	Frequency	Number Cuttings
Dewberry (*Rubus* spp.)	Woody	44.8	28
Greenbrier (*Smilax* spp.)	Woody	5.6	27
Woody stems (unidentified)	Woody	49.1	25
Savannah panicgrass (*Phanopyrum gymnocarpon*)	Herbaceous	4.1	4
Butterweed (*Senecio glabellus*)	Herbaceous	35.8	3
Willow oak (*Quercus phellos*)	Woody	0.8	2
Japanese honeysuckle (*Lonicera japonica*)	Herbaceous	4.2	2
Violet (*Viola* spp.)	Herbaceous	21.1	2
Red-berried moonseed (*Cocculus carolinus*)	Herbaceous	1.3	1
Thistle (*Cirsium* spp.)	Herbaceous	5.0	1
Water willow (*Justicia ovata*)	Herbaceous	6.6	1

[1]Scientific names in accord with Kartesz (1994).

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Evaluation of Two Methods to Infect Soybean with *Macrophomina phaseolina* (Deuteromycota) under Controlled Environmental Conditions.

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ABSTRACT

To investigate plant resistance mechanisms or control techniques, a method for consistent infection of soybean by *Macrophomina phaseolina* must be used. The objective of this research was to evaluate the effectiveness of two methods to inoculate soybeans with *M. phaseolina* under controlled environmental conditions. A single isolate of *M. phaseolina* was introduced into soybean stems by puncturing a hanging drop from a prepared sclerotial suspension or by adding a cornmeal/sand culture mixture into potting soil prior to planting soybean in a greenhouse. Infection was determined visually by the presence of charcoal rot lesions on root tissue and by laboratory culture of root sections. Results showed that there was no difference in the incidence of *M. phaseolina* in soybean for either inoculation method used in this study. The cornmeal/sand method and the hanging drop method resulted in 58% and 45%, respectively. Application of a lime, peat, or starch based seed coating did not significantly (P=0.05) change the infection rate compared to no seed coating. Either method could be used for *M. phaseolina* infection of soybean under controlled environmental conditions. However, the ease of using the cornmeal/sand method compared to the hanging drop method makes it a preferable technique for soybean pathology research.

INTRODUCTION

Macrophomina phaseolina (Tassi) Goid. is a soilborne pathogen that causes charcoal rot of soybean. Soybean yield and seed quality are reduced when disease symptoms are severe. Host seeds are suspected of carrying *M. phaseolina* within the seed coat as ectophytic and/or endophytic sclerotia and hyphae. These serve as effective propagules for dissemination of the pathogen (Nyvall, 1999). Sclerotia remain viable for less than 8 weeks if exposed to continuously wet soils. Fungal growth and disease symptoms increase rapidly when ambient temperatures are between 28° and 35° C (Gray, 1989; Bowers and Russin, 1999). *M. phaseolina* can infect 100% of seedlings emerging in infested soil within 2-3 weeks following planting [Wyllie (1976) in Bowers and Russin (1999)]. Infection rate increases with higher soil temperatures and low soil moisture. Also, acidic (pH 4.3) and alkaline soils (pH 8.0) generally cause increased sclerotial production.

In the soil, sclerotia of *M. phaseolina* germinate on host plant root surfaces and produce multiple germ tubes (Gray, 1989). Root penetration usually occurs when appressoria form over anticlinal walls of epidermal cells, however, penetration can also occur through natural openings. Fungal

hyphae will initially grow intercellularly and subsequently grow intracellularly through the xylem of the plant. Disease symptoms are more evident in drought-stressed plants due to disruption of already limited water and nutrient movement within the host plant. Most root damage, which later contributes to yield reduction, occurs early in the growing season. However, disease symptoms are not evident until the beginning of flowering when sclerotia begin to appear. Infected soybean plants will senesce prematurely; foliage will appear chlorotic and pods fail to fill completely (Bowers and Russin, 1999). To investigate plant resistance mechanisms or control techniques, a method for consistent infection of soybean by *M. phaseolina* must be used. The objective of this research was to evaluate the effectiveness of two methods to infect soybeans with *M. phaseolina* under greenhouse growing conditions.

MATERIALS AND METHODS

A single isolate of *M. phaseolina* (obtained from R. Baird, Dept. Entomology and Plant Pathology, Mississippi State University, Mississippi State, MS) was used in all experiments. The isolate was from cotton (*Gossypium hirsutum* L.) grown in Lee County, MS in 1999 and was cultured on potato dextrose agar (PDA) at 22° C ($\pm$ 2° C) under ambient conditions of 12 hour day^{-1}. PDA was comprised of 39 g of agar liter^{-1} of distilled water plus 0.25 ml Danitol $^®$. In addition, stock solutions of 0.50 ml of chlortetracycline, and 2.5 ml of streptomycin were added to agar to prevent bacterial growth. Research was conducted at the Foil Plant Science Research Center (FPSRC) greenhouse complex located at Mississippi State University to determine a consistent method to introduce *M. phaseolina* into host soybean plants. The commercial soybean cultivar, Hutcheson, was selected for use throughout the experiment. This variety was

chosen because it is a late maturing variety (maturity group V) adapted to environmental growth conditions occurring across the east coast and the southern United States. A peatmoss seed coating (PSC), lime seed coating (LSC), and starch seed coating (SSC) were prepared on the day of planting to evaluate their effects on infection of soybean seedlings by *M. phaseolina*. For clarity, seed coatings will refer to material applied to the seed, and seed treatment will refer to actual treatments with or without a seed coating. Peatmoss (Premier Horticulture Inc., Red Hill, PA) (pH 4.0) was passed through a 1 mm^2 gap wire mesh sieve and then coated onto inoculated seed via rotation in an Erlenmeyer flask. The same procedure was used to coat the seeds with pulverized dolomitic limestone (pH 8.5) (Southdown Inc., Easton, PA). The starch seed coating was made by adding 20 g of cornstarch (pH 5.3) to 300 ml distilled water, heating to a boil, and thoroughly cooling. This material was then coated onto the seed following application of the fungal suspension. Potting soil (Pioneer Southern, Lancaster, NY) (pH 7.0) was placed into 11 L plastic pots, and soybean seeds were planted into each pot at a depth of 2.5 cm. Each treatment consisted of 20 pots containing three plants each. Each pot was an experimental unit within the seed treatments. At 30 days post-emergence, *M. phaseolina* was introduced directly into seedlings. Using a modified technique described by Hanson (2000), a droplet from a suspension containing three sclerotia ml^{-1} was applied to the seedling stem at 2 cm below the first cotyledonary node with a 26-gauge needle. The needle was punctured through the inoculum droplet and into the stele of the seedling. Each seedling was inoculated a second time on the opposite side of the stem, similar to the first inoculation. Controls were inoculated twice with sterile water. For the remaining experimental units, *M. phaseolina* was

infested into the soil at 30 days post-emergence using a modified technique described by Baird et al. (1996). *M. phaseolina* was cultured in sterilized cornmeal/sand mixtures (CMS) in 1L Erlenmeyer flasks for 14 days at 22° C. Flasks were rotated each day for 5 min to establish uniform growth of *M. phaseolina.* Fifty ml of infested CMS were then mixed into the upper 4 cm of soil in each experimental unit. Experimental units included as controls were not infested.

At 90 days post-emergence, all plants were excised from pots and visual disease severity (VDS) represented as charcoal rot lesions on root tissue was determined using a modified disease index as described by Chakraborty and Purkayastha (1983). After disease symptoms were rated, five plants were randomly chosen from each inoculation method and seed treatment. Two 1 cm root tissue pieces from the upper portion of the tap root were excised and surface sterilized in 0.5 % NaOCl for 2-3 min, and plated on water agar (WA) containing chlorotetracycline and streptomycin. Plates were incubated at 22° C and examined every 2 days for 2 weeks or until signs of fungal growth were visible. Fungal isolates were taken from each active root tissue culture and transferred to PDA containing antibiotics and miticide and were allowed to grow for 7 days. *M. phaseolina* isolates from root tissue were identified using characteristics described by Rifai (1969) and Watanabe (1994).

The experimental design was completely randomized with 20 replications in a two-way factorial arrangement of treatments. The procedure general linear model (PROC GLM;

SAS, 1994, SAS Institute, Inc., Cary, NC) was used to account for uneven data sets, and means were separated by Fisher's protected least significant difference (LSD).

RESULTS

There was no difference in the incidence of *M. phaseolina* in soybean for either inoculation method used in this study (Table 1). *M. phaseolina* was present for all seed treatments in which the soil was infested with cornmeal sand inoculum or when the hanging drop infestation method was used (Table 2). Within the cornmeal sand inoculation method, plants from all seed treatments, except the control, had isolation ratings for *M. phaseolina* that were not significantly different from the MP treatment (Table 2). The LSC and PSC isolation ratings for *M. phaseolina* from root tissue were not different from the untreated control. Within the hanging drop method, plants from all seed treatments had isolation ratings for *M. phaseolina* that were not significantly different from the MP treatment, except the untreated control. The LSC isolation ratings were not different from the untreated control.

Plants from the MP seed treatment had the greatest VDS ratings for both inoculation methods. VDS ratings for MP seed treatment were not different from the LSC treatment in the cornmeal/sand method (Table 3). Both PSC and SSC seed treatments resulted in lower VDS ratings regardless of the method used to introduce inoculum. VDS ratings were lowest for the untreated control in both introduction methods.

Table 1. Mean isolation rating (MIR) for the presence of *Macrophomina phaseolina* in soybean root tissue taken 90 days post-emergence from seedlings planted in a greenhouse and inoculated by two different methods.

	Mean Isolation Rating [*]	
	Cornmeal sand method	Hanging drop method
M. phaseolina	0.58 a [†]	0.45 a

[*] 1 = present in culture; 0 = not present in culture
[†] Means followed by the same letter are not significantly different according to Fisher's LSD (P = 0.05) test.

Table 2. Mean isolation rating (MIR) for the presence of *Macrophomina phaseolina* in soybean root tissue taken 90 days post-emergence from soil containing cornmeal/sand inoculum or from seedlings inoculated with a hanging drop of sclerotial suspension.

Seed Treatment	Mean Isolation Rating [*]	
	Cornmeal sand method	Hanging drop method
MP	0.78 a [†]	0.50 a
LSC	0.40 ab	0.29 ab
PSC	0.45 ab	0.72 a
SSC	0.75 a	0.60 a
C	0.13 b	0.00 b

[*] 1 = present in culture; 0 = not present in culture
[†] Means followed by the same letter within a column are not significantly different according to Fisher's LSD test (P = 0.05).
MP = *M. phaseolina* only, no seed coating; LSC = lime seed coating; PSC = peat seed coating; SSC = starch seed coating; and, C = untreated control.

Table 3. Visual disease severity (VDS) ratings for charcoal rot in soybean root tissue taken 90 days post-emergence after growing in soil containing cornmeal/sand inoculum of *M. phaseolina* or from seedlings inoculated with a hanging drop of sclerotial suspension.

Seed treatment	VDS Rating as Percent Infection	
	Cornmeal sand method	Hanging drop method
MP	87 a [†]	96 a
LSC	91 a	55 b
PSC	44 c	56 b
SSC	65 b	45 b
C	3 d	0 c

[†] Means followed by the same letter within a column are not significantly different according to Fisher's LSD test (P = 0.05)
MP = *M. phaseolina* only, no seed coating; LSC = lime seed coating; PSC = peat seed coating; SSC = starch seed coating; and, C = untreated control.

DISCUSSION

Willey (1976) reported a potential for 100% infection of soybean seedlings by *M. phaseolina* within 2-3 weeks following planting. Although this percentage was not reproduced in this study, an infection level of 78% was achieved for plants growing in a potting mixture infested with cornmeal/sand inoculum. The fluctuation of the soil environment in the greenhouse and pot conditions may have impacted the level of *M. phaseolina* infestation in our study, as earlier implicated by Willey (1976).

Inoculum prepared in cornmeal/sand did not result in greater isolation ratings for *M. phaseolina* from root tissue compared to isolations from plants inoculated by the hanging drop method. These results were similar to a previous study conducted by Hsi (1961) in which sorghum seeds were planted into soil naturally infested with *M. phaseolina*. In a previous study (Young, 1943), seedlings were artificially inoculated with the pathogen at 2 weeks after pollination using an infested toothpick. The artificial inoculation method from such study did not result in disease that was significantly different from disease developing in plants grown in naturally-infested soil.

The application of selected seed coatings reduced infection of soybean seedlings by *M. phaseolina* using either inoculation method. However, the reductions were not statistically different in this study. Disease development was also reduced for all seed treatment applications except one treatment. The numerical reduction in isolations of the fungus, therefore, has as yet unexplained implications in subsequent disease development. Seed coatings such as PSC and SSC should be avoided when conducting experimentation on *M. phaseolina* infection of soybean under greenhouse culture. Results of the current study argue for the use of untreated seed in such studies to maximize infection and disease development.

Although VDS provided a quick estimate of disease, it appeared to over estimate infection level but was consistent with the presence or absence of *M. phaseolina*. Under conditions of this study, the pathogenicity of the fungus could depend on factors independent of infection level.

CONCLUSIONS

The soilborne pathogen, *M. phaseolina*, is the causal organism of charcoal rot of soybean. This fungus causes external and internal damage to the host and often reduces soybean yield and seed quality. Infection by *M. phaseolina* did not differ whether inoculum was prepared in cornmeal/sand or introduced directly into the soybean seedling. Based on these results, future research which utilizes the cornmeal/sand method will benefit from the simplicity of inoculum preparation and the lack of damage to soybean seedlings during the infection process. The cornmeal sand method specifically eliminates puncture wounds to soybean seedlings which are a necessary element of the hanging drop method of inoculation. Use of VDS to quantify levels of *M. phaseolina* infection was not consistent with true isolation ratings but did provide a distinct evaluation of the level of disease development on soybean caused by this organism.

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Motivation and Learning Strategies of Students in Distance Education

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A quantitative and qualitative study on the motivation and learning strategies of students in distance education was conducted during the spring 2001 and summer 2002 semesters within the course BSC 305, Evolution. The quantitative study was conducted using the Motivated Strategies for Learning Questionnaire (MSLQ) for measuring motivational and learning strategies. Data on motivation were collected at the beginning of the semester and data on the learning strategies were collected at the end of the semester. Scores from each subheading were correlated with the final grades. The following subscales may predict achievement in online courses: elaboration, organization, critical thinking, and effort management. Curiously, organization was found to be a negative predictor. For the qualitative study three sets of email questions were distributed at the beginning, in the middle, and at the end of the semester. Additionally, a telephone interview was conducted at the end of the semester. Students involved in the qualitative section were asked to take the MSLQ at the beginning and end of the semester along with the remainder of the class. Qualitative findings indicate that students need to organize their data. Findings also suggest that students require interaction from other students and people outside the class to feel successful.

Key words: *learning strategies, motivation, distance education, online learning*

INTRODUCTION

"Distance education is the process of instruction and learning via virtual classrooms where teachers and students are separated in space and sometimes in time" (Sankaran & Bui, 2001, p. 191). Sankaran and Bui claim that more universities are incorporating distance learning into their curriculum. In our rapidly changing world, distance education is playing an evermore important role. According to Miltiadou and Yu (2000), distance education is a dynamic and enriching form of learning. It offers an educational opportunity to those that may not be able to attend a traditional university. This type of instruction depends on "the Internet and computer-mediated communication systems for the delivery of instruction and interaction between students and instructors" (p. 4).

According to Vermunt (1996) "instruction does not lead to learning automatically" (p. 25). The outcome of students' achievement in the course depends on the learning strategies they use. Vermunt defines learning activities as, "thinking activities that people employ to learn, learning strategies as particular, often used combinations of learning activities' (p. 25). Olgren, (1998) points out that if we want students to learn, then we should have knowledge about how they learn. Improving

the quality of learning should begin with this question, "What and how are people learning and what affects that process" (Morrison, 1989, as cited in Olgren, 1998, p. 77).

Filcher and Miller (2000) explain that learning strategies are vital to lifelong learning. Our society is going through a technological revolution and the workforce must adapt to the new technology and information in order to remain productive. People who have learned how to learn will continue to learn throughout their lifetime. According to Olgren (1998), "Distance education provides an avenue by which individuals can access this new information and continue to learn for the rest of their lives" (p. 61). Additionally, Olgren states that capable learners have the ability to design and carry out their own learning strategies.

Theoretical Basis. This research is based on a social-cognitive view of motivation and learning strategies. The student is an active processor whose beliefs and cognitions control instructional input and task characteristics. By emphasizing that students are in control of their learning, the Motivated Strategies for Learning Questionnaire (MSLQ) addresses advances in self-regulated learning (Garcia & Pintrich, 1995). McKeachie, Pintrich, Smith, and Sharma (1990) describe self-regulated learning as "a combination of cognitive and metacognitve involvement with a task, as well as motivational involvement with a task" (p. 4). Students are described as self-regulated learners to the level they are actively involved in their own learning process (Zimmerman, 1986). Zimmerman (1989) explains that these students will initiate and direct their own learning rather than having teachers do this. These students know when they are accomplishing their goals and when they are not. If they are not mastering the task, they find a way to succeed.

Pintrich (1995) explains that there are three components of self-regulated learning. The first component is the ability to control one's behavior, motivation and affect, and cognition. When students monitor their own behavior, cognition and motivation, they can then regulate these in order to achieve their goal. The second component is establishing a goal. Students must set a goal to accomplish which is the standard by which students monitor their progress. The third component is the individual student. If students change their behavior based on what someone else has suggested, this is not considered self-regulated learning. If a student is to monitor and change their behavior, they must be intrinsically motivated.

Zimmerman (1989) asserts that in order for students to be self-regulated learners, they must use specified strategies to achieve their goals. "Self-regulated learning strategies are actions and processes directed at acquiring information or skills that involve agency, purpose, and instrumentality perceptions by learners" (p. 329). Learning strategies should improve students' self-regulation of their "(a) personal functioning, (b) academic behavioral performance, and (c) learning environment" (p. 337).

Hypotheses. The following hypotheses were tested using multiple linear regression:

1.   The motivational subscales which include intrinsic goal orientation, task value, and self-efficacy for learning and performance are positive predictors for success in a distance learning class.

2. The learning strategies subscales which include elaboration learning strategies, organization strategies, critical thinking strategies, and metacognitive self-regulation are positive predictors for success in a distance learning class.
3. The resource management subscales which include time and study management strategies, effort regulation strategies, and help-seeking strategies are positive predictors of success in a distance learning class.

Research Questions. The following research questions were answered using case study analysis:
1. What are the learning strategies that students in distance learning use when preparing for quizzes, discussions, and examinations?
2. What changes do students make in their learning strategies over the course of a semester?
3. Do the students perceive these changes in learning strategies as beneficial?

MATERIALS AND METHODS

Course Description. The biology course BSC 305, Evolution, was taught completely online by the authors of this article through University of Southern Mississippi using WebCT course management software during a typical, 15-week semester. This course had three major components for assessing student learning: quizzes, mandatory discussions, and examinations. The structure of the course required that students read a chapter and then take a five-question, multiple-choice quiz. Each quiz was open-book, but the students had only six minutes to answer the five questions which forced them to read carefully in preparation for the quiz. Responses made after six minutes were not accepted. Studying for the quiz prepared students for the asynchronous discussion of the chapter. We posted three discussion topics per chapter. The students were required to render five meaningful responses to these three topics which meant they had to respond not only to the posted topics, but to each other's comments. Early posting was important to the success of the asynchronous discussion, so we awarded one bonus point for each response made on the first day the topics were posted. Essay examinations were closely related to the discussion topic questions as each examination contained approximately six previously posted discussion topic questions drawn evenly from the chapters that had been covered during the examination period. Students were required to respond in more detail than had been required with the discussion topics.

Both the raw score and a letter grade to date were posted through WebCT throughout the semester to allow the students to keep up with their grades. The final letter grade was calculated as a percent of total points available using a ten-percentage point scale (i.e., 90% = A, 80% = B, etc.).

Quantitative Analysis

Survey Instrument. The Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1991) was used to gather quantitative data on the learning strategies and motivation of each student. The MSLQ "is a self-report instrument designed to assess college students' motivational orientations and their use of different learning strategies for a college course" (Pintrich et al., 1991; p. 3). It contains a total of 81 items divided into two sections, motivation and learning strategies.

The motivation section (31 items) is based on a broad social-cognitive model (Garcia and Pintrich, 1995; Pintrich and Smith, 1993). This section contains three general motivational constructs: (1) expectancy, (2) value, and (3) affect. (1) The subscales of self-efficacy and of control of learning beliefs measure the expectancy construct. (2) The value construct contains three subscales: intrinsic goal orientation, extrinsic goal orientation, and task value beliefs. (3) The third construct is affect which has one subscale, test anxiety.

Students were asked to complete all subscales, but only the subscales of intrinsic goal orientation, task value, and self-efficacy were used for our data analysis. This part of the MSLQ was administered at the beginning of the semester.

The learning strategy section (50 items) is based on Weinstein and Meyer's (1986) general cognitive model of learning and information processing (Garcia and Pintrich, 1995; Pintrich and Smith, 1993). This section is divided among three general types of scale: (1) cognitive, (2) metacognitive, and (3) resource management. (1) Cognitive strategies include both basic and complex strategies. Basic strategies are measured in a rehearsal subscale. Two subscales measure complex strategies of elaboration and organization. The elaboration strategies subscale includes strategies such as paraphrasing and summarizing. The second subscale, organization, measures complex learning strategies such as outlining and creating tables. A critical thinking subscale is also included in the cognitive scale. (2) Metacognition is measured by one subscale which is concerned with the learners' ability to control and regulate their own cognition. (3) The resource management scale contains four subscales which measure the learners' ability to control their own environment and includes strategies students use to control resources other than cognition including time management and study environment management, as well as the learner's interaction with peers and instructors.

Students were asked to complete all subscales, but we used only seven learning strategies subscales in the data analysis: elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, and help-seeking. The learning strategies section of the MSLQ was administered at the end of the semester.

Data Collection. Quantitative data were collected using both sections of the MSLQ. Permission to move the MSLQ to WebCT software was granted by Dr. Pintrich. The motivation section was administered at the beginning of the semester. Eight demographic questions were answered at the first part of this questionnaire in order to gather basic background information concerning students' gender, race, academic major, academic classification, whether they use their own computer, whether they live in the city where the course is taught, whether they have taken an online course before, and why they were taking the course. Students then answered the 31 questions on the motivation section of the MSLQ. This resulted in a total of 38 questions requiring 25 minutes or less to answer. The learning strategy section was administered at the end of the semester. These 50 questions took no longer than 30 minutes to answer. Both portions of the MSLQ were administered online.

Students answered the questionnaire on a voluntary basis, although extra credit was offered as a motivation. Students who completed the survey rated themselves on each item of the MSLQ (both the motivation and the

learning strategies section) using a seven-point Likert-type scale with ranges from "not at all true of me" to "very true of me" (Pintrich, Smith, Garcia, and McKeachie, 1991). The scores for each question in a subscale were recorded, and an average for that subscale was calculated. For example, task value had six items. Each student's score was calculated by adding the score on each question in the subscale task value and then by determining the average of the six scores. Some questions are marked as "reverse" which indicates they are negatively worded. Scores for these questions were reversed before the average score was computed.

Qualitative Analysis

Qualitative data were collected from four students during summer 2002 through three sets of email questions sent to the participants as the course progressed. The first set was distributed at the beginning of the semester, the second set was distributed in the middle of the semester, and the last set was distributed at the end of the semester. Data were also collected via a telephone interview at the end of the semester. A transcript of the telephone interview was sent to each student, and they were asked to make corrections or additions to the transcript. Three students returned the transcript with no corrections or additions. The fourth student did not return the transcript. Additionally, students were asked to fill out the learning strategies portion of the Motivated Strategies for Learning Questionnaire (MSLQ) at the beginning of the semester and again at the end of the semester.

Students were chosen for this study based on the following criteria: (1) they were a biology major, (2) they did well on the first quiz, (3) they were enrolled on the first day of class, and (4) this was their first distance learning class. The criteria were chosen because past experience in teaching the class indicated that those who meet these requirements were likely to complete the course. The fourth criterion was important to this study. Geographical diversity was added by choosing one student who lived in another state, one student who lived on the campus as the university where the course was taught, and two students who lived withing 90 miles of the university. The reason for choosing geographical diversity was to ensure that not all students had direct access to the instructor. In order to achieve this diversity, an exception was made to criterion one. The student that lived in another state was not a biology major.

Descriptions of the four students

Laura. Laura (pseudonym) was a white female who lived in a different state from the university where the course was taught. She was a senior and owned her own computer. She was majoring in a nonscience field and a course of this type was required of her major. Her final grade in this course was a C.

William. William (pseudonym) was a white male who lived on the campus of the university where the course was taught. He was a senior and owned his own computer. William was majoring in biology and was taking the course to fulfill the upper level (300/400) course requirements of his major. His final grade in the course was a B.

Janet. Janet (pseudonym) was a white female who lived approximately 90 miles from the university where the course was taught. She was a senior and owned her own computer. Janet was majoring in biology and was taking the course to fulfill the upper level (300/400) course requirements of her major. Her final grade in the course was a B.

Crystal. Crystal (pseudonym) was a white female who lived approximately 90 miles from

the university where the course was taught. She was a senior and did not own her own computer. Crystal was majoring in biology and was taking the course to fulfill the upper level (300/400) course requirements of her major. Her final grade in the course was a B.

RESULTS

Quantitative Analysis

Demographics. A total of 54 students participated in the study, including 30 students who participated during spring 2002 and 24 students who participated during summer 2002. The class was largely female (67%) and Caucasian (83%). The majority of students (76%) were classified as seniors and 61% were biology majors. Most students (52%) had not taken a distance education course prior to this one and 81% owned their own computer. The principal reason for taking the class for 41% of students was that it fulfilled a requirement for an upper level (300/400) course. Table 1 shows the final grade distribution for the course. The mean score for the final grade was 3.56 (5 point scale where A = 5, F = 1) with a standard deviation of 1.40.

Tests of Hypotheses. The purpose of this part of the study was to determine if students' motivation and learning strategies could predict their final grades. Data collected using the Motivated Strategies Learning Questionnaire was correlated with final grades to test three hypotheses based on the structure of the MSLQ. This design used multiple linear regression in which correlation to final grades was the special case. Means for each subscale of the motivation section and the learning strategies section are found in Table 2. All variables met skew ness and kurtosis normal values. A statistical significance level of 0.05 was used. Descriptive and correlative techniques were used to analyze the data.

Table 1. Grade distribution (N = 54).

Grade	Number	Percent
A	15	18
B	21	25
C	6	7
D	3	4
F	9	11

Table 2. Descriptive Data (N = 54).

	M	*SD*
Intrinsic Goal Orientation	5.3	1.0
Task Value	5.7	1.2
Self Efficacy	5.9	0.9
Elaboration	4.8	1.1
Organization	3.7	1.2
Critical Thinking	4.8	1.0
Metacognitive Self-Regulation	4.4	0.7
Time and Study Environment	5.0	1.1
Effort Regulation	5.5	0.8

Hypothesis one: The motivational subscales which include intrinsic goal orientation, task value, and self-efficacy for learning and performance are positive predictors for success in a distance learning class. Multiple linear regression was used to determine if success was predicted by the independent variables of intrinsic goal orientation, task value, and self-efficacy for learning and performance. Pearson's correlations were used to describe associations between each of the motivational subscales and between each of the motivational subscales and grades (Table 3). Statistically significant correlations were found between grades and intrinsic goal orientation ($r = 0.24$), task value and intrinsic goal orientation ($r = 0.60$), self-efficacy and intrinsic goal orientation ($r = 0.45$), and self-efficacy and task value ($r = 0.26$).

Multiple linear regression was used to determine if the final grade (dependent variable) could be predicted by the predictors motivation subscales which include intrinsic goal orientation, task value, and self-efficacy for learning and performance. The regression [$F(3,50) = 1.19, p = 0.32, R^2 = 0.067$] was not statistically significant, and therefore the hypothesis was rejected.

Table 3. Correlations for Grades and Motivation Subscales (N = 54).

		Grades	Intrinsic Goal Orientation	Task Value
Pearson Correlation	Intrinsic Goal Orientation	0.24*		
	Task Value	0.14	0.60*	
	Self Efficacy	0.20	0.45*	0.26*

* $p < 0.05$

Hypothesis two: The learning strategies subscales which include elaboration learning strategies, organization strategies, critical thinking strategies, and metacognitive self-regulation are positive predictors for success in a distance learning class. Pearson's correlations were used to describe associations between each of the learning strategies subscales and between each of the learning strategies subscales and grades (Table 4). Statistically significant correlations were found between grades and elaboration ($r = 0.41$), grades and critical thinking ($r = 0.46$), elaboration and organization ($r = 0.45$), elaboration and critical thinking ($r = 0.41$), elaboration and metacognitive self regulation ($r = 0.52$), organization and critical thinking ($r = 0.28$), organization and metacognitive self-regulation ($r = 0.62$), and metacognitive self-regulation and critical thinking ($r = 0.45$).

Multiple linear regression was used to determine if the final grade (dependent variable) could be predicted by learning strategies subscales which include elaboration, organization, critical thinking, and metacognition. The regression [$F(4,49) = 1.87$, $p < 0.001$, $R^2 = 0.41$] was statistically significant, and therefore the hypothesis was accepted. The subscales elaboration and critical thinking were positive predictors of final grades (Table 5). An R^2 value of 0.41 indicated that only 41% of the variance was explained. Organization was found to be a negative predictor of final grades. The mean for the B students was the highest and the mean for the A students the lowest.

Table 4. Correlations Between Learning Strategies and Grades (N = 54).

		Grades	Elaboration	Organization	Critical Thinking
Pearson Correlation	Elaboration	0.41*			
	Organization	-0.12	0.45*		
	Critical Thinking	0.46*	0.41*	0.28*	
	Metacognitive Self- Regulation	0.18	0.52*	0.62*	0.45*

*$p < 0.05$

Table 5. Coefficients for Learning Strategies (N = 54).

Model	Standardized Beta Coefficients	p
Elaboration	0.41	0.004
Organization	-0.44	0.003
Critical Thinking	0.39	0.004
Metacognitive Self-Regulation	0.06	0.730

Hypothesis three: The resource management subscales which include time and study management strategies, effort regulation strategies, and help-seeking strategies are positive predictors of success in a distance learning class. Pearson's correlations were used to describe associations between each of the resource management strategies subscales and between each of the resource management subscales and grades (Table 6). Statistically significant correlations were found between grades and time and study environment ($r =$ 0.24), grades and effort regulation ($r = 0.48$), and time and study environment and effort regulation ($r = 0.49$).

Multiple linear regression was used to determine if the final grade (dependent variable) could be determined by resource management subscales which include time and study environment, effort regulation, and help-seeking. The regression [$F(3,50) = 4.9, p = 0.005, R^2 = 0.23$] was statistically significant, and therefore the hypothesis was accepted. Effort regulation was a positive

predictor of the final grade (Table 7). The R^2 value was low (0.23) indicating the effort regulation explains 23% of the final grade.

Table 6. Correlations for Resource Management (N = 54).

		Grades	Time and Study	Effort Regulation	Help-Seeking
Pearson Correlation	Time and Study	0.24*			
	Effort Regulation	0.48*	0.49*		
	Help-seeking	-0.02	-0.07	-0.02	

*$p < 0.05$

Table 7. Coefficients for Resource Management.

Model	Standardized Beta Coefficients	p
Time and Study Environment	0.010	0.940
Effort Regulation	0.470	0.002*
Help-Seeking	-0.006	0.960

*$p < 0.05$

Qualitative Analysis

The purpose of this qualitative research was to determine not only the learning strategies of students but also to determine if students changed their learning strategies over the semester and whether they felt these changes were important.

Four students participated in this aspect of the study. Three of the four were biology majors (the other student was majoring in a nonscience field), all did well on the first quiz, all were taking a distance education course for the first time, and all were enrolled in the course on the first day. One student lived on-campus, two students lived within 90 miles of the campus, and one student lived in another state. Three students made a B in the course and one student made a C.

Our first research question was, "What are the learning strategies that students in distance learning use when preparing for quizzes, discussions, and examinations?" The most important learning strategy reported by all students was organization. Organization includes strategies such as picking out important ideas and outlining the material to organize thoughts. Laura reported her grade fell because she was not able to read and outline the material as much as she did in the

beginning of the semester. According to Laura, "It was real, really, really, useful to outline as I read." A quantitative aspect of the study conducted for the entire class (54 students) reported that organization was negatively correlated to grades. However the highest mean for organization was recorded for the B students and three of the four students who participated in the qualitative section of this study earned a B. William reported that he relied heavily on reading the material and on the instructor's notes. He stated, "I would usually reread what it was I didn't understand — just study it extra until I understood it." He did not organize by taking notes, but he would mentally organize the material. Laura also reported using an elaboration strategy. When she needed additional information she would go on-line to find out more about the topic. Elaboration strategies would include pulling together information from different sources. Crystal reported using a critical thinking strategy. "I participate in the discussions by reading what others write and agreeing or disagreeing." Janet would read and reread the material. She would also seek help form other sources such as the Internet. She would also read responses from other students to aid in understanding the material.

Our second research question was, "What changes do students make in their learning strategies over the course of a semester?" Laura's changes were the most significant. She was not able to keep up with the readings and outlining which caused her grade to drop. She finished the course with a C. Her scores on the MSLQ subscales supported this change. Her scores fell in all categories except effort regulation and help-seeking. The largest drop in her scores between the beginning of the semester and the end of the semester was in

organization. While Janet said that she did not change her strategies, she also said that she began to keep a planner which helped her organize her activities. Her scores on the MSLQ changed very little with all scores changing less than 1.00. In the telephone interview, Crystal said she did not change her strategies. However, in the email, she stated that she began to reread the material. When she read the material several times, she would understand it better. Crystal's scores on the MSLQ subscales showed modest change. The largest gain was in the subscale of effort regulation and the largest drop was in the subscale of elaboration. Crystal reported using help from family members mainly at the beginning of the semester which correlated with her MSLQ scores in help-seeking that subsequently fell at the end of the semester. When asked directly, William repeatedly stated he did not change his learning strategies during the semester, but he reported in the telephone interview that he started using the professor's notes at the end of the semester and "then going back and being sure to cover in the chapter what he covered." The changes in his MSLQ scores were slight. The largest change was in the category of effort regulation in which his score increased by 2.00. His time and study environment scores decreased by 1.58.

Our third research question was, "Do the students perceive these changes in learning strategies beneficial?" Laura reported the changes she made were not beneficial. She was not able to organize the material which lead to her lower grade in the course. She told us that she mainly sought help from her family at the beginning of the semester. She did not say whether this was beneficial but she did not use her family as much toward the end of the semester. Janet began keeping a planner with

helped her organize her time and study environment which she found to be beneficial. Crystal and William reported that they did not change their learning strategies over the semester. But as we have noted, William began to use the professor's notes and then reviewing the chapter again. He did this toward the end of the semester and he stated it was the most beneficial preparation.

By the end of the semester, all four students scored above a four on the seven point metacognitive self-regulation subscale (the scale ranged from one to seven). Questions that addressed what the students did when they encountered an obstacle were aimed at discovering metacognitive self-regulation strategies. Most would read other students postings when they did not understand a concept. William would read the material until he understood it. Crystal would discuss the material with family members.

All but William indicated that they used help-seeking strategies. William's score was low on the subscale help-seeking, and he did not report seeking help from others. Laura, Crystal, and Janet stated that they would read other students' postings to help them understand the material. Crystal also asked family members to help. She stated, "I will read out loud to someone in my house and discussion will get started between the others in the house. That seems to help a lot." In the third set of email questions, she said that she mainly used family members at the beginning of the semester. This correlates with her MSLQ score (help-seeking subscale) of 5.5 at the beginning of the semester and then at the end (3.75). Laura reported an increased use of help-seeking which would coincide with the difficulties she had with the course. Even though Janet reported that she sought help

from others, her scores on the MSLQ help-seeking subscale were low at the beginning of the semester (2.75) and at the end (3.0).

Janet, Crystal, and Laura reported difficulty with time and study environment. Janet had a difficult time organizing her time around other activities. She stated keeping a daily planner to help overcome this. Crystal reported having difficulty finding quiet time. Laura reported difficulty completing assignments around her morning sickness. By the end of the semester, she was managing her time better and enjoyed the distance education format. Laura scored above a four on the time and study environment subscale both at the beginning and at the end of the semester. Crystal and Janet scored the highest on this subscale. William reported that he did not have any problem with time and study environment, but his subscale score was a 3.37 at the end of the semester This does not correlate with his statements concerning time and study environment. This was his second lowest score on the MLSQ learning strategies subscale.

DISCUSSION

Quantitative Analysis. The purpose of this research was to discover the degree to which motivation and learning strategies affected the success of students in distance education. Pintrich (1995) explained that successful students were self-regulated. They are able to monitor and control their learning and not depend on someone else for their success. They should also be self-motivated.

Hypothesis one suggested that the motivational subscales which include intrinsic goal orientation, task value, and self-efficacy for learning and performance were positive

predictors for success in our distance learning class. Self-motivation would include intrinsic goal orientation, placing value on the task, and having self-efficacy. The students in this study were intrinsically motivated, valued the task, and had high self-efficacy at the beginning of the semester. However, some were not successful in the course. One possible explanation is that motivation was measured at the beginning of the semester and compared to the final grade. Changes in motivation may have occurred for those who were not successful.

Hypothesis two suggested that the learning strategies subscales which include elaboration learning strategies, organization strategies, critical thinking strategies, and metacognitive self-regulation were positive predictors for success in a distance learning class. This proposal was supported by our regression analysis. The subscales elaboration and critical thinking were positive predictors of success while organization was a negative predictor. Elaboration strategies include strategies that "help the learner integrate and connect new information with prior knowledge" (Pintrich et al., 1991; p. 20). Olgren (1998) suggested that in order for students to construct knowledge, they must be able to integrate knowledge. Olgren goes on to state that learning involves actively searching for understanding. To understand and construct knowledge, students relate the new knowledge to prior experiences. In order to do this, students must use elaboration strategies. This would be very important in a course designed with elaborate discussions as BSC 305 was where students had to apply their knowledge. Critical thinking would also be very important. Critical thinking strategies involve the application by students of previous knowledge to new information which would

allow them to solve problems (Pintrich et al., 1991).

Curiously, organization was not found to be a positive predictor of success which is contrary to indications from educational literature. Doljanac (1994), for example, investigated whether motivation and learning strategies observed of college students could predict academic performance which was measured by the grade earned in the course. In this study we see that higher grades are correlated with higher rates of the cognitive learning strategies which include the subscales of rehearsal, elaboration, and organization.

We propose possible explanations for the results of organizational skill. (1) The MSLQ is a self-report instrument. Students who made the lower grades may have perceived that they were organized. Those who made a B in the class had the highest mean for organization and those who made an F had the next highest mean. The students who made an A in the class had the lowest mean, and these highest achievers may never feel that they are sufficiently organized. (2) Alternatively the format of the class was such that students had to understand and apply the material. Organization involves organizing the material to study. A student can be well organized in other respects measured by MSLQ, but not understand the material.

Other studies have reported that the implementation of learning strategies is important to be successful. Shih (1998) conducted a study in which correlations between achievement in a web-based course and the variables of motivation and learning strategies were analyzed. Shih collected data with a self-developed on-line questionnaire which included the scales of motivation, learning strategies, patterns of learning, and

attitude scales. The results of this study indicated that the two most important variables used to determine achievement are motivation and learning strategies.

Hypothesis three suggested that the resource management subscales which included time and study management strategies, effort regulation strategies, and help-seeking strategies were positive predictors of success in a distance learning class. The regression was statistically significant with the subscale of effort regulation being a positive predictor of success. Effort regulation is important in a distance education course, where the more obvious deadlines of coming to class and taking examinations in class are absent. Help-seeking had a low overall mean indicating students were not asking for help. This may be inherent in an online environment where students have no face-to-face contact with the instructor or other students. They may have perceived that they were not able to ask for help.

Qualitative Analysis. Students who participated in the qualitative study reported that the main strategy they used was organization. Three of the four students in the qualitative study earned a B in the course, and the highest mean for organization in our quantitative study was for B students. The types of organization these four students reported apparently was insufficient to help them understand and apply their knowledge of the material to earn an A.

CONCLUSIONS

This study contributes information on the learning strategies and motivation of successful students in distance education. The students who participated in this study were highly motivated at the beginning of the semester, but motivation was not a positive predictor of grades. Elaboration, critical thinking, and effort regulation were found to be positive predictors of success while organization was a negative predictor of success. Zimmerman and Pons (1986) states that self regulated learning is correlated to achievement with 93% accuracy. However, this study did not find that to be true. The participants do not appear to be self-regulated, but were successful. In fact, the grade distribution was negatively skewed which means the distribution curve indicated that the class mean was higher toward the for higher grades.

Students who participated in the qualitative study reported that the main strategy they used was organization. The students in the qualitative study earned a B in the course and the highest mean for organization in the quantitative study was for B students. Perhaps this type of organization is not enough to help students understand and apply their knowledge of the material. The students in the qualitative section also sought help from others (mainly others in the class) but help-seeking was not statistically significant in the quantitative study. They would read other students' material, but they may not have considered this asking for help.

According to Zimmerman (1986), learning is not something that can be done for students, rather it is something that is done by them" (p. 22). Students who are self-regulated take charge of their learning and become active participants. Pintrich (1995) states college students have control over their time management and study schedule but they may have difficulty managing the freedom as the

quality of cognitive effort they put into mastering academic goals. Students will adapt better and are more likely to succeed if they can learn to control their learning. Because of this, research on self-regulation is especially important for college students enrolled in distance education courses. The students in the qualitative study show some evidence of being self-regulated learners. All used cognitive strategies to master the material and when they did not understand the material, they were aware of this and made an effort to master the concepts. Additionally, they scored above a 3.5 on most subscales. The exception was help-seeking, but some of the students in the study indicated that they did seek help from either their peers or from family members. They may not have realized that reading other students' postings in order to better understand that material is a help-seeking strategy.

Distance educators must become skillful in supporting learners and disseminate information. In order to do this, we must know what methods the students use to learn and how are they motivated. Students of distance education should be highly motivated and self-monitoring. They should also know the cognitive skills needed to succeed. These are aspects of self-regulation. If it is important for college students to be self regulated as stated by Pintrich (1995), then it should even more important that students of distance education be self-regulated.

More students are enrolling in distance education courses. Moore (1998) says that the ability to link students and teachers through technology has never been so powerful. Gibson (1998) states "Yes, the students will come, but one has to ask, will they succeed (p. viii)?" For students to be successful in distance education, it is important to understand how learning occurs and what influences learning (Olgren, 1998). If instructors know what learning strategies and motivational factors are important, then perhaps these instructors can help students in distance education succeed. This information should be disseminated to students who enroll in distance education courses. Granger and Benke (1998) explain that one way instructors can help students succeed is to provide orientation that presents methods that will help students of distance education. According to this researcher's study, information on organizing material, along with critical thinking skills and elaboration skills could be included in the orientation. Students should also be aware of how important effort management is in distance education. This information could be delivered via videotapes or the Internet. Based on the results of this research, students need to integrate elaboration strategies and critical thinking strategies while managing their effort. Students must be aware of the strategies such of organizing and integrating information in order to construct knowledge. Olgren goes on to state "Cognitive strategies cannot be divorced from the learnerr's [*sic*] purpose in using them" (p. 84). As a result, students must also be motivated to learn. Only by helping students of distance education discover learning strategies and motivating them to learn can instructors help them become successful distance learners.

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President's Column
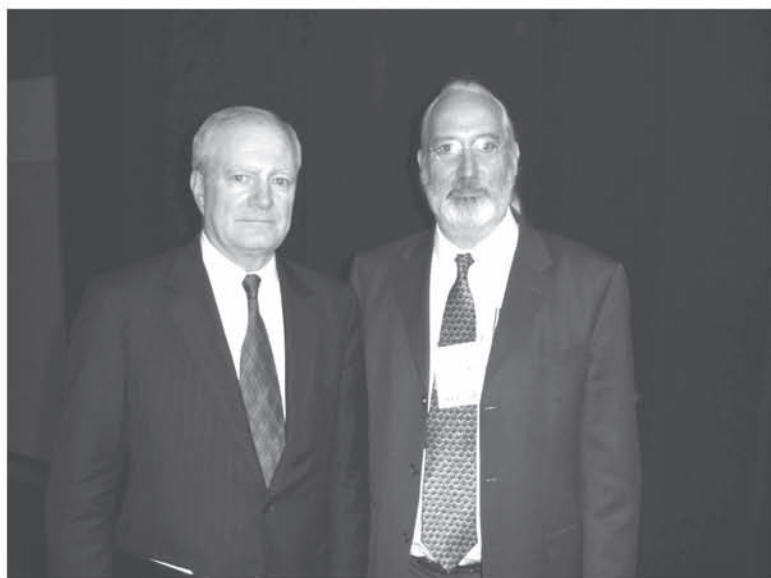
Dr. John Marburger, III (on the left) with Dr. Larry McDaniel, President of MAS, at the MAS Meeting in February, 2006 in Vicksburg, MS.

The 70th annual meeting of the Mississippi Academy of Sciences was held at the Vicksburg Convention Center in Vicksburg, Mississippi, February 23-24, 2006. The meeting was well attended and there was a high level of participation from throughout the state. This was very significant because of initial concerns raised after the devastation that had plagued our state. All that attended and participated are to be commended. The Academy has and will prosper as long as we the members continue to support the mission of our Academy.

The highlight of the meeting was the annual Dodgen Lecture presented by Dr. John H. Marburger, III, Science Advisor to the President of the United States and Director of the Office of Science and Technology Policy. Dr. Marburger gave a very timely historical and well-received presentation on the shaping of US science policy and the future direction of that policy. In addition Dr. Richarcd O'Callaghan, Chairman of the Department of Microbiology at the University of Mississippi Medical Center, delivered the opening session address. Also, there were several interesting symposia presented during the meeting.

A number of people contributed in very significant ways to assure the success of the meeting. I will mention some of these and will apologize for not recognizing all that did a fantastic job. I would like to thank Ms. Cynthia Huff, Administrative Assistant of the Academy, for her tremendous effort and keeping everyone on track. Dr. Edwin Swiatlo was instrumental in making arrangements for Dr. John Marburger, and Dr. Swiatlo also served as chair of the exhibits committee. Dr. Ann Marie Kinnell assembled the program edition of the Journal and was a photographer of the meeting. Drs. Sarah Lee McGuire, Rob Rockhold, Roy Duhe, Michelle Tucci, and Juan Silva helped with the development of the scientific program for the meeting. There was tremendous effort and time put forth by all the division chairs which meant that meeting ran smoothly. The effort of dealing with
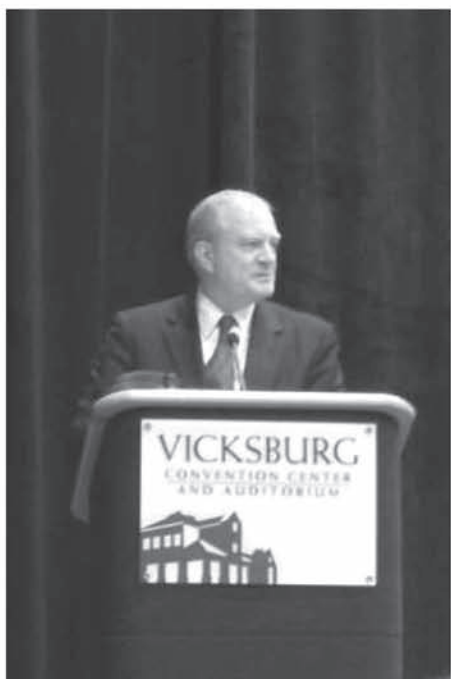
audio-visual needs for sessions is greatly acknowledged. I would like to thank Quincy Moore, Joel Davis, and Scott Wingerter for their efforts with the poster sessions. The assistance of Dr. Olga McDaniel in many aspects of the meeting preparation and on-site efforts were invaluable. Once again I would like to express my appreciation to all who attended the meeting without whom such a successful gathering would not have been possible. Finally, I would like to recognize Dr. William Turner, Chairman of the Department of Surgery at the University of Mississippi Medical Center, for his support. Thanks to everyone for providing me the opportunity to serve you and the Academy. – Larry S. McDaniel

Editorial

Dear Colleagues:

We are hoping that you are enjoying the breathtaking scene on the cover of our journal. Many of you are probably wondering about the changes. Some of you may not have been aware that Dr. Ken Curry has retired as our Journal's Editor. He had been at that post for the past decade, where he performed this job tirelessly. It wasn't until we started putting this first issue together, that we realized how much time and effort that it takes to produce a quality publication. We are extremely grateful to Dr. Curry for all of his efforts over the years, and truly understand that we have some big shoes to fill. In fact, we have divided his job into at least four parts (Editor, Michelle Tucci, Associate Editor, Ed Swiatlo, Abstracts Editor, John Boyle, and Program Editor, Ann Marie Kinnell). The home location for our journal is the School of Health Related Professions at the University of Mississippi Medical Center. We are looking forward to your input as to what you would like to see within the journal. We have sent out a survey form with this year's election ballots and would appreciate each of you taking a few minutes of your time to complete the form, and send it back with your election ballot. This is "OUR" academy of sciences journal and we want each of you to have input. We are striving to make this a journal that recognizes the works of all scientists in our state. Please do not hesitate to contact us regarding your likes, dislikes or other information that you feel should be addressed.

Dr. John Marbuger…Dodgen Lecture

Carina Lewis, Bailey Magnet High School Student, (left) with Ms. Wendy Walker High School Teacher of the year.

Photographs from the 2006 Annual Meeting in Vicksburg, MS

Health Sciences Poster Session

The Mississippi Junior Academy of Science

Maxine Woolsey and Ken Sleeper of the University of Mississippi have accepted the responsibility of co-directors of the Mississippi Junior Academy of Science. We want to support teachers in encouraging students to be creative in developing projects and conducting research and promoting students to consider careers in science, engineering, and math.

Students required to complete a senior project before graduation from high school that choose a topic of science, engineering, or math, could greatly benefit from participation in the annual meetings of the MJAS. Students participating with projects in the Mississippi Science and Engineering Fairs can restructure their research and experimentation into poster sessions for presentation. Students wishing to have their research project published or

those wishing to attend the National Convention of the Junior Academy of Science may compete for these honors by developing and presenting their projects as poster sessions during the annual meetings. This event is an excellent opportunity to help prepare high school students for a future in science.

For the 2006 MJAS Meeting/Workshop, they invited students to participate with research projects in the form of poster sessions. Students participated individually or in teams. These students presented their posters to other students, teachers, and professors. Students learned how to convert a research paper to a poster session. They learned how to modify a science project to develop a poster for a poster session, how a poster created in elementary school for a science fair is different from a poster developed for a poster session, and how a poster session differs from a science and engineering fair. Several professional posters were displayed and presented during the Workshop.

Teachers were encouraged to bring their students to the 2006 Meeting of the Mississippi Junior Academy of Science to meet fellow teachers and students with similar interests and to gain the knowledge and information of poster session techniques to better prepare themselves for future development and presentation of research projects.

More information on the Junior Academy of Sciences will be published in the July issue. The following is contact information for both Maxine Woolsey and Ken Sleeper.

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Divisional Reports

Report of the Division of Mathematics, Computer Science, and Statistics.

In the Mathematics, Computer Science, and Statistics (M|CS|S) Division of the MAS on Thursday and Friday there were 9 talks and 2 poster presentations given. The subject of the talks were in the areas of graph theory, mathematical interpolation formulas, estimating data errors in geographic information systems, how to rank computer performance, how to compare of databases of genetic information, how to write programs to make databases from computer surveys, and image feature recognition in remote sensing. Poster presentations considered ways to test robotic performance and understand how to design algorithms for graph coloring. On Friday morning, the special sub session on supercomputing was well attended by the heads of computing of many of the State Universities. At the end of the main sessions,

on Friday four cash awards ($50 and $25) in the student and professional categories and four certificate awards were presented. The winners were 1) 1st place professional division: Dr. Joseph Kolibal, for his talk on "Algebraic Properties of Sum One Matrices" and 2) 2nd place professional division: Mr. Olexandr Isayev and Mr. Taner Pirim, for their talk, "Carr-parinello Molecular Dynamics Benchmark Performance", 3) 1st place student division: Tisha Brown for the .

poster presentation, "Robotic Formation: Correcting Boe-bot's Error by Trial Installation", and 4) 2nd place student division: John D. Stepney for his talk: "Mathematics, Computer and Information Sciences Alumni Survey Online From". This year, as it did in 1995,1996, 1997, and 2005 paper and poster presenters were invited to submit expanded versions of their talks to be published in a divisional proceedings.

Report of the Division of Ecology and Evolutionary Biology

The Division of Ecology and Evolutionary Biology was represented by 9 oral presentations and 1 poster presentation at the 2006 MAS meeting. Presenters came from the University of Southern Mississippi, Mississippi College, the University of Mississippi, Jackson State University, and Mississippi State University. Presenters included both graduate students and faculty. A new division chair was elected for 2006, Dr. Robert Hamilton of Mississippi College.

Clifford Ochs, Ph.D.

Department of Biology
University of Mississippi
University, MS 38677

Geology and Geography

The 2006 Geology and Geography Division meeting was fruitful in the exchange of ideas and knowledge. It was a small one-day session, but allowed time for questions and discussion after each presentation. There were seven oral presentations, but one had to cancel due to transportation trouble. Two poster presentations were given in the meeting room. The meeting began with an emphasis on hurricane Katrina and then diversified into

coal bed methane, greenhouse warming, gas hydrates, and watersheds. Presentations represented Mississippi Office of Geology, Kansas Geological Survey, Information Management Systems, Stennis Space Center, University of Southern Mississippi, Mississippi State University, University of Mississippi, and University of Rome.

From a past donation of Dudley Hughes, a $100 award was split between the two student presenters: Jennifer Kuykendall for *The Impact of Hurricane Katrina on the Pearl River Marsh* and Michael A. Haney for *Greenhouse World Proxy Records in the Lower Tuscaloosa Formation, Mississippi.*

At the divisional business meeting, Dr. David Ufnar, University of Southern Mississippi, Dept. of Geology, was elected chair for 2006-2007. James Starnes, Mississippi Dept. of Environmental Quality, Office of Geology, was elected vice-chair. --- Barbara Yassin

Report of the Division of Marine and Atmospheric Sciences
February 22-24, 2006
Chair: Paulinus Chigbu (JSU/UMES)
Vice Chair: Judith Williams (USM)

This year the division held on an open session on Thursday, February 23. Five oral presentations were given; one talk was changed to a poster presentation. A total of five posters were presented. Dr. Zikri Arslan of Jackson State University was nominated and accepted to serve as vice chair of the division for the year 2006/2007. Dr. Stephan Howden (USM) was nominated, and he accepted to serve as chair of the division for 2006/2007. Dr. Judith Williams of USM-Gulf Coast the vice chair of the division for 2005/2006 declined to assume the position of chair for the upcoming year because of personal reasons.

Report of the Division of Chemistry and Chemical Engineering

The Chemistry and Chemical Engineering Division had a very successful meeting. It was expected that the number of submitted abstracts would decrease this year because of the tragedy and devastation that occurred with Hurricane Katrina. However, participation was comparable to previous years. There were twenty-nine oral presentations and eight poster presentations with presenters from the University of Southern Mississippi, Jackson State University, Mississippi University for Women, Millsaps College, Mississippi Gulf Coast Community College, Mississippi State University, Tougaloo College, Delta State University, and Mississippi Valley State University.

The Division Chair for next year is Professor Mudlagiri Goli of Mississippi Valley State University. The Vice Chair is Professor Douglas Masterson of the University of Southern Mississippi.

Division of Cellular, Molecular and Developmental Biology

The Division accepted **26** and **19** abstracts for oral and poster presentations respectively. The Division successfully organized **22** oral and **19** poster presentations over the two-day period of the meeting.

Day 1: Morning session: with **58** meeting participants in attendance in Exhibit Hall 2A, eleven (**11**) oral presentations were made from 8:30am – 11:45am.

Afternoon session: with more **250** meeting participants in attendance in Exhibit Hall B, nineteen (**19**) poster presentations were displayed from 5:30pm – 7:00pm.

Day 2: Morning session: with 41 meeting participants in attendance in Meeting Room 1, eleven (**11**) oral presentations were made from 8:30 am – 11: 50am.

Immediately following these presentations, the Divisional business meeting was held during which the leadership of the Division for the 2006 – 2007 year was elected. The presentation award winners were announced and recognized. The out-going Division Chair, Dr. Stephen I.N. Ekunwe proposed a five dollar ($5.00) donation per CMDB member be made toward monetary award to encourage more participation in oral and poster presentations. He also challenged the members to support the proposal made by Dr. Sabine Heinhorst for more oral presentations at the next meeting.

Division Officers, 2006 – 2007
Chair: Dr. Barbara Graham-Evans, Jackson State University
Vice-Chair: Dr. Lauren D. Brandon, Mississippi University for Women, who was nominated by Dr. Sarah Lea McGuire and seconded by Dr. Roy Duhe. Dr. Brandon was the only candidate for the office and **11** people of the **19** that remained for this exercise, voted for her.

Award Winners
Poster presentation: (Certificates)
1st place winner: Jonathan Priester, Murrah High School, Jackson.

2nd place winner: Tamica Collins, Jackson State University

Oral presentation: (Certificate)
Undergraduate: Brandy N. Roberts, Mississippi University for Women
Oral presentation: (Certificate + $50.0 check)
Graduate: Scott Walper, University of Southern Mississippi

Acknowledgement
Thanks to all presenters in our Division for a wonderful job.
Many thanks to all our judges and supporters:
Dr. Ross Whitwam
Dr. Barbara Graham-Evans
Dr. Sarah Lea McGuire
Dr. Mohamed Elasri
Dr. Roy Duhe
Special thanks to Cynthia Huff for being there for this Academy all the time.

Submitted by: Stephen I.N. Ekunwe, Ph.D. Immediate Past Chair, CMDB, 2005-2006.

Division Report of Psychology and Social Sciences

The Division of Psychology and Social Sciences hosted 17 paper presentations and 10 poster presentations at the 2006 Conference of the MAS. Several universities, including University of Southern Mississippi, University of Mississippi, Delta State University, Tougaloo College, and Millsaps College, were represented by undergraduate, graduate student, and faculty presentations. The paper presentation topics included a variety of topics, such as cell phone usage, racial correlates of self-esteem, health status and causes of death in nineteenth century Natchez and Vicksburg, and financial impact of aging

populations. Poster topics were equally varied, including posters on the effects of modafinil on working memory in rats, effects of early food restriction on weight gain, psychological correlates of self-esteem, and effects of age and gender on seat belt usage.

A special symposium on the impact of Hurricane Katrina was included in the afternoon session. The symposium was organized by Dr. David Swanson (UM) and included speakers from USM and MSU. The topics addressed the impact of the hurricane on federally funded research programs in the state of Mississippi, the effects of disaster related trauma on the residents in the disaster area, and disaster preparedness plans for animal facilities. This session was instrumental in soliciting input from Mississippi's scientific community that will facilitate improved responding and preparedness in the event of future disasters.

The Thelma Gipson Awards for graduate and undergraduate oral and poster presentations were sponsored by Dr. Pamela Banks of Jackson State University. The award for best oral presentation by an undergraduate was awarded to Reginald Riggins for his presentation of How Do Interracial Couples Strategize Against The Complexities of Racism? Best oral presentation by a graduate student was awarded to Harold Webster, Jr. for Comparative Analysis of the Relationships of Age, Gender, and Cause of Caucasian Deaths in Late Nineteenth Century Vicksburg and Natchez, Mississippi. The award for best undergraduate poster presentation went to Monica Stevens for Effects of Modafinil on Working Memory. The award for best graduate student poster presentation was awarded to Miranda Page for Health and Activity of a Plaquemine Necropolis in Claiborne County, Mississippi. Each student received a monetary award and a certificate.

At the divisional business meeting, Dr. David Swanson (UM) was elected chair of the division for 2006-2007. Dr. Ron Cossman (MSU) was elected vice-chair. Special thanks go to Ann Marie Kinnell for guidance and assistance in making the 2006 division session a great success. – Sheree Watson and David Swanson.

Health Sciences Division
Mississippi Academy of Sciences
Report from Annual Meeting 2006

Thanks to the following sponsors of the Health Sciences Division: Department of Orthopedics and Rehabilitation at University of MS Medical Center; University Neurology Group; and University of MS School of Nursing. In addition, we would like to recognize Ricky Nations, Shelter Insurance; Godwin Dafe, State Farm Insurance; and Johnny Ray, BankPlus for their support for the Drug Delivery Symposium. Election was held and Co-chairs for the Health Sciences Division are Dr. Tina Martin and Dr. Lisa Haynie. Vice Chairs are Dr. Mary Tan and Dr. Ed Switlo. Reporters are Dr. Pam Jones and Dr. LaToya Richards. The Health Sciences Division has already started on working towards next years meeting. Thanks to all the students and faculty that presented their research and we strongly encourage them to present next year as well. The following are the awards given on behalf of the Health Sciences Division. Thanks to all the judges for their hard work in evaluating the students. Your efforts are greatly appreciated.

Faculty Awards:
Excellence in Health Sciences Education:
 Faye Johnson
Excellence in Applied Science Education:
Carolyn Beck

Student Awards:
Poster Presentations:
High School: 1st place: Rachel Lockhard
2nd place:Erin Wiggers
3rd place:LaRue Sutton
Undergraduate:
1st place: Derrick Huang
2nd place: Michael Opata
3rd place: Joshua Swan, Gabrielle
Pickle, Matthew Burford

CHS Undergraduate:
1st place: Katie Womack and Cassie
McClendon
2nd place: Heather DeLaSalle
3rd place: Mary Gao

Graduate:
1st place: Laura Franklin
2nd place: Leshundra Young
3rd place: Janelle Pryor

CHS Graduate:
1st place: Scott Wingerter
2nd place: LaToya Richards
3rd place: Joel Davis

Oral Presentations:
High School:
        1st place: Sara Ali
Undergraduate:
        1st place: Katrice Martin
        2nd place: Christopher Bennett
        3rd place: John Stoker
Medical Students:
        1st place: Crystal Berry
        2nd place: Laura Piazza
        3rd place: Courtney Shires
Graduate Students:

1st place: Chinwendu Onwubiko
2nd place: Pamela Ruffin
3rd place: Alexis Han**d**

Mississippi Academy of Science Divisional Report: Physics and Engineering - February 2006 Meeting

There were eight professional and fifteen student oral presentations, and
one student poster presented.

The symposium, which was given in six technical sessions, was well attended by members of other conference divisions with attendance increasing for each subsequent session. I am pleased to report that the quality of talks presented was excellent. I was very much impressed with presentations done by graduate students from the University of Mississippi and Mississippi State University. We had interesting and fruitful discussions of every paper presented. I believe that the graduate students and professionals are encouraged to keep a professional level of the symposium at the future meetings.

Graduate Student Awards
Oral Competition (15 presentations)
1st Place   Mahmoud Ismail $50.00
Paper: "Performance of Dual-Branch Maximal Ratio Combining Diversity Over
Non-Identical Correlated Weibull Fading Channels Using Pade Approximation"
2nd Place   Tutku Karacolak $40.00
Paper: "Simulation of Double-Sided Rounded Bow-Tie   Antennas   For   UWB Communications"

3rd Place   1. Yizhe Zhang $30.00
Paper" FDTD Analysis of a Probe-Fed Dielectric Resonator Antenna Array
With Hard Horn For Spatial Power Combiner"
              2. Dalia Elsherbeni $30.00

Paper: "Design of a Wideband Microstrip Power Divider"

The $150.00 cash award in oral competition was donated by the School of
Engineering at The University of Mississippi. The meeting was chaired by Dr. Alexander Yakovlev of the Electrical
Engineering Department at The University of Mississippi and co-chaired by Dr. S. Kant Vajpayee of the University of Southern Mississippi
Division Officers elected for 2006-2007 are:
Chairman: Dr. S. Kant Vahpayee, The University of Southern Mississippi
Vice Chmn: Dr. Erdem Topsakal, Mississippi State University

Mississippi Academy of Science
Divisional Report
Division of Zoology and Entomology

During this past Seventieth Annual Meeting, all the activities of the Division were held in the afternoon {from 1:00 to 4:00 pm) on Thursday, February 23, 2006. The Division hosted six oral presentations and three posters representing several universities including: Mississippi University for Women, Mississippi Valley State University, Alcorn State University, University of Mississippi, Jackson State University, and Mississippi State University. The attendance was very good.

About 25-30 individuals attended the presentations; however only 10 individuals attended the Business meeting. In our Business meeting our Vice-Chair Dr. Julius Ikenga from Mississippi Valley State University was elected as the Division Chair and Dr. Aex D. W. Acholonu from Alcorn State University as the Vice-Chair. Dr. Acholonu has been the Chair of the Division during 2003-2004 and 2004-2005 Meetings, and we thank him to accept to come back. During the discussion, recommendations were made to encourage more participation.

Division Chair, Elgenaid Hamadain

2006 Supplemental Abstracts

MISSISSIPPI ACADEMY OF SCIENCES
Seventieth Annual Meeting—February 2006
Errata – new life members and new abstracts

Cellular, Molecular and Developmental Biology

Addition to poster presentations, 6:00p Thursday

HUNT AND PECK: IN SEARCH OF GO TERMS FOR CHICKGO

Susie M. Baker*[1], Fiona M. McCarthy[2], and Shane M. Burgess[2], [1]Mississippi University for Women, Columbus, MS 39701 and [2]Mississippi State University, Mississippi State, MS 39762

The chicken is the first agricultural animal to have its genome sequenced. The chicken genome was sequenced primarily because of its importance in evolutionary biology, but also it is an important source of protein and used as an immunological model. However prior to biological modeling, chicken gene products must first be functionally annotated. Gene Ontology (GO) has become the *de facto* method for functional annotations. A mere 17% of chicken proteins have GO annotation, and more than 99% of these proteins have been assigned their annotation from the least accountable form, inferred by electronic annotation (IEA). I assigned GO annotations to chicken gene products via ChickGO, which is a part of the AgBase, a database established to provide functional annotations for agricultural organisms. A list of bursal B-cell mitochondrial proteins was generated from experimental data. I searched the UniProt database for UniProt accession numbers and for any annotations listed for these proteins. Proteins for which no annotations were listed were submitted into Goanna, which returned several possible homologue matches to each protein. I manually compared sequences strict homology matches to our chicken protein. If the comparison was suitable, I was able to take GO annotations from the homologue and transfer them to the corresponding chicken protein. Using this method, I manually annotated 629 mitochondrial proteins for ChickGO based upon sequence similarities (ISS). These annotations will provide a basis for further research into the biological function of these proteins, aid biological modeling using chicken gene products and assist comparative biology studies.

Chemistry and Chemical Engineering

Addition to poster presentations, 6:00p Thursday

CONFORMATIONAL STUDIES OF DI-TERT-BUTYLCYCLOHEXANES BY AB INITIO MOLECULAR ORBITAL CALCULATIONS

Gurvinder Gill, Diwakar M. Pawar, and Eric A Noe, Jackson State University, Jackson, MS, 39217

The conformational space was searched for 1,1-di-*tert*-butylcyclohexane (1), *trans*-1,2-di-*tert*-butylcyclohexane(2), and *trans*-1,3-di-*tert*-butylcyclohexane (3) with Allinger's molecular mechanics program (MM3 and MM4), and free energies were obtained at various temperatures. Calculations were repeated for low - energy conformations and intermediate transition state for interconversion of chair and twist - boat conformation with ab initio methods until the

HF/6-311+G(d) level was reached. Ab initio calculations for 1 and 3 predict that twist - boat conformation is lower in free energy than the chair conformation, whereas chair (ax) form is found to be more stable for 2. Molecular mechanics calculations are in qualitative agreement with Ab initio calculations except for 1, the chair conformation is predicted to be more stable. At the HF/6-311+G* level the barriers to interconversion of the chair and twist - boat conformations, molecular geometries, symmetries, relative strain energies, and relative free energies and calculated (GIAO) chemical shifts for four conformations and comparisons with published results of compounds 1 - 3 will be presented. Experimental work is in progress. This work was supported by NSF - CREST Grant No. HRD-9805465.

EFFECT OF ELECTRODE MATERIAL AND ELECTROLYTE ON THE ELECTROGENERATED CHEMILUMINESCENCE BEHAVIOR OF RU(BPY)$_3$$^{2+}$/ TPRA SYSTEM[1]

Shijun Wang*, Wujian Miao, University of Southern Mississippi, Hattiesburg, MS 39406

Electrogenerated chemiluminescence (ECL) is a process of light generation by electrode reactions. ECL was observed at an electrode placed in contact with Ru(bpy)$_3$$^{2+}$ (bpy = 2,2'-bipyridyl)/tripropylamine (TPrA) solution when the electrode was scanned positively. Because ECL intensity is solution pH dependent, where the highest ECL signals are obtained around pH 7-8, neutralization of basic TPrA with an acid is needed when TPrA is added to a neutral buffer such as a phosphate buffer solution. Phosphoric acid, hydrochloric acid, and perchloric acid, are often used for such a purpose. In 0.10 M TPrA-0.10 M phosphate buffer (pH 7.4, neutralized with H$_3$PO$_4$), two ECL waves were observed at both glassy carbon (GC) and Au electrodes, but only one at a Pt electrode, when micro-molar levels of Ru(bpy)$_3$$^{2+}$ were used. The first ECL wave has a peak potential of ~0.9 V vs. Ag/AgCl, and the second one at ~1.15 V vs Ag/AgCl. The ECL generated at a Pt corresponds to the second ECL wave. ECL intensity was also found to be electrode material dependent. The limit of detection for Ru(bpy)$_3$$^{2+}$ was determined to be ~1H10^{-11} M at GC, ~1H10^{-10} M at Au, and ~1H10^{-7} M at Pt, on the basis of the second ECL signals. No difference in ECL behavior and the limit of detection was found when the electrolyte solution was neutralized with either HCl or HClO$_4$ for the electrode of GC and Pt. However, at a gold electrode, the first ECL wave was significantly decreased and the second one was disappeared. This kind of ECL quenching behavior could be associated with the redox reactions between the electrogenerated oxidant, e.g., AuCl$_4$$^-$, and the electrogenerated strong reducing agent TPrA$^!$ free radical. Because, based on the previous studies, TPrA$^!$ free radicals are essential for the ECL generation, any process that eliminates their existence near the electrode could result in the disappearance of ECL signals.

Health Sciences
Addition to poster presentations, 9:30a Thursday
BETA-2-MICROGLOBULIN COMPARED WITH FOURTEEN OTHER ANTIGENS FOR THE DETECTION OF BREAST CANCER
Mary Guo[1]*, Sharae Johnson[1], Rasheeda

Crowell[1], Tammy Sims-Davis[1], Wileen Cooksey, Slobodanka D. Manceva[1], Sabrina Bryant[1], Margaret Jackson[1], James T. Johnson[1], Harold Schultze[1], Shawn Clinton[1], Kevin Beason[1], Cynthia Wilson[2], Debbie Fortenberry[1], Cynthia Bright[1], Helen Hua[1], Jiarong Ying[1], Paul Sykes[1], Rafat AlKurd[1], Kay Hollifield[3], Charlton Vincent[3], and Margot Hall[1], [1]University of Southern Mississippi, Hattiesburg, MS 39406, [2]University of Mississippi Medical Center, Jackson, MS 39216, and [3]Laurel Clinic for Women, Laurel, MS 39442

Breast cancer has the highest prevalence (17.9%) worldwide of all the non-skin cancers. Similarly, in the USA, there are approximately 211,000 new cases annually making it the number one solid tumor among American females. Tumor antigens are often used for therapeutic monitoring and have been used together with other methods for diagnosis of breast cancer. The goal of this study was to compare the diagnostic potential of beta-2-microglobulin ($2M) with that of fourteen other tumor antigens for breast cancer. Sera from 554 patients (87 breast cancer, 272 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, NSE, Ferritin, CA242), Hybritech (CEA, CA195, CA549), Centocor/Fugirebio Diagnostics (CA125, CA19-9, CA72-4, CA15-3, CA27.29, Cyfra21-1), CIS Biointernational (CA50), and Abbott (AFP) were used to test for the concentration of these antigens. Using the manufacturers' decision values the following diagnostic sensitivities were obtained: $2M 28.1%, NSE 0.0%, Ferritin 40.0%, CA 15-3 63.4%, CA27.29 39.3%, CA549 40.3%, CEA 22.4%, CA195 31.8%, CA19-9 12.2%, CA50 22.2%, CA72-4 12.9%, CA125 12.1%, Cyfra21-1 12.2%, AFP 21.8%, CA242 29.3%. Diagnostic specificities were >75%. Interestingly, $2M demonstrated diagnostic sensitivies of 50.0%, 50.0%, and 66.7% for pancreatic, hepatic, and testicular cancer respectively. From these data we conclude that $2M was inferior to ferritin and the three traditional breast cancer markers (CA15-3, CA27.29, CA549) and roughly equal to the other markers for diagnosis of breast cancer. It was useful for testicular cancer.

THE ROLE OF REM SLEEP IN THE DEVELOPMENTAL EXPRESSION OF NMDA RECEPTOR SUBUNITS IN VISUAL CORTEX.

Kimystian Harrison, Adrian Dreher, Jorge Lopez, Howard Roffwarg, and James P. Shaffery, University of Mississippi Medical Center, Jackson, MS 39216

The objective of this project is to determine in immature kittens the effect of REM (rapid eye movement) sleep deprivation on expression of subunits of the excitatory, glutamatergic NMDA receptor (NMDAR) in the brain that are involved in the development of the central nervous system. REM sleep is believed to have important effects on central nervous system processes that are involved in brain development of young animals. This idea is based upon the positive correlation between the relatively large REM sleep quantities and extensive central nervous system development that are present during early life. Glutamate and its receptors provide for excitatory synaptic transmission in the visual system. In this study, we analyze using Western Blot analysis two specific subunits of the glutamate receptor NMDAR2 that are differentially regulated during development of

visual cortex, subunits (NR2A and NR2B). A commercial software package is used to visually score stages of recorded sleep for study kittens during the baseline and days 1, 3, and 6 of the study to ensure that the rats are deprived of REM sleep during the week-long study. We hypothesize that the relative amounts of NR2A and NR2B in REM sleep deprived kittens will be altered from those in non-deprived controls. This is part of a larger study that seeks to increase our understanding of REMS mechanisms and the function of this sleep stage in early life. A better understanding of REMS function may lead to the prevention and treatment of certain sleep and mental disorders, including depression.

Addition to poster presentations, 3:00p Thursday

SCREENING OF PANAMANIAN PLANT EXTRACTS FOR ACTIVITY AT ß1 ADRENOCEPTORS

Joshua T. Swan*, Catherina Caballero-George, and Robert C. Speth, University of Mississippi, University, MS 38677

Panamanian plants have long been used by traditional healers for cardiovascular effects. To determine a possible mechanism of action of these plants, 45 extracts from Panamanian plants reported to have beneficial effects on the cardiovascular system were screened for their ability to bind to the ß1 adrenoceptor by competition binding assays with ^{125}I-cyanopindolol (^{125}I-CYP). ß1 adrenoceptor transfected Chinese Hamster Ovary cells were incubated with ^{125}I-CYP at 37 C for one hr. The Kd of ^{125}I-CYP binding to the ß1 adrenoceptor (" 10 :M propranolol) was 196 pM. The transfected receptors were demonstrated to be ß1 based on pharmacological specificity of beta adrenoceptor subtype selective ligands: CGP 20712 (Ki=68 nM) ICI 118,551 (Ki=3170 nM) SR59230A (Ki=565 nM). Two concentrations; 10 and 100 :g/ml of extract were evaluated initially with a cut-off of 50% inhibition of binding at 10 :g/ml for subsequent determination of an IC_{50}. Only one extract showed >50% inhibition at 100 μg/ml and none showed >50% inhibition at 10 μg/ml. Interestingly, 3 extracts enhanced ^{125}I-CYP binding >50% at 100 μg/ml, but not at 10 μg/ml. These results suggest that the beneficial effects of Panamanian plant extracts on the cardiovascular system do not involve effects on the ß1 receptors which are located in the heart and control its contractile force and rate, or the juxtaglomerular cells of the kidney which control the release of renin which activates the renin-angiotensin system.

IDENTIFICATION OF A CDNA CLONE TO THE EXTRACELLULAR MATRIX PROTEIN HLAMP-1 IN THE CHICK

Sakeli Hall* and Allan R Sinning, Murrah High School,Jackson, MS 39202, and University of Mississippi Medical Center, Jackson, MS 39216

HLAMP-1 is an extracellular matrix protein that is secreted into areas of the embryo undergoing epithelial/mesenchymal transformation. We have recently identified a 1.1 kb cDNA clone of hLAMP-1 named KMS-2 using a quail cDNA expression library (accession number AY313452). BLAST analysis of this clone revealed no significant homologies in the GenBank database suggesting that KMS-2 represents a previously

unidentified sequence. This clone reacts with chick tissue by in situ hybridization and labels areas that have been shown to express hLAMP-1. This report describes the isolation and sequencing of a chick cDNA clone using reverse transcriptase (RT) PCR. Initial experiments utilized oligonucleotide primers designed from KMS-2 that were used in RT-PCR. These experiments showed a cDNA of the appropriate size for the primers indicating an mRNA species consistent for hLAMP-1. A second set of experiments used RT-PCR reactions designed for direct sequencing and for TOPO cloning of the isolated cDNA. Finally experiments are ongoing to extend the chick cDNA using anchored PCR and screening a chick cDNA expression library.

Addition to poster presentations, 6:00p Thursday

KNOWLEDGE VS CHOICE ASSESSMENT IN PURSUING CAREERS IN HEALTH RELATED PROFESSIONS

Faye Johnson*, Jamil Ibrahim, Hamed Benghuzzi, University of Mississippi Medical Center, Jackson, MS 39216

This study aimed (a) to assess the background and magnitude of knowledge of various student groups toward health related professions (HRP) disciplines, and (2) to provide the HRP programs with sufficient information that may contribute in revising as well as upgrading recruitment efforts and admission polices. A questionnaire was sent to intercity sites (2 high schools and historic black universities) regarding the knowledge of various SHRP programs. A total of 106 questionnaires were completed (return rate 50%). Data collected was analyzed using standard descriptive statistical software. The groups were divided into two groups based on age (Group 1 = 15-21) and (Group 2 = 22-52).

There were 19 females and 9 males respectively. The results of this study revealed that the student knowledge of SHRP programs are in the following order: Dental Hygiene (46%)> Physical Therapy (44%)> Medical Technology (30%)> EMT (28%)> OT (25%)> HIM (23%)> CT (5%)>. In contrast, knowledge vs choice demonstrated the following order PT (33%)> HIM (29%)> DH 28%> MT (30%)> OT (16%)> EMT (16%)> CT (9%). This descriptive study offers a golden opportunity across health related professions programs aimed at increasing the number of minority applicants. The results of such studies would not only provide needed information aimed at meeting the specific health card providers need for the state of Mississippi, but may also contribute towards laying a framework to help in building a bridge between some health related professions disciplines and minority groups. More research is needed to evaluate these initiatives effectiveness.

Marine and Atmospheric Sciences
Addition to lecture presentations, Friday
11:30 **A Comparison of Physiological Parameters between Thirteen Species of Sharks**

Will V. Bet-Sayad and Glenn R. Parsons, University of Mississippi, University, MS 38677

Sharks exhibit numerous body morphologies ranging from the fusiform shape of the mako shark *Isurus oxyrhynchus* to the almost anguilliform shape of the benthic species. Traditionally, anatomical indicators such as body shape, gill surface area, and caudal fin aspect ratio have been used as indicators of the activity level (swimming speed) of an elasmobranch. In this study we classified 13 species of sharks into three

activity levels (active, intermediate, sluggish) using the aforementioned anatomical indicators. We then attempted to correlate various physiological parameters against their activity rating. We obtained sharks during NMFS/NOAA cruises in the Gulf of Mexico and Bering Sea (June-Sept. 2003-2005). For each individual we measured caloric and water content of hepatic and skeletal tissue, as well as glycogen content of skeletal muscle tissue. Additionally, we measured cardiosomatic index (CSI), hepatosomatic index (HSI), and hematocrit. ANCOVA revealed positive correlations (highest mean averages) for caloric content, CSI, HSI, and hematocrit amongst the most active species and declined according to activity level rank. Caloric content and HSI supported previous reports of buoyancy regulation and was most evident in the Pacific sleeper shark *Somniosus pacificus*.

Mathematics, Computer Science and Statistics
Addition to lecture presentations, Friday
11:10 **APPLICATION OF PROBABILISTIC NEURAL NETWORKS FOR THE CLASSIFICATION OF REMOTESENSING SPECTRAL REFLECTANCE DATA OF STRESSED SOYBEAN LEAF**
Abdullah Faruque and Gregory A. Carter, Mississippi Valley State University, Itta Bena, MS 38941, and Gulf Coast Research Laboratory, Ocean Springs, MS 39566

This research paper describes the application of probabilistic neural networksas a superior pattern recognition tool for the classification of remote sensing spectral reflectance data of stressed soybean leaves. The objective of this study funded by National

Aeronautics Space Administration (NASA) at Stennis Space Center was to record and classify the spectral reflectance differences of leaf stress caused by drought, fungal disease, and lead contamination of the soil. Reflectance spectra of drought stressed, lead contaminated and fungal infected leaves were measured using GER1500 Spectroradiometer for 512 spectral bands with 1.52nm intervals from 308nm to 1089nm. Probabilistic neural network model was used to train and predict the different classes of stressed leaves from their spectral signature. The classification performance of probabilistic neural networks was compared to K-nearest neighbor and other statistical pattern recognition techniques. The superior classifica!tion capability of probabilistic neural networks refined with an additional research can be used to monitor more precisely the signs of damaging stress due to different factors on economic crops.

Psychology and Social Sciences
Addition to poster presentations, 6:00p Thursday
HEALTH OF THE MANGUM MOUNDS (22Cb584) POPULATION: A LOOK AT ENAMEL HYPOPLASIAS AND STATURE
Amber Martin, University of Southern Mississippi, Hattiesburg. MS 39406

This paper looks at the health of the prehistoric population from the Mangum site, located in Claiborne County, Mississippi, on the Natchez Trace and dating to the Plaquemine cultural period (1400-1650 AD). Teeth were examined from 21 individuals for whom a central maxillary incisor and/or mandibular canine was available. Hypoplasias were considered present if there was a transverse furrow across the tooth's

surface. The non-specific defect results from any sort of growth disruption; age at formation was determined as well. Stature was determined based on long bone lengths using regression formulae (Trotter-Gleser 1958). Results showed that 5 individuals (24%) had at least one hypoplasia. Most of the episodes were slight. Age at formation centered between ages 2.5 and 4. When the sexes were compared, 2 of 11 males (18%) were affected as compared to 2 of 13 females (15%). Average age at formation did not vary by sex. Mean male height was 169.83 cm whereas mean female stature was 163.06 cm. These results were quite tall compared to other regional groups. When hypoplasia formation was compared with stature, no significant correlation was seen. These results of low hypoplasia formation and tall stature suggest that the Mangum population was well adapted to their environment. Many groups dependent on maize agriculture experienced significant health problems, especially as they were undergoing transition. The Mangum group, however, dates to several centuries after transition. Thus, the examination of the skeletal material helps us to understand their health status in relation to subsistence.

Zoology and Entomology

Addition to lecture presentations, Thursday
2:40   **MOLECULAR SYSTEMATICS OF THE HETEROCERIDAE, BASED ON 28S RDNA AND EF-1&ALPHA SEQUENCE** Jonas King, University of Mississippi, University, MS 38677

The Heteroceridae are a cosmopolitan family of beetles that occur on everycontinent except Antarctica. There are currently around 250 described species worldwide, with 87 known from the New World, including 34 from the United States. Despite the abundance and ecological significance of the family, heterocerids are poorly studied and their taxonomy is unresolved. The current study aims at resolving infrafamilial relationships within the group using data from DNA sequences. A brief introduction to molecular systematics and DNA marker selection will be included.

2006 MAS Outstanding Contribution to Science Award Winner
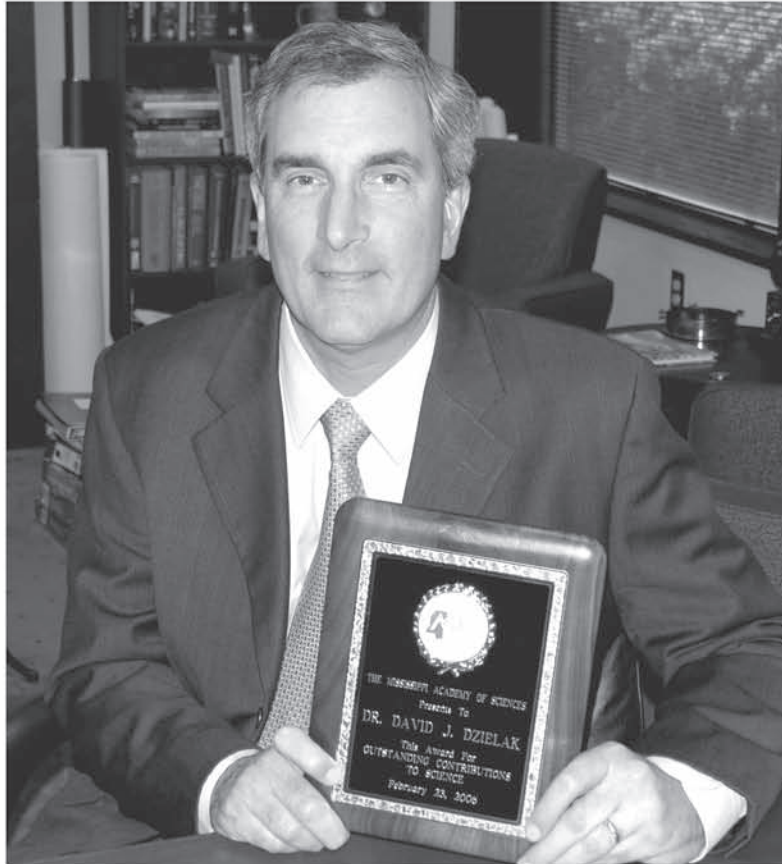
MAS Outstanding Contribution to Science Award Winner. Dr. David Dzielak, Associate Vice Chancellor, Office of Research, University of Mississippi Medical Center.

Dr. David Dzielak's outstanding record in teaching, research and service to the community has earned him accolades from the Mississippi Academy of Sciences.

Dzielak, associate vice chancellor for strategic research alliances, is the 2006 recipient of the Mississippi Academy of Sciences "Outstanding Contribution to Science Award."

"I was really surprised to get nominated," Dzielak said. "It really is quite an honor."

Dzielak was nominated by Dr. Ham Benghuzzi, professor and interim chair of cytotechnology and chairman of health sciences.

"He has helped our students to understand the basic and advanced physiological components of the nervous and

gastrointestinal systems," Benghuzzi said. "The students find Dr. Dzielak easy to understand as well as readily available to help them on a one to one basis to understand the concepts."

A New York native, Dzielak received his baccalaureate degree from Cornell University and earned his PhD in pharmacology and toxicology at the Medical Center in 1981. He completed a postdoctoral fellowship in physiology and biophysics here in 1983 and joined the UMC faculty as an assistant professor in the department of physiology and biophysics. After a brief stint in the pharmaceutical industry in 1986 he returned to the Medical Center in 1987 in the Department of Surgery. He is currently a professor of surgery and an associate professor of physiology and biophysics. Dzielak was cited for teaching excellence by the M1s in 1995 and by the Carl G. Evers Society in 1997-1998. He was named executive director of the Office of Research in 1998, associate vice chancellor for research in 2001, and to associate vice chancellor for strategic research alliances in 2005.

Dzielak has been a recipient of the Special Research Achievement Award from the Mississippi Affiliate of the American Heart Association. Included among his professional memberships are the American Physiological Society Sigma Xi, the American Association for the Advancement of Science and the American Society of Hypertension.

"I am pleased the Mississippi Academy of Sciences has recognized Dr. Dzielak's contributions to science with this award," said Dr. Dan Jones, vice chancellor for health affairs. "Dr. Dzielak has been a key to our institution's progress in research in the recent years. I congratulate him on this recognition."

Benghuzzi said he has witnessed first hand Dr. Dzielak's love for teaching.

"He is very dynamic and uses many motivational approaches to try and instill the same interest in his field to the students," he said. "Dr. Dzielak's mannerisms and character allow the students to feel comfortable to approach him for help."

"What is most impressive about Dr. Dzielak is his ability to listen. He is never too busy to listen and advise whether it be students, colleagues, or congressman. There is no doubt that he is truly an excellent teacher, researcher and administrator."

-Jenny Woodruff

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Information for Contributors

Journal of the Mississippi Academy of Sciences

Submit three clear copies of the manuscript, together with a covering letter, to the editor of the journal. The covering letter should authorize publication; give the full names, addresses, and telephone numbers for all authors; and indicate the author of correspondence to whom bills, proofs, reprints, and other correspondence should be sent. Notify the editor of any changes prior to publication. All manuscripts should be typed, double spaced throughout, including literature lists, tables, and figure legends, on 8½ x 11 inch paper with 1 inch margins on all sides. Place the last names of each author, an abbreviated title, and the page number at the top of each page.

General articles. The format for general articles is flexible. You may use any style and organization appropriate to the subject matter. However, if the manuscript includes literature citations, tables, or figures, these should conform to the style and format given below for research papers.

Research papers. The following sequence should be used:

1. Title page. Give the concise title of the paper and the full name and complete address of each author. If a scientific name of an organism appears in the title, include an indication of its taxonomic position (e.g., "Survival of *Scenedesmus acuminatus* (Chlorophyceae) in darkness"). Indicate with a superscript number the author to contact regarding correspondence and reprints if there are multiple authors.
2. Abstract. Include a concise abstract of no more than 250 words. This abstract should contain only objectives, results, and conclusions, and should not make reference to tables or figures or to literature. It should be useable by abstracting services without change.
3. Introduction. Discuss briefly the rationale for and purpose of the investigation. You may include important findings. Consider that many readers will not be expert in the particular field.
4. Materials and methods. Include sufficient detail so that the results of your investigation could be duplicated.
5. Results. Report data you have collected. Tables and figures may be appropriate, but a prose description of significant data is necessary. Note that the significance of your data should be reported in the Discussion section. Metric units (International System of Units, SI) must be used for quantitative data.
6. Discussion. Report the significance of the results of your research here. In this section you must convince your readers that you accomplished the purpose of your research described in the introduction. You may combine results and discussion into one section, in which case a brief Conclusions section may be appropriate.
7. Acknowledgments. Financial or other assistance should be acknowledged in this section rather than in the body of the text.
8. Literature cited. List references alphabetically. Cite references in the text by author and year of publication (e.g., Smith, 1975; Black and Jones, 1982; Smith et al., 1989; Jones, 1985a, 1985b). The following examples illustrate the style to be used in the literature list.

> Wilson, M.C. 1988. Euphoria and other behavioral sequelae to cocaine abuse. J. Miss. Acad. Sci. 33:25–27.
> Evert, R.F., R.D. Warmbrodt, and S.E. Eichhorn. 1989. Sieve-pore development in some leptosporangiate ferns. Amer. J. Bot. 76:1404–1413.
> Bold, H.C., C.J. Alexopoulos, and T. Delevoryas. 1980. Morphology of plants and fungi, 4th ed. Harper and Row, NY. 819 pp.
> Keohn, R.K., A.J. Zera, and J.G. Hall. 1983. Enzyme polymorphism and natural selection. Pages 115–136 *in* M. Nei and R.K. Koehn, eds. Evolution of genes and proteins. Sinauer Associates, Sunderland, MA.

9. Tables. Reference tables sequentially in the text. Type each table on a separate page. A descriptive title including the table number in Arabic numerals must appear at the top of each table. Keep footnotes to a minimum. Use superscript lower case letters to mark footnotes.
10. Figures. Reference figures sequentially in the text. Submit original art with black ink or laser print on white paper or a glossy black and white photograph. Plan drawings so that lettering and lines will remain visible if reduction is necessary for journal page constraints. Drawings and photographs where a scale is needed must contain a measured mark. Type figure legends double spaced on a separate page from the figures. Number legends sequentially with Arabic numerals followed by a descriptive title. Include sufficient explanatory material to interpret the figure.

Laboratory and field exercises. Descriptions for laboratory or field exercises should include the title page, introduction, and literature cited sections as described for research papers. The general format is flexible, but should include sections describing objectives, materials needed, length of the exercise, any necessary teacher background information, and procedural notes including any required advance preparation. The inclusion of questions for students is appropriate.

Brief communications. Manuscripts under two pages concerning any aspect of science in Mississippi are considered. An abstract is not required and the format is flexible.

Consult recent issues of the journal for further guidance. The editor uses the Council of Biological Editors Style Manual for guidance.

All correspondence concerning publication should be directed to the office of the Mississippi Academy of Sciences:

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