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EDITOR

103rd Annual Meeting

April 18, 2011

Minot, North Dakota

TABLE OF CONTENTS

EDITOR'S NOTES

HISTORY

The *Proceedings of the North Dakota Academy of Science* (NDAS) was first published in 1948, with Volume I reporting the business and scientific papers presented for the 40th annual meeting, May 2-3, 1947. Through Volume XXI**,** the single yearly issue of the *Proceedings* included both abstracts and full papers. Commencing with Volume XXII, the *Proceedings* was published in two parts: A, published prior to the annual meeting, contained an abstract of each paper to be presented at the meeting, and B, published later, contained full papers by some of the presenters.

In 1979 (Vol. 33) the *Proceedings* changed to an 8½ x 11-inch format. Produced from camera-ready copy submitted by authors, it was distributed at the annual meeting. As desktop computing became more prevalent vol. 51-vol. 64 of the *Proceedings* were assembled with desktop publishing software from submitted computer disks. The current volume was assembled from electronic submission of abstracts via email and the *Proceedings* archived online as pdfs.

VOLUME 65 ORGANIZATION

In 2003 the NDAS council voted to accept all abstracts scheduled for presentation at the Annual Meeting. Thus, communications in volumes 58 to present haven't undergone a "typical" peer review. Rather, they provide an accurate reflection of the material presented before the NDAS membership at the Annual Meeting. The presentations in this year's *Proceedings* are presented in three major sections. The first contains the undergraduate communications presented as part of the A. Rodger Denison Student Research Competition. The second section comprises the graduate Denison Competition papers, and the final section comprises professional communications presented by faculty members of the Academy. Readers may locate communications by looking within the major sections of these *Proceedings (see table of contents)* or by referring to the author index on page 91.

IN APPRECIATION

The Academy wishes to acknowledge current and emeritus members of the Academy who continue to support the mission of the North Dakota Academy of Science Research Foundation through their special gifts. A listing of these supporters accompanies the Financial Report. The Academy also wishes to express its thanks to the presenters of papers at the Annual meeting, the session chairs, as well as all who have helped in organizing spaces and places, soliciting manuscripts, and compiling of this year's communications. The President of the Academy also wishes to sincerely thank Spero Manson who served as honored guest speaker at this year's meeting.

Lyle Best,
President

Paul Lepp,
Secretary-Treasurer

SUMMARY SCHEDULE

Time			Auditorium	Room 125
8:00 AM	8:50 AM	Breakfast, Registration	--	--
8:50 AM	9:00 AM	Welcome - Lyle Best	--	--
9:00 AM	9:20 AM	--	Boomersbach	McLean
9:20 AM	9:40 AM	--	Bruenjes	Chaithawiwat
9:40 AM	10:00 AM	-	Cain	Samanta
10:00 AM	10:20 AM	-	DeLorme	Best
10:20 AM	10:40 AM	Break	--	--
10:40 AM	11:00 AM	--	Badh	Burckhard
11:00 AM	11:20 AM	--	Nelson	Namanny
11:20 AM	11:40 AM	--	Goldenstein	Chen
11:40 AM	12:00 AM		Wu	Dasari
12:00 PM	1:00 PM	Lunch	--	--
1:00 PM	1:20 PM	--	Marwarha	Soumaila
1:20 PM	1:40 PM	--	Wagner	Uran
1:40 PM	2:00 PM	--	Rath	Nkuni
2:00 PM	2:20 PM	--	Lynnes	Soh
2:20 PM	2:40 PM		Kraft	Beachy
2:40 PM	3:00 PM	break	--	--
3:00 PM	3:20 PM	--	Lepp	Weiler
3:20 PM	3:40 PM	--	Dedra Buchwald	--
3:40 PM	4:00 PM		Dedra Buchwald	--
4:00 PM	4:20 PM		Dedra Buchwald	--
4:20 PM	5:00 PM	break		

5:00 PM	7:00 PM	Award ceremony, NDAS elections, dinner
7:00 PM	8:00 PM	Guest Speaker – Spero Manson
8:00 PM	9:00 PM	Social Hour

AUDITORIUM SCHEDULE OF PRESENTATIONS

MORNING SESSION

9:00 AM SPECIES DIVERSITY AND POPULATION DENSITIES OF UNIONID MUSSELS IN THE MAPLE RIVER. Adam J. Bommersbach, Louis M. Wieland, Gerald L. Van Amburg, Andre W. DeLorme

9:20 AM COMPARISON OF POPULATION DYNAMICS OF TWO UNIONID MUSSEL SPECIES IN BEDS OF HIGH AND LOW SPECIES DIVERSITY. Joseph D. Bruenjes, Gerry Van Amburg, and Andre W. DeLorme

9:40 AM VASCULAR ENDOTHELIAL GROWTH FACTOR (VEGF) REGULATION OF EARLY FOREBRAIN NEURALEPITHELIUM DEVELOPMENT. Cain, J.T., Berosik, M.A., Frisch, S., Odens, P.W., Urquhart, S. Dvorak, S., and Darland, D.C.

10:00 AM THE MUSSEL FAUNA OF NORTH DAKOTA RIVERS. Andre W. DeLorme

10:20 AM Break

10:40 AM UNDERSTANDING GROWING DEGREE DAYS FOR CORN IN THE UNITED STATES OF AMERICA. Ambika Badh, Adnan Akyuz, Gary Vocke and Barbara Mullins

11:00 AM A1A ADRENERGIC RECEPTOR ACTIVATION ATTENUATES HIPPOCAMPAL EPILEPTIFORM ACTIVITY AND INCREASES SEIZURE RESISTANCE IN MICE. Brian W. Nelson, Brianna Goldenstein, Dianne M. Perez & Van A. Doze

11:20 AM CHRONIC A1A –ADRENERGIC RECEPTOR ACTIVATION ENHANCES SYNAPTIC PLASTICITY IN THE HIPPOCAMPAL CA1 REGION OF AGED MICE. Brianna L Goldenstein, Brian W Nelson, Dianne M Perez, Van A Doze

11:40 AM SENSITIVE DETECTION OF DNA BASED ON GOLD NANOPARTICLES AND AUTONOMOUS DNA MACHINE. Xu Wu, Siyang Qin, Julia Xiaojun Zhao

12:00 AM Lunch

AFTERNOON SESSION

1:00 PM IGF-1 AND LEPTIN MUTUALLY UPREGULATE THE EXPRESSION OF EACH OTHER IN THE RABBIT HIPPOCAMPUS – IMPLICATIONS FOR ALZHEIMER'S DISEASE. Gurdeep Marwarha and Othman Ghribi

1:20 PM DOES ABSCISIC ACID CONTROL THE GROWTH EFFECTS OF INDOLE-3-ACETIC ACID IN EXPANDING ARABIDOPSIS LEAVES? Samuel L. Wagner, Amanda M. Roise, and Christopher P. Keller

1:40 PM EVALUATING HOST BASED DIFFERENCES IN AGGRESSIVENESS OF FUSARIUM GRAMINEARUM AND FUSARIUM CULMORUM. Kishore Chittem, Travis Rathand Rubella S. Goswami

2:00 PM DEVELOPMENT OF A PCR-BASED ASSAY FOR THE DETECTION OF RESISTANT ISOLATES OF ASCOCHYTA RABIEI TO QoI FUNGICIDES. Javier A. Delgado, Ty C. Lynnes, Steven W. Meinhardt, Samuel G. Markell, and Rubella S. Goswami

2:20 PM CADMIUM TISSUE INTEGRATION IN THE WESTERN TIGER SALAMANDER, AMBYSTOMA MAVORTIUM, IN NORTHWEST NORTH DAKOTA WETLANDS. Amanda Kraft, Naomi Winburn, Ryan Winburn, Kenneth Cabarle, and Christopher Beachy

2:40 PM BREAK

3:00 PM BACTERIAL POPULATION STRUCTURE AND DYNAMICS OF A GASIFICATION COOLING TOWER. Paul W.Lepp, Joshua J.Sweet, and Brian Striefel

3:20 PM DEDRA BUCHWALD - GUEST SPEAKER

ROOM 125 SCHEDULE OF PRESENTATIONS

MORNING SESSION

9:00 AM PHYTOREMEDIATION OF COAL ASH AND COAL ASH MIXED WITH ADDITIVES. Erin McLean, Fakira Soumaila, Andrew J. Hager, Aaron Dobmeier, and Jerzy Bilski

9:20 AM EFFECTS OF NANOSCALE ZERO-VALENT IRON ON BACTERIAL VIABILITY: ROLE OF GROWTH PHASES. Krittanut Chaithawiwat, Alisa Vangnai, John Mcevoy, Birgit M. Pruess, and Eakalak Khan

9:40 AM GENE REGULATION IN *ESCHERICHIA COLI* BIOFILMS. Priyankar Samanta, Shelley M. Horne, Birgit M. Prüβ

10:00 AM PRELIMINARY ANALYSIS OF MICROARRAY GENOTYPES FROM AN AMERICAN INDIAN POPULATION**.** Lyle G. Best,1 Kylie Davis, Shellee Bercier, Felicia Lamb, Shyleen Poitra, Brendan J. Keating

10:20 AM Break

10:40 AM RAPID SYNTHESIS OF N-[1-(4-METHOXYPHENYL)ETHYL]FORMAMIDE**.** Braden A. Burckhard, Mikhail M. Bobylev

11:00 AM RAPID SYNTHESIS OF N-(4-ISOPROPYLBENZYL)FORMAMIDE**.** Halee Namanny, Mikhail M. Bobylev

11:20 AM DEVELOPMENT OF A BIOSENSOR FOR MONITORING OF MERCURY POLLUTION IN NATURAL WATER. Jiao Chen, Julia Xiaojun Zhao

11:40 AM CHOLESTEROL-ENRICHED DIET CAUSES AGE-RELATED MACULAR DEGENERATION-LIKE PATHOLOGY IN RABBIT RETINA. Bhanu Dasari, Jaya Prasanthi R.P., Gurdeep Marwarha, Brij B Singh, Othman Ghribi

12:00 AM Lunch

AFTERNOON SESSION

1:00 PM UTILIZATION OF DIFFERENT RATES OF COAL FLY ASH IN FLY ASH/SOIL PLANT GROWTH MEDIA. Fakira Soumaila, Erin Mclean, Andrew Hager, Aaron Dobmeier, and Jerzy Bilski

1:20 PM RAPID SYNTHESIS OF N-(4-T-BUTYLBENZYL)FORMAMIDE. Luke Uran, Doug M. Fredrich, Mikhail M. Bobylev

1:40 PM RAPID SYNTHESIS OF N-(1-NAPHTHYLMETHYL)FORMAMIDE. Yannick Nkuni, Mikhail M. Bobylev

2:00 PM ENOLASE-2 EXPRESSION IS INDUCED IN HUMAN BREAST EPITHELIAL (MCF-10A) CELLS EXPOSED TO OR MALIGNANTLY TRANSFORMED BY ARSENIC (As^{+3}) AND CADMIUM (Cd^{+2}). Maureen Soh, Scott H Garrett, Chandra Bathula, Jane Dunlevy, Xu Dong Zhou, Don A Sens, Seema Somji, Mary Ann Sens

2:20 PM CADMIUM INDUCTION OF GENE EXPRESSION IN SALAMANDER AND BIOMONITORING IN AN AGRICULTURAL LANDSCAPE . Christopher K. Beachy, Kenneth C. Cabarle, Robert B. Page, and S. Randal Voss

2:40 PM BREAK

3:00 PM AN OCCURRENCE OF THE FOSSIL INSECTIVORE, ANKYLODON PROGRESSUS IN THE BRULE FORMATION OF SOUTHWESTERN NORTH DAKOTA AND IMPLICATIONS REGARDING ANKYLODON SYSTEMATICS. Matthew W. Weiler and Karew K. Schumaker

UNDERGRADUATE COMMUNICATIONS

IN THE

A. ROGER DENISON COMPETITION

(communications are listed alphabetically by the last name of the presenting author)

SPECIES DIVERSITY AND POPULATION DENSITIES OF UNIONID MUSSELS IN THE MAPLE RIVER

Adam J. Bommersbach*[1], Louis M. Wieland[1], Gerald L. Van Amburg[2], Andre W. DeLorme[1]

[1]Department of Biology, Valley City State University, Valley City, ND 58072; [2]Department of Biology, Concordia College, Moorhead MN, 56562.

Introduction - In the summers of 2008 - 2010 our lab conducted timed searches on North Dakota rivers looking for mussels (Unionacea). Those qualitative surveys have shown that, of the 15 species of mussels known to exist in North Dakota, 9 of them can be found in the Maple River, thus making it one of the most species rich rivers in the state for mussels. The Maple River is located in southeastern North Dakota. It confluences with the Sheyenne River near Fargo, North Dakota and enters the Red River north of Fargo. In order to better understand the population dynamics of the mussels that occupy the Maple River, and to build baseline data for use in future mussel monitoring studies, in 2010 we conducted a quantitative survey on 2 sites on the Maple River.

Methods - Qualitative timed samples were done on 13 sites on the Maple River. Timed searches consist of a crew of four searchers wading the river and searching for mussels for 30 minutes. This provides 2 person hours of search time per site. From these 13 sites, 2 sites were chosen for a more rigorous quantitative sampling protocol. This quantitative survey employed a quadrat sampling technique with multiple random starts. At each of the two sites we sampled a one hundred meter stretch, then moved down an additional 100 meters, and sampled a second one hundred meter stretch. We examined a range of 98 to 131 0.25 m^2 quadrats in a 100 meter stretch of the river.

Results - There is a clear increase of species and diversity in certain areas of the Maple River. This fact is displayed by the presence of as few as 2 species per site, to other areas with as many as 6 species per site. No mussels were found at three of the thirteen qualitative sites, all three of these were in the upstream area of the river. Density estimates peak approximately midway downstream, with a maximum of 3.0 mussels/M^2, after which they drop to 0.9 mussels/M^2. In both quantitative sites sampled there was a relatively high variability between the two one hundred meter sampling sections. We did observe what seemed to be a large die off of mussels in a site just east of the town of Enderlin. Few live mussels were found, but large numbers of dead mussels with empty shells were present.

Discussion - The Maple River contains some of the highest diversity of mussel species of any river in North Dakota. The apparent die off near Enderlin may be cause for concern, but did not seem to affect sites farther downstream. The Maple River showed a similar pattern to other tributaries of the Red River in that it had its' highest diversity and densities in the middle section of the river, with these numbers decreasing both upstream and downstream. The information that is gathered during surveys such as these is an invaluable tool for monitoring and preserving the status of unionid mussels in North Dakota.

This project was funded by a State Wildlife Grant from the North Dakota Game and Fish Department.

COMPARISON OF POPULATION DYNAMICS OF TWO UNIONID MUSSEL SPECIES IN BEDS OF HIGH AND LOW SPECIES DIVERSITY

Joseph D. Bruenjes[1*], Gerry Van Amburg[1], and Andre W. DeLorme[2];

[1]Department of Biology, Concordia College, Moorhead, MN 56562; [2]Department of Science, Valley City State University, Valley City, ND 58072.

Introduction: Many organisms experience growth limitations with respect to several factors. Population density of particular organisms has been shown to limit specific growth patterns by competition for space and resources. Native North American bivalves often thrive in mussel beds with high densities. We hypothesized that species richness and density of a bed negatively affect the size distribution of a particular population. Size characteristic of the Unionid mussel species *Pygandon grandis* and *Lampsilis siliquoidea* at three sites on the Sheyenne River were examined to determine the effect of species richness and density on mussel population size. The three sites surveyed varied in mussel density and species richness.

Methods: The three sites in this study were located between Flora (Lat: 47.90792, Long: -99.41576) and Kathryn (Lat: 46.67372, Long: -97.94555) on the Sheyenne River. The sites were sampled following a systematic method of sampling advocated by Strayer and Smith (2003). In this method, three random starts were used to randomly place sample quadrats of 0.25 m² along two 100 m reaches of the selected river sites (separated by 100 m). Every fourth quadrat placed was excavated to a depth of 10 cm. The mussel species was identified using shell characteristics, while length, width, and depth measurements were recorded. Length measurements were taken at the longest reach between anterior and posterior ends. Width measurements were taken from the ventral umbo to the dorsal side of the mussel. Depth measurements were taken at the widest lateral distance.

Results: The site with the highest density (46.76 mussels/ m^2) and species richness (8) had the greatest average length of *P. grandis* and *L. siliquoidea* (10.43 cm, 9.00 cm). This site also had the largest size range found for the two mussel species (10.43 cm, 9.3 cm) and had the most even size distributions. The site with the lowest density (9.61 mussels/m^2) and species richness (2) had the smallest average length for *P. grandis* and *L. siliquoidea* (9.10 cm, 8.28 cm), while the site with the moderate density (10.81 mussels/ m^2) and species richness (2) had the smallest size range (7.4 cm, 5.3 cm).

Discussion: We found an increase in the average size and size range of the mussel species *P. grandis* and *L. siliquoidea* at the site with the highest species richness and density. This suggests that an increase in mussel density does not have a negative correlation to mussel size and growth. Likely, many other ecological factors play an important role in the population dynamics of Unionid mussels. These ecological factors may include in stream vegetation, food availability, sedimentation, fish populations, dams, climate, and water quality.

Strayer, D. L., and Smith, D.R. 2003. A Guide to Sampling Freshwater Mussel Populations. American Fisheries Society Monograph 8.

This project was funded by a State Wildlife Grant from the North Dakota Game and Fish Department

RAPID SYNTHESIS OF N-[1-(4-METHOXYPHENYL)ETHYL]FORMAMIDE

Braden A. Burckhard*, Mikhail M. Bobylev

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Background and Objective: Substituted 1-phenylethylamines are important intermediates in the synthesis of numerous biologically active compounds, including agrochemicals and pharmaceuticals. They can be obtained from the respective substituted acetophenones via the intermediate substituted 1-phenylethylformamides. Recently, we developed an accelerated procedure for the synthesis of formamides. It was important to investigate if the procedure can be successfully applied for the synthesis of 1-phenylethylformamides with electron-donating substituents, for example N-[1-(4-methoxyphenyl) ethyl]formamide.

Methods: The reaction was conducted on 10 mmol scale at 188-192ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.

Results: The reaction was fully completed in 10 minutes and produced N-[1-(4-methoxyphenyl)ethyl] formamide in good yield. One byproduct was isolated and its structure was determined.

Discussion and Conclusions: The first rapid synthesis of N-[1-(4-methoxyphenyl)ethyl]formamide has been developed. The new reaction opens the way for the fast synthesis of N-[1-(4-methoxyphenyl)ethyl] amine and its derivatives in the laboratory practice and industry.

The project is supported by NIH grant P20 RR016741 from the NCRR

CADMIUM TISSUE INTEGRATION IN THE WESTERN TIGER SALAMANDER, *AMBYSTOMA MAVORTIUM*, IN NORTHWEST NORTH DAKOTA WETLANDS

Amanda Kraft[1*], Naomi Winburn[1], Ryan Winburn[1], Kenneth Cabarle[2,4] and Christopher Beachy[3,4]

[1]Department of Chemistry, Minot State University, Minot ND; [2]Department of Biology, University of North Dakota, Grand Forks ND; [3]Department of Biology, Minot State University, Minot ND; [4]Amphibian Growth Project, Minot State University, Minot ND

Earlier sampling and testing for cadmium in wetland soils and water, and in the liver of the western tiger salamander, *Ambystoma mavortium*, indicated that salamanders in North Dakota wetlands may bioaccumulate cadmium and could represent an excellent vertebrate biomonitoring system. We have begun a set of experiments designed to more explicitly test the (1) the bioaccumulation hypothesis, (2) the hypothesis that salamanders that differ in age and life cycle expression will differ in cadmium accumulation, (3) the hypothesis that geographic variation in cadmium risk is associated with cadmium loads in salamanders, and (4) possible positive correlation between cadmium integration in liver and tail/skin samples (which can be harvested without killing the salamander). Cadmium tissue integration was examined using standard chemical analyses using . Preliminary analyses suggest that (1) salamanders skin samples may not be a good predictor of liver cadmium load and (2) paedomorphic salamanders have lower cadmium loads than juvenile larval salamanders. These data suggest that younger salamander may be a more sensitive assay that older salamanders of water cadmium exposure.

This study was supported by NIH Grant Number P20 RR016741 from the INBRE Program of the National Center for Research Resources and a non-game research grant from the North Dakota Department of Game and Fish.

DEVELOPMENT OF A PCR-BASED ASSAY FOR THE DETECTION OF RESISTANT ISOLATES OF *ASCOCHYTA RABIEI* TO QoI FUNGICIDES

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Ascochyta blight of chickpea, caused by the fungal pathogen *Ascochyta rabiei*, causes significant yield losses in all chickpea growing areas of North America (2, 3). The disease is managed primarily by fungicide seed treatments and multiple foliar applications throughout the growing season (3). Quinone outside inhibitors (QoI) are a class of fungicides that had been very effective in controlling *A. rabiei*. However, the pathogen's populations in United States and Canada have been reported to have developed QoI resistance for over five years (4, 5). Since then, the disease management has been difficult and economically challenging. We have recently cloned and characterized a cytochrome b gene fragment that bears a point mutation which confers resistance to the quinone-outside inhibiting (QoI) fungicides in *A. rabiei*. Multiple alignments of gDNA, cDNA and protein sequences revealed a nucleotide point mutation that changed the codon 143 from GGT to GCT introducing an amino acid substitution from glycine to alanine (G143A). This mutation in the cytochrome b gene is known to confer resistance to QoI fungicides in several fungal plant pathogens (1).

A PCR-based diagnostic assay has been developed using a mismatch amplification mutation assay (MAMA) approach with allele-specific reverse primers that allows the screening of QoI sensitive and QoI resistant isolates of *A. rabiei*. This PCR assay is carried out with two endpoint PCRs: QoI sensitive MAMA-PCR and QoI resistant MAMA-PCR. For this assay, two reverse primers 30 bp in length were designed to amplify either the wild-type G143-allele or the mutant A-allele. The amplified gDNA fragment is 202 bp long in both MAMA-PCRs. This assay was evaluated using QoI resistant and sensitive isolates that had been previously characterized using conventional spore germination tests with the QoI fungicide azoxystrobin and pyraclostrobin by Wise et al. (4, 5) and found to be capable to differentiating resistant and susceptible isolates accurately as shown in Fig 1.

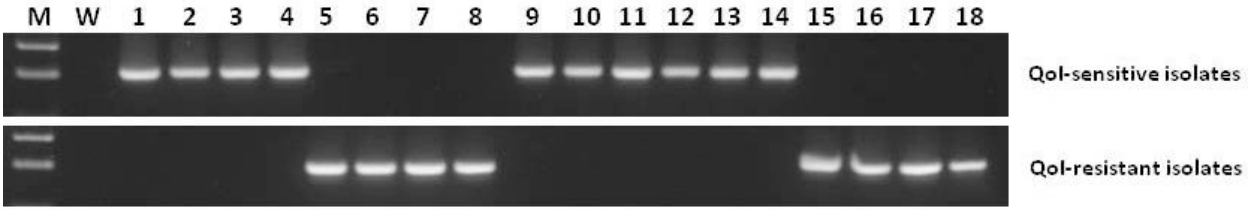

Fig. 1. Mismatch amplification mutation assay (MAMA) for screening of the G143A mutation on the cytochrome b gene of *A. rabiei*. Top picture illustrates QoI-sensitive isolates, while bottom picture shows QoI-resistant isolates. M stands for DNA ladder, W for water template. The amplicon size is 202 bp.

References

1) Fungicide Resistance Action Committee. 2006. Mutations associated with QoI-resistance Crop Life, Brussels, Belgium. Online: http://www.frac.info/frac/meeting/2007/Mutations_associated_with_QoI_resistance.pdf
2) Gan, Y.T., Siddique, K.H.M., MacLeod, W.J., and Jayakumar, P. 2006. Management options for minimizing the damage by ascochyta blight (*Ascochyta rabiei*) in chickpea (*Cicer arietinum* L.). Field Crops Res. 97:121-134.
3) Shtienberg, D., Vintal, H., Brener, S., and Retig, B. 2000. Rational management of *Didymella rabiei* in chickpea by integration of genotype resistance and postinfection application of fungicides. Phytopathology 90:834-842.
4) Wise, K.A., Bradley, C.A., Pasche, J.A. and Gudmestad, N.C. 2008. Baseline Sensitivity of *Ascochyta rabiei* to Azoxystrobin, Pyraclostrobin, and Boscalid. Plant Dis. 92:295-300.
5) Wise, K.A., Bradley, C.A., Pasche, J.S., and Gudmestad, N.C. 2009. Resistance to QoI fungicides in *Ascochyta rabiei* from chickpea in the Northern Great Plains. Plant Dis. 93:528-536.

PHYTOREMEDIATION OF COAL ASH AND COAL ASH MIXED WITH ADDITIVES

Erin McLean*, Fakira Soumaila, Andrew J. Hager, Aaron Dobmeier, and Jerzy Bilski

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The utilization of coal fly ash (FA) as a soil amendment is one of the most extensively studied reutilization options. Several studies have shown that FA can be used as a soil amendment for growing plants, despite the toxicity of heavy metals present in FA, FA high salinity, and high pH of FA. We have investigated the effects of the amelioration of FA based growth media which includes sphagnum peat moss (SPM), vermiculite (VC), soil and sand (S) on growth of six crop plants. The plant growth media were composed of FA alone (control), 50% FA+50% SPM, 33% FA+33% SPM+33% soil, 33% FA+33% VC+33% S, and 25% FA +25% VC +25% S +25% soil. Organic barley, Sudan grass, canola, rapeseed, alfalfa, perennial ryegrass were grown on petri dishes or 14-21 days. Experiment was conducted three times, each time in three replications. For each plan species, germination rates was determined, and plants were harvested, dried, dry matter weight was determined and analyzed for heavy metal concentration. Results demonstrated that the growth of tested plant species was greater on media containing additives, as compared to media composed of FA only. The addition of SPM to media containing FA expressed the highest ameliorative effect on FA. Among plant species tested, barley was especially adaptive to FA based media. In conclusion, FA based plant growth media supplements including SPM, VC and S should be considered as a subject of further in-depth study as FA additives. In addition, barley seems to be a plant which might be used to ameliorate coal ash piles.

Supported by North Dakota INBRE Grant Number P20 RR016741 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH).

RAPID SYNTHESIS OF N-(4-ISOPROPYLBENZYL)FORMAMIDE

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Background and Objective: Substituted benzylamines are important intermediates in the synthesis of numerous biologically active compounds, including agrochemicals and pharmaceuticals. They can be obtained from the respective substituted benzaldehydes via the intermediate substituted benzylformamides. Recently, we developed an accelerated procedure for the synthesis of formamides. It was important to investigate if the procedure can be successfully applied for the synthesis of benzylformamides with electron-donating substituents, for example N-(4-isopropylbenzyl)formamide.

Methods: The reaction was conducted on 10 mmol scale at 182-186ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.

Results: The reaction was fully completed in 2 minutes and produced N-(4-isopropylbenzyl)formamide in good yield. Three byproducts were isolated and their structures were determined.

Discussion and Conclusions: The first rapid synthesis of N-(4-isopropylbenzyl)formamide has been developed. The new reaction opens the way for the fast synthesis of N-(4-isopropylbenzyl)amine and its derivatives in the laboratory practice and industry.

The project is supported by NIH grant P20 RR016741 from the NCRR

RAPID SYNTHESIS OF N-(1-NAPHTHYLMETHYL)FORMAMIDE

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Background and Objective: N-(1-naphthylmethyl)amine is an important intermediate in the synthesis of biologically active compounds, including allylamine fungicides, such as naftifine, terbinafine, and butenafine. In the literature, N-(1-naphthylmethyl)amine has been synthesized by many different methods, but never from 1-naphthylcarboxaldehyde via an intermediate N-(1-naphthylmethyl)formamide. Recently, we developed an accelerated procedure for the synthesis of formamides. In this work, the accelerated procedure was applied to the synthesis of N-(1-naphthylmethyl)formamide.

Methods: The reaction was conducted on 10 mmol scale at 190-192ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was fully completed in 1 minute and produced N-(1-naphthylmethyl)formamide in good yield. Two byproducts were isolated and their structures were determined.

Discussion and Conclusions: The first rapid synthesis of N-(1-naphthylmethyl)formamide has been developed. The new reaction opens the way for the fast synthesis of N-(1-naphthylmethyl)amine and its derivatives in the laboratory practice and industry.

The project is supported by NIH grant P20 RR016741 from the NCRR

EVALUATING HOST BASED DIFFERENCES IN AGGRESSIVENESS OF *FUSARIUM GRAMINEARUM* AND *FUSARIUM CULMORUM*

Kishore Chittem, Travis Rath*and Rubella S. Goswami

Department of Plant Pathology, North Dakota State University, Fargo, ND 58108

Introduction: Root rots are a growing concern in edible legumes such as field peas/dry peas and dry beans in north central United States. These crops are commonly grown in rotation with cereals as they are capable of fixing nitrogen and are believed to be non-hosts for most cereal pathogens. However, disease surveys conducted in North Dakota overthe last three years demonstrated that *Fusarium*species including *F. graminearum*, and *F. culmorum,* known cereal pathogensassociated with Fusarium Head Blight (FHB), are causing root rots in field peas and dry beans.Findings from the survey prompted a study to evaluate the cross pathogenicity of isolates of these two fungal pathogens from legumes.

Objectives:

1) To evaluate the ability of isolates of *F. graminearum* and *F. culmorum*from field peas, dry beans and wheat to infect all three crops.
2) To assess the whether the ability of an isolate to produce mycotoxin is associated with its aggressiveness.

Materials and Methods: Ten*F. graminearum* isolates (5 dry bean, 3 field pea and 2 wheat), and seven *F. culmorum* (5 field pea, 1 dry bean and 1 wheat) were used in this study. The field pea variety DS Admiral andthe dry bean variety Red Hawk were inoculated using the sand corn-meal layer method (1).Disease severity was calculated as the percentage of lesion length compared total root length, 10 and 14 days after inoculation in field peas and dry beans, respectively. This experiment was laid out in a randomized complete block design with four replications and three plants per each replication, and repeated twice. Wheat heads were inoculated using a 10^6/ml spore suspension and rated at 14 days after inoculation (2). The inoculation was repeated once and eight heads were inoculated. Toxin production was analyzed using GC-MS. Data analysis was performed using PROC GLM procedure of SAS.Means werecompared using Fisher's protected leastsignificant difference (LSD), where $\alpha = 0.05$.

Results: Inoculation studies showed that all the *Fusarium* species used in these experiments can infect both legume hosts and wheat (Fig 1). Variation in aggressiveness among isolates was also observed (Table 1). Overall, higher disease severity was recorded on field pea compared to dry bean. Isolate wise comparison between hosts also revealed that, field pea is more susceptible than dry bean. Toxin analysis with a subset of above isolates on wheat heads confirmed the DON toxin accumulation, ranging from 54.5 to 262.7 ppm and a positive correlation between amount of toxin produced and disease severity was found (data not presented). Toxin assay on legume roots is yet to be determined.

Conclusions:*F. graminearum* and *F. culmorum,* which were considered as major cereal pathogens (FHB complex), are also associated with field pea and dry bean root rots.Our current study reveals that, irrespective of the host from which isolated from, these two pathogens can infect both legume hosts and cereals. Variation in aggressiveness among isolates, and between hosts was observed. A correlation between toxin production and aggressiveness on wheat heads was observed. The findings from our study,highlight the fact that such changes in the host may threaten the use of crop rotation as a disease management option.

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UTILIZATION OF DIFFERENT RATES OF COAL FLY ASH IN FLY ASH/SOIL PLANT GROWTH MEDIA

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A vegetative cover is a remedial technique to stabilize coal fly ash (FA) landfills, and to physicaly and chemicaly immobilize heavy metals present in FA. However, there is a great concern, that plants planted or voluntarily growing on media with high content of FA may absorb toxic amounts of Se and/or heavy metals. Despite these objections, the utilization of FA as a growth medium for plants is an attractive alternative for disposal of FA in landfills. We hypothesized that selected plants will grow in media containing FA and/or soil mixed with FA. Therefore, the objective of this experiment was to determine the effects of growth media containing FA and FA mixed with soil on several cereal crop plants growth including germination, seedlings growth, and heavy metals, B and Se accumulation in the seedlings. We studied the influence of various FA concentrations (e.g., 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of FA in growth media by weight basis) in FA/soil composed media on the germination, growth, and heavy metals uptake of the following plants: barley, Sudan grass, ryegrass, rape, alfalfa, and canola. Plants were grown on Petri dishes (10 cm diameter, 3 replications) for 14-21 days, harvested, dried, and weighed. Experiments have been replicated three times. The concentrations of Ag, Al, As, B, Ba, Be,Ca, Cd, Ce, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, V, Zn, and Zr in growth media was determined, and the concentrations of the same elements in young plants was analyzed. Addition of 10, 20, 30 and 40 % of FA to the soil was beneficial for the plants as compared to FA alone used as a growth media. Preliminary results of chemical analysis of FA and harvested young plants implicate that plants do not accumulate toxic amounts of heavy metals even being grown on media containing 100% FA. Our research results indicate that coal FA might be used as a plant growth media additive,. However, additional studies should be undertaken to determine the effects of FA on plants grown till maturity.

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RAPID SYNTHESIS OF N-(4-T-BUTYLBENZYL)FORMAMIDE

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Background and Objective: Substituted benzylamines are important intermediates in the synthesis of numerous biologically active compounds. They can be obtained from the respective substituted benzaldehydes via the intermediate substituted benzylformamides. Recently, we developed an accelerated procedure for the synthesis of formamides. It was important to investigate if the procedure can be successfully applied for the synthesis of benzylformamides with electron-donating substituents, for example N-(4-t-butylbenzyl)formamide.

Methods: The reaction was conducted on 10 mmol scale at 190ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.

Results: The reaction was fully completed in 1 minute and produced N-(4-t-butylbenzyl)formamide in good yield. Three byproducts were isolated and their structures were determined.

Discussion and Conclusions: The first rapid synthesis of N-(4-t-butylbenzyl)formamide has been developed. The new reaction opens the way for the fast synthesis of N-(4-t-butylbenzyl)amine and its derivatives in the laboratory practice and industry.

The project is supported by NIH grant P20 RR016741 from the NCRR

DOES ABSCISIC ACID CONTROL THE GROWTH EFFECTS OF INDOLE-3-ACETIC ACID IN EXPANDING ARABIDOPSIS LEAVES?

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Indole-3-acetic acid (IAA), a plant morphogenic hormone, controls multiple aspects of plant growth including vascular development and root and leaf initiation. Earlier reports presented at this venue[1,2,3] have described how IAA can also effect leaf expansion. Increasing the IAA content of intact expanding leaves of Arabidopsis and Phaseolus, either through exogenous application or through trapping the endogenous hormone in leaves, results in inhibition of leaf growth.

[2,3,4] Paridoxicaly, other work has clearly shown that treatment of excised leaf strips from tobacco (Nicotiana) and Arabidopsis with IAA stimulates rather than inhibits growth.[1,]

Earlier investigations have suggested that leaf tissue must be both wounded and detached from the plant for IAA to induce increased growth. Supporting evidence includes that the growth of excised intact leaves is inhibited by IAA and that the growth of wounded attached leaves is also inhibited by IAA while similarly wounded leaves once detached grow more treated with IAA[1].

The current study addresses the requirement for detachment from the plant for IAA-induced growth. Implied is that an entity, continuously supplied by the rest of the plant, somehow interacts with IAA or auxin signal transduction in leaf blades of the intact plant to inhibit growth and preventing IAA-induced growth. A chemical signal seems most likely. Given the root to shoot movement of xylem transport, the chemical signal would seem most likely to originate from the root. Several candidate root derived chemical signals are known but the isoprenoid compound abscisic acid (ABA; 5-(1-Hydroxy-2,6,6-trimethyl-4-oxo-2-cyclohexen-1-yl)-3-methyl-2,4-pentanedienoic acid) seems a particularly strong candidate as it is a known plant growth inhibitor.

As for previous experiments for this ongoing project, seedlings of Arabidopsis were grown in moist potting soil in a growth chamber at 19°C, with continuous illumination. After 10-14 days, plants were selected with both the first two true leaves 2.8-3.2 mm in diameter and rapidly expanding. One of these first two leaves from each plant served as the experimental (IAA +/- ABA treated) leaf and the other leaf served as a paired control. Scaled digital images of excised leaf strips (0.7 mm wide cut transversely across the midpoint of the leaves) were prepared for determination of initial leaf strip area. Leaf strips were then treated 24 hours with full strength Murashige and Skoog media (with 10 mM KCl and 0.1 mM Mes/Btp (pH 6.0)) or the same +/- 50 µM IAA +/- 10 µM ABA. After 24 hours increased area of leaves and strips was determined from digital images.

As in previous experiments IAA was found to inhibit the expansion of excised leaf strips while leaf strips treated with 10µM ABA grew significantly less over 24 hours than control strips. In other paired experiments ABA and IAA treated strips grew less than IAA treated strips while ABA and IAA treated strips grew more than strips treated with ABA alone. These results showing antagonistic growth effects of the two hormones suggests that, in the intact plant, elevation of leaf IAA may induce ABA synthesis, both within the leaf and in the root. Ongoing efforts to test this possibility will be described.

This project is supported by NIH grant P20 RR016741 from the NCRR

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GRADUATE COMMUNICATIONS

IN THE

A. ROGER DENISON COMPETITION

(communications are listed alphabetically by the last name of the presenting author)

UNDERSTANDING GROWING DEGREE DAYS FOR CORN IN THE UNITED STATES OF AMERICA

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The base temperature for corn is 50°F (10℃). Above this temperature corn starts to accumulate heat units also termed as growing degree days (GDD). Each stage of corn development needs a certain amount of GDD units. There are different varieties of corn and each requires different amounts of GDD units to mature. We have tried to tabulate GDD variations for corn in various states of US over the past century. GDD Data based on 50°F (10℃) from local climatological data (LCD) sites has been directly used and statistically tested for significance. Trends in the annual accumulated GDD have been studied. An online data base for the same has been prepared to make the GDD data for all states available to the public, here is the link, http://www.ndsu.edu/pubweb/flood/GDD/.

The GDD trends for various states in the country have shown varied results. Out of the 245 different locations studied in the US, 156 locations showed a significant trend (5% significance level) in the annual accumulated GDD, out of which 127 locations showed a positive trend and 29 showed a negative trend. The results depicts that 64% of the locations used in this study have significant trends in the annual accumulated GDDs. Among those, 81.4% of the locations show a positive trend in the annual GDD accumulation. These progressive trends can be attributed to the changing climate and the numbers depict that the warming trend is more predominant in the US. The online data base developed in the study will provide farmers, policy makers and scientists with an online tool to understand the annual accumulated GDD patterns for corn in the US.

VASCULAR ENDOTHELIAL GROWTH FACTOR (VEGF) REGULATION OF EARLY FOREBRAIN NEURALEPITHELIUM DEVELOPMENT

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Purpose: We investigated the role of VEGF in regulating neural development in early mouse forebrain. VEGF exists in the mouse primarily as three isoforms, VEGF 120, 164, and 188, that differ in their ability to bind heparan sulfate proteoglycans on the cell surface and in the extracellular matrix. Our hypothesis is that the bioavailability of VEGF mediates vascular cell-radial glia interactions, including radial glia proliferation and differentiation during developmental neurogenesis and angiogenesis. Therefore, we investigated proliferation of neural stem cells and differentiation of the intermediate progenitor cells in primitive cortex in a transgenic mouse model of altered VEGF isoform expression. We examined an embryonic (E) time point associated with extensive neuralepithelial expansion and vascular investment preceding cortical layer formation.

Methods: E11.5 mouse embryos expressing all or only single VEGF isoforms were fixed in 3.7% buffered paraformaldehyde, equilibrated in 30% sucrose and cryosectioned at 30 µm. Sections were permeabilized in 3% donkey serum, 1% goat serum, 1% bovine serum albumin, and 0.1% Triton-X 100 in phosphate-buffered saline overnight. Primary antibody (Ab) incubation was overnight with either Phospho-Histone H3 (PHH3, 1:200) to label mitotic cells or T-box related protein 2/eomes (Tbr2, 1:400) to identify the intermediate progenitor cells. A Horseradish peroxidase-conjugated secondary Ab was used to visualize bound primary Ab and developed using Vectastain ABC kit and diaminobenzidine as a substrate. Sections were counterstained with methyl green and quantified for the number of PHH3- and Tbr2-positive cells and total nuclei in the forebrain neuralepithelium using design-based stereology with Stereo-Investigator software (MicroBrightfield, *V.9*). An optical fractionator optical dissector probe (75 μm^2) was used with a randomly placed grid of 150 µm X 200 µm and a 10-section counting interval.

Results: Quantification of proliferating cells showed that the VEGF 120 mice have significantly reduced numbers of PHH3-positive cells compared to wildtype (Figure 1A; p=0.015, t test). This decrease in proliferating cells corresponded to a decrease in total cell number (Figure 1B; p=0.02, t test) and neuralepithelial volume (Data Not Shown, p=0.007, t test) in the VEGF 120 forebrain. Quantification of differentiating cells showed that there was no change in Tbr2+ positive cells (Figure 1C; p=0.87, t test). The ratio of intermediate progenitor cells relative to proliferating cells was significantly higher in VEGF 120 forebrain (Figure 1D; p=0.0001, t test) reflecting a shift in proliferating versus differentiating precursor populations.

Conclusions: Loss of the localized VEGF isoforms (VEGF 164 and VEGF 188) in the VEGF 120 mice reduces proliferation of neural stem cells at the ventricular surface in the developing forebrain leading to a decrease in overall neuralepithelial cell number and volume. However, the VEGF120 mice have comparable numbers of Tbr2-positive cells indicating that the diffusible VEGF 120 isoform is sufficient to allow specification and survival of the intermediate progenitor population. These data support a critical role for VEGF and its bioavailability during early cortical development.

Figure 1

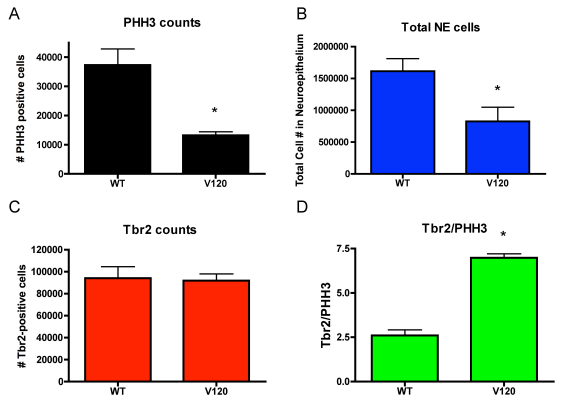

Figure 1. Stereological quantification of proliferating and differentiating cells of the E11.5 forebrain neuralepithelium (NE). The PHH3+ and Tbr2+ cells and total cells in the developing forebrain are compared for wildtype (WT) and VEGF 120 (V120) mice (Figure 1A,1B, and 1C). Values shown are the mean and standard error of three animals of each genotype from separate litters. The ratio of Tbr2+ versus PHH3+ cells (Figure 1D) are graphed for comparison. A two-tailed t test (GraphPad Prism) was used to test for significance, indicated by *.

EFFECTS OF NANOSCALE ZERO-VALENT IRON ON BACTERIAL VIABILITY: ROLE OF GROWTH PHASES

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In-situ remediation of halogenated organic contaminants in groundwater by nanoscale zero-valent iron (nZVI) particles has been widely practiced. However, this application of nZVI could negatively affect indigenous beneficial bacteria such as contaminant degraders and element circulators. Recent research studies have confirmed the toxic effects of nZVI on bacterial cells. Previous studies on the effects of nZVI on bacteria were based mainly on cells from stationary growth phase. Since bacterial cells in different growth phases have different physiological characteristics, they may exhibit different responses to nZVI. Moreover, the growth of bacteria is dependent on nutrient availability and growth conditions resulting in bacterial cells in different growth phases in environment. In this study, we determined the effects of nZVI particles on bacteria from different growth phases. Four different bacterial strains were experimented including *Escherichia coli* JM109, *Escherichia coli* BW25311, *Pseudomonas putida* KT2440, and *Pseudomonas putida* F1. Initially, the growth characteristic of each strain was determined. Then, bacterial cells from different phases were collected and exposed to nZVI and the number of survival cells was determined by a plate count method. Among the four major bacterial growth phases, bacterial cells in lag and exponential phases showed higher resistance to nZVI for all four strains. On the contrary, bacterial cells in exponential and declining phases were less resistant and rapidly inactivated by nZVI. These results suggested that bacterial cells in different phases have different levels of susceptibility toward nZVI. Results also indicated that *P. putida* strains were more resistant to nZVI compared to *E. coli* strains. Different levels of nZVI toxicity between the two strains of each species were observed. These results suggest that the degree of toxicity of nZVI is species as well as strain dependent.

DEVELOPMENT OF A BIOSENSOR FOR MONITORING OF MERCURY POLLUTION IN NATURAL WATER

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Mercury is a very toxic element, which may cause severe healthy problems even at a very low concentration (the maximum allowable level of mercury in drinking water is 2 ppb). However, this is a level that few mercury sensors are sensitive enough to measure. Therefore, it is extremely desirable to develop a highly sensitive, selective, facile, and practical sensor to monitor mercury pollution.

Our novel design of the Hg^{2+} sensor is mainly based on two biological approaches – rolling circle amplification (RCA) and thymine-mercury-thymine (T-Hg^{2+}-T) mismatch. RCA is a highly sensitive nucleic acid amplification technique, which has been used in the detection of DNA, RNA, single-nucleotide polymorphisms, and other biological species. It enables the amplification of the probe DNA sequence more than 10^9-fold with an isothermal reaction condition, making an extraordinarily low detection limit possible. T-T mismatch has very high selectivity to Hg^{2+}, which the binding constant of T-Hg^{2+}-T is even higher than A-T. The T-Hg^{2+}-T mismatch bases are designed in the primer DNA sequence, which can trigger the RCA process only in the presence of Hg^{2+} and synthesize long single strand DNA containing thousands of sequence repeats. These repeat sequences serve as the detection sites by hybridizing with detection probe to form double strand DNA (dsDNA) on the long ssDNA. The specific binding between dsDNA and Eva Green gives the fluorescence signal. In addition, the displaced Hg^{2+} in the process of RCA will take part in other mismatch primer DNAs and trigger a second RCA process. Based on the RCA process and reuse of Hg^{2+}, the detection limit is dramatically decreased and an extremely low concentration of Hg^{2+} can be detection.

This is the first time that RCA is applied in the Hg^{2+} detection.

CHOLESTEROL-ENRICHED DIET CAUSES AGE-RELATED MACULAR DEGENERATION-LIKE PATHOLOGY IN RABBIT RETINA

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Background

Alzheimer's disease (AD) and age-related macular degeneration (AMD) share several pathological hallmarks including β-amyloid (Aβ) accumulation, oxidative stress, and apoptotic cell death. The causes of AD and AMD are likely multi-factorial with several factors such as diet, environment, and genetic susceptibility participating in the pathogenesis of these diseases. Epidemiological studies correlated high plasma cholesterol levels with high incidence of AD, and feeding rabbits with a diet rich in cholesterol has been shown to induce AD-like pathology in rabbit brain. High intake of cholesterol and saturated fat were also long been suspected to increase the risk for AMD. However, the extent to which cholesterol-enriched diet may also cause AMD-like features in rabbit retinas is not well known.

Methods

Male New Zealand white rabbits were fed normal chow or a 2% cholesterol-enriched diet for 12 weeks. At necropsy, animals were perfused with Dulbecco's phosphate-buffered saline and the eyes were promptly removed. One eye of each animal was used for immunohistochemistry and retina dissected from the other eye was used for Western blot, ELISA assays, spectrophotometry and mass spectrometry analyses.

Results

Increased levels of Aβ, decreased levels of the anti-apoptotic protein Bcl-2, increased levels of the pro-apoptotic Bax and gadd153 proteins, emergence of TUNEL-positive cells, and increased generation of reactive oxygen species were found in retinas from cholesterol-fed compared to normal chow-fed rabbits. Additionally, astrogliosis, drusen-like debris and cholesterol accumulations in retinas from cholesterol-fed rabbits were observed. As several lines of evidence suggest that oxidized cholesterol metabolites (oxysterols) may be the link by which cholesterol contributes to the pathogenesis of AMD, we determined levels of oxysterols and found a dramatic increase in levels of oxysterols in retinas from cholesterol-fed rabbits.

Conclusions

Our results suggest that cholesterol-enriched diets cause retinal degeneration that is relevant to AMD. Furthermore, our data suggests high cholesterol levels and subsequent increase in the cholesterol metabolites as potential culprits to AMD.

CHRONIC α_{1A}–ADRENERGIC RECEPTOR ACTIVATION ENHANCES SYNAPTIC PLASTICITY IN THE HIPPOCAMPAL CA1 REGION OF AGED MICE

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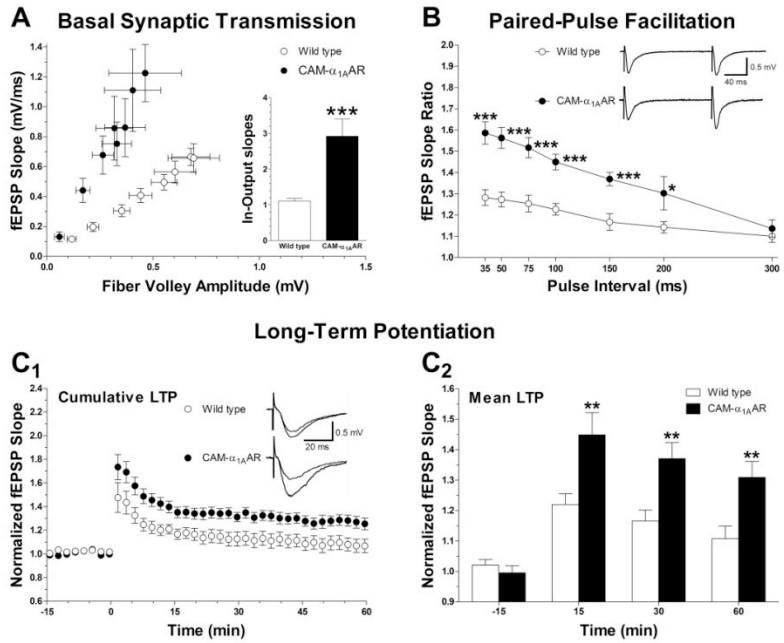
Neurogenesis is the production of new neurons and continues throughout the adult mammalian lifespan in the subventricular zone of the lateral ventricles and the subgranular zone of the hippocampal dentate gyrus (DG). The DG is a major target of noradrenergic input and is critical for learning and memory. Previously, we showed that activation of α_{1A}-adrenergic receptors (ARs) increases neurogenesis, learning, and memory in mice with constitutively active mutant (CAM) α_{1A}-ARs, compared to wild type (WT) mice. Enhanced synaptic plasticity has been shown to be necessary for learning and memory. This project used electrophysiological field recordings to study long-term potentiation (LTP) in 22-24 month old CAM α_{1A}-AR mice and aged-matched WT mice. Simultaneous stimulation of the Schaffer collaterals and recording from the CA1 region of the hippocampus was performed in aged CAM α_{1A}-AR and WT mice, and the evoked field excitatory post synaptic potential (fEPSP) slopes were recorded. Basal synaptic transmission was also recorded along with paired pulse facilitation, at varying intervals. Results showed enhanced basal synaptic transmission, short-term potentiation (assessed with paired-pulse facilitation) and LTP in CAM α_{1A}-AR mice when compared to age-matched WT mice. These findings are potentially important because they link the behavioral improvements of CAM α_{1A}-AR mice to the underlying cellular mechanisms. Investigation of this mechanism may lead to new treatment strategies for learning disabilities and other neurodegenerative diseases.



IGF-1 AND LEPTIN MUTUALLY UPREGULATE THE EXPRESSION OF EACH OTHER IN THE RABBIT HIPPOCAMPUS – IMPLICATIONS FOR ALZHEIMER'S DISEASE

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Evidence implicates the dysregulation of IGF-1 and leptin signaling in the pathogenesis of Alzheimer's disease (AD). IGF-1 is a neurotrophic factor expressed in the brain shown to regulate amyloid beta (Aβ) levels and tau phosphorylation. Leptin, an adipocytokine also expressed endogenously in the brain, decreases Aβ levels and ameliorates tau phosphorylation in the brain. Furthermore, leptin regulates STAT5 activation in the periphery, a transcription factor requisite for IGF-1 expression. We have shown previously that Aβ inhibts leptin expression in the rabbit hippocampus by inhibiting the AkT/mTORC1 pathway. There is cogent evidence demonstrating the activation of mTORC1 signaling by IGF-1, thus implicating IGF-1 in leptin expression. Evidence also suggests that Aβ inhibits the JAK–STAT signaling pathway, thus potentially inhibiting IGF-1 expression. In this study we demonstrate that incubation of organotypic slices from rabbit hippocampus with Aβ42, downregulates IGF-1 expression by inhibiting JAK2-STAT5 pathway. Leptin treatment reverses the Aβ42–induced attenuation of IGF-1 expression by increasing the activation of JAK2-STAT5. Our results demonstrate for the time that Aβ42 regulates IGF-1 expression by inhibiting the activation of the transcription factor STAT5 and leptin treatment reverses this effect of Aβ42 on IGF-1 expression by increasing STAT5 activation. We also show in this study that IGF-1 reciprocally also induces the expression of leptin via the activation of mTORC1 signaling and the transcription factor C/EBPα. IGF-1 treatment also reverses the Aβ42–induced attenuation of leptin expression.. Our study provides a valuable insight into the leptin–IGF-1–Aβ interplay and the molecular mechanisms involved.

α_{1A} ADRENERGIC RECEPTOR ACTIVATION ATTENUATES HIPPOCAMPAL EPILEPTIFORM ACTIVITY AND INCREASES SEIZURE RESISTANCE IN MICE

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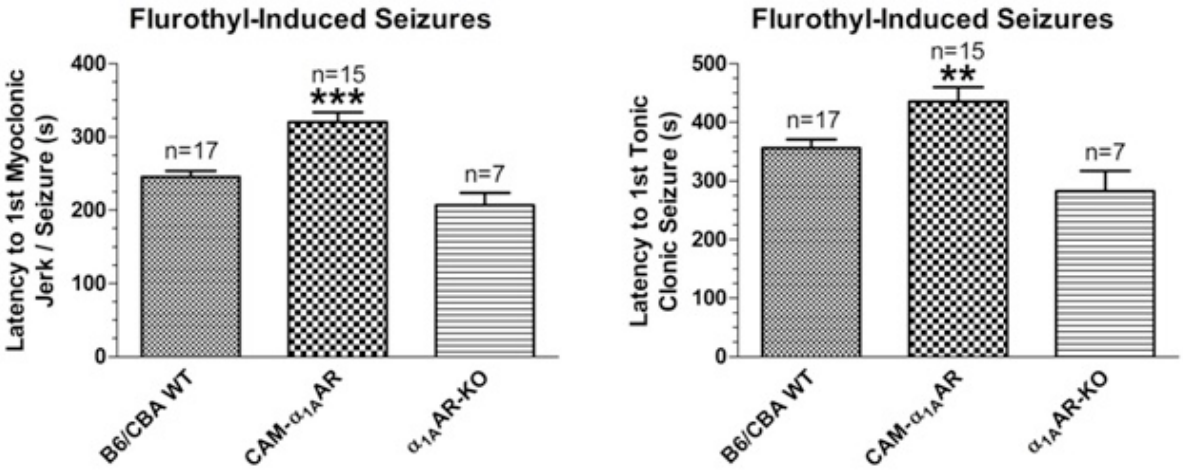
We have seen evidence that chronic α_{1A} adrenergic receptor (AR) activation plays a role in regulating neurogenesis, improving cognition, and modulating synaptic plasticity in mice; however, preliminary evidence suggests that α_{1A}AR activation also affects seizure resistance. In this study, we examine the inhibitory tone conveyed by GABAergic hippocampal interneurons after activation of α_{1A}ARs, as well as the effect of chronic α_{1A}AR activation of seizure threshold. Electrophysiological recordings of hippocampal interneurons have showed that α_{1A}AR activation increases action potential frequency synaptic release of GABA to regional pyramidal neurons (Hillman et al., 2010), an effect that we expect to be antiepileptic, which was not present in α_{1A}AR knockout (KO) mice. Additionally, we observed that mice possessing constitutively active mutant (CAM) α_{1A}ARs produced a significantly greater latency to myclonic jerk and tonic clonic state compared to wild-type in flurothyl-induced seizures. Taken together, these results suggest that acute activation of α_{1A}ARs conveys antiepileptic effects by inhibitory GABA release, that chronic α_{1A}AR activation enhances seizure threshold as a result of increases to hippocampal interneuron populations, or a combination of both. These preliminary results strengthen our hypothesis that α_{1A}AR activation is neuroprotective and illuminate a potential therapeutic target for the treatment of epilepsy.



GENE REGULATION IN *ESCHERICHIA COLI* BIOFILMS

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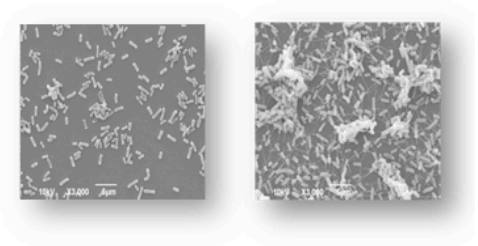
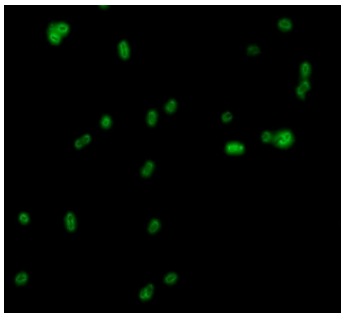
Background-Biofilms are sessile communities of bacteria that have almost 1500 times more antibiotic resistance than single planktonic bacteria. Biofilm formation is regulated by numerous regulators, including several two-component systems. In this study, we confirmed the hypothesis that acetate metabolism may have an important role in biofilm formation [1] and started to investigate the temporal and spatial expression from the promoters of selected biofilm associated genes.

Methods-We performed scanning electron microscopy (SEM) to determine structural and quantitative differences in biofilm produced by *ackA* (encoding acetate kinase)*, pta* (encoding phosphotransacetylase), *ackA-rcsB* (encoding acetate kinase and regulator of capsule synthesis B)*, ackA-ompR* (encoding acetate kinase and outer membrane porin regulator) and *ackA-dcuR* (encoding acetate kinase and regulator of (C4)-dicarboxylic acid megabolism) mutants, in comparison with their isogenic parent strain. Biofilm was produced on 12 mm glass cover slips in six well plates and prepared for microscopy as previously described [2]. Images were obtained with a JEOL JSM-6490LV scanning electron microscope at 3,000-x magnification. For the temporal and spatial expression study, the promoters for *flhD* (flagellar master regulator) and *ompR* (osmoregulator) were fused in front of the open reading frame for green fluorescence protein (GFP). An *E.coli* K-12 strain was transformed with these plasmids. A 96 well plate assay was performed to determine temporal expression from the respective promoters in planktonic bacteria. Initial Zeiss Axio Observer Z1 inverted fluorescence microscope was performed with biofilms formed by the transformed bacteria.

Results-SEM determined that both acetate mutants, *pta* and *ackA,* produced biofilm that was qualitatively and quantitatively different from their parent strain (Fig. 1). Both mutant's biofilm contained almost twice as many bacteria as did biofilm produced by their parent strain. In addition, mutant biofilms contained clusters of more densely packed bacteria, which the parent biofilm were lacking. An additional mutation in *rcsB* was able to reduce the number of bacterial clusters without impacting the number of bacteria within the biofilm. The additional mutation in *dcuR* was able to reduce the amount of biofilms in compare to their parent strain. We conclude that acetate metabolism is a sensor of environmental signals that affects biofilm amounts and structures.



From the 96 well plate assay experiment, we conclude that the highest expression level of *flhD* is after 24 hours and of *ompR* after 6 days.



We then performed fluorescence microscopy with the *ompR*::GFP strain and obtained a fluorescence signal after 2 days (Fig. 2). We are currently optimizing the microscopy.

Conclusion- From the SEM experiment, we can conclude that the qualitative difference between the *ackA* mutant and the parent can be explained by *rcsB*, but the quantitative difference depends on *dcuR.* From the 96 well plate experiment, we conclude that *flhD* gets expressed earlier during biofilm development (reversible attachment?) than *ompR* (maturation?).

Fig. 2. *E. coli* transformed with the *ompR*::GFP plasmid fluorescence microscopy

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Acknowledgement

The authors thank Dr. Jayma Moore at NDSU's Electron Microscope Facility for performing the SEM and Dr. Alan J. Wolfe (Loyola University Chicago, Maywood IL) for providing bacterial strains. The work was funded by NIH grant 1R15AI089403 and an earmark grant on Agrosecurity through USDA/APHIS.

ENOLASE-2 EXPRESSION IS INDUCED IN HUMAN BREAST EPITHELIAL (MCF-10A) CELLS EXPOSED TO OR MALIGNANTLY TRANSFORMED BY ARSENIC (As^{+3}) AND CADMIUM (Cd^{+2}).

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Cadmium (Cd^{+2}) and Arsenite (As^{+3}) are carcinogens [1,2] (IARC, 1980; IARC, 1993).Arsenite (As^{+3}) and cadmium (Cd^{+2}) exposure have been associated with many types of cancers including bladder, skin, liver, prostate and lung, and in case of breast, they have been implicated in estrogen receptor mediated gene transcription, and endocrine disruption [3,4,6]. Our laboratory has implicated cadmium and arsenic in the transformation of normal urothelial cells and in the development of bladder cancers [5].

The goal of this study was to determine if both these heavy metals could also transform the breast epithelial cell line MCF-10A. For this purpose the MCF-10A cells were exposed to 1 μM As^{+3} or Cd^{+2} for a long period of time with the end point being the ability to form colonies in soft agar. These transformed cells were subjected to microarray analysis and one of the differentially expressed gene that was identified was enolase-2 (ENO-2) which is a glycolytic enzyme that catalyses the conversion of 2-phosphoglycerate to phosphoenol pyruvate. It is also over expressed in certain breast cancers that have a neuroendocrine differentiation.

The next goal of the study was to determine if Cd^{+2} and As^{+3} could induce the expression of this enzyme in the MCF-10A cells upon exposure. The results obtained indicate that both the metals can up-regulate the expression of ENO-2 in a time and dose dependent manner. The direct implication of metal induction of ENO-2 is not known, but it is possible that these metals might induce neuroendocrine differentiation in MCF-10A cells. Although the mechanism involved in the up-regulation of ENO-2 is unknown, our study provides evidence that the increased expression of ENO-2 may have implications in the increased glycolytic capacity of tumors.

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AN OCCURRENCE OF THE FOSSIL INSECTIVORE, *ANKYLODON PROGRESSUS* IN THE BRULE FORMATION OF SOUTHWESTERN NORTH DAKOTA AND IMPLICATIONS REGARDING *ANKYLODON* SYSTEMATICS

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Introduction – In 1994, remains of a fossil insectivore were collected by the Pioneer Trails Regional Museum (PTRM) from the Brule Formation present on Rattlesnake Butte, southwestern North Dakota. The specimen (PTRM 1600) consists of a partial left dentary with a m2 and was assigned to the genus *Ankylodon.* When *Ankylodon* was first described in 1937, it was placed within the Erinaceidae, the family containing hedgehogs, and only the type species, *Ankylodon annectens*, was named (1). In 1953, *Ankylodon progressus* was named by Galbreath (2). Since then, *Ankylodon* has had a somewhat problematic history regarding family-level and higher taxonomic assignment. In 1975, *Ankylodon* was placed in the Adapisoricidae, transferred to the Soricomorpha in 1983 and the Dormaaliidae in 1985 (3). Additionally, *Ankylodon* has been placed in numerous subfamilies with the most recent being the Sespedectinae (4). At present, there are potentially three species of *Ankylodon*: *Ankylodon annectens, Ankylodon progressus*, and a third species that has not been formally named. Taxonomic assignment is further complicated because some authors feel that *Ankylodon annectens* and *Ankylodon progressus* are not separate species. PTRM 1600 provides additional support for the retention of three distinct species of Ankylodon (5). *Ankylodon annectens* and *Ankylodon progressus* are both index taxa for the Orellan land mammal age (33.7 – 32.0 mya) (6). *Ankylodon annectens* is known from Colorado, Wyoming, and Nebraska (6); and *Ankylodon progressus* has been reported from Colorado (6) and now North Dakota with specimen PTRM 1600.

Systematic paleontology – The specimen PTRM 1600 can be confidently assigned to the genus *Ankylodon*. *Ankylodon* is characterized by having moderate curvature of the trigonid, reduced paraconid, strongly convex buccal margin of the protoconid and metaconid, and boarder nature of the tooth when compared to *Metacodon* (1) all of which are seen in PTRM 1600. In *Ankylodon* and PTRM 1600, the metaconid is taller than the protoconid, connection of the cristid obliqua is buccal to the trigonid notch on the posterior margin of the trigonid and the specimen is larger than what is seen in the morphologically similar genus of *Centetodon* (5).

In *Ankylodon progressus* and PTRM 1600, the protoconid and metaconid have a direct buccal-lingual alignment as opposed to an oblique orientation in *Ankylodon annectens*. Additionally, *Ankylodon progressus* has a reduced anterior cingulid relative to *Ankylodon annectens* and a well developed hypoconulid (2) both of which are seen in PTRM 1600. Additionally, a third distinct species exists in manuscript form and can be differentiated by smaller size and a wider talonid than trigonid on the m1 (7). Preliminary phylogenetic analysis using previously published data (2, 3) and data gathered from PTRM 1600 suggests that *Ankylodon annectens, Ankylodon progressus*, and the third informally named species are separate taxa.

Discussion –Lillegraven et al. (4) questioned the validity of *Ankylodon progressus* because they felt that Galbreath's (2) attributed differences are minor. Despite this lack of certainty, a more recent reference (7) continues to recognize *Ankylodon progressus* as a separate species. No analytical justification has been given to support either the potential subjective synonymization or the retention of the species separate. Based on morphologic differences, such as the principal cusps transverse alignment, anterior cingulid reduction, and hypoconulid reduction and the preliminary phylogenetic analysis *Ankylodon progressus* and *Ankylodon annectens* should be considered separate species. The occurrence of *Ankylodon progressus* in North Dakota is a biogeographic range extension for the species. Finally, the presence of *Ankylodon progressus* in the Brule Formation in North Dakota helps constrain the age of the strata in southwestern North Dakota as Orellan.

Conclusions – PTRM 1600 is assigned to the species *Ankylodon progressus*. Based on a preliminary phylogenetic analysis, *Ankylodon annectens*, *Ankylodon progressus*, and a third unnamed species are all separate taxa with the unnamed species potentially being a common ancestor for the other two. The occurrence of *Ankylodon progressus* in North Dakota is a biogeographic range extension for the species. Finally, the presence of *Ankylodon progressus* in the Brule Formation in southwestern North Dakota constrains the age of the formation to the Orellan land mammal age.

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SENSITIVE DETECTION OF DNA BASED ON GOLD NANOPARTICLES AND AUTONOMOUS DNA MACHINE

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We have developed a simple and sensitive DNA sensor utilizing DNA amplification (autonomous DNA machine) and gold nanoparticles (AuNPs). As low as 1 pM of target DNA was detected using this sensor. The autonomous DNA machine is a DNA amplification method based on the DNA scission and replication. Compared to the traditional PCR, this new method is isothermal and cost-effective. Thus, this method was used in our design to amplify target DNA sequences. Then, the target DNA was detected based on the absorbance change of AuNPs when they aggregated in the existence of double strand DNA. In this design, the autonomous DNA machine was triggered by the hybridization between a long DNA probe sequence and a short target DNA sequence in the presence of polymerase and endonuclease. As the target DNA was amplified, thousands of ssDNA copies were synthesized and hybridized with long probe to form dsDNA. The generation of dsDNA led to the aggregation of AuNPs, The advantages of this sensor include simpleness and high detection sensitivity. In addition, no complicated DNA modification is needed. It is expected that the method can shed light on how to design a better DNA sensor for the detection of trace amount of DNA target.

PROFESSIONAL COMMUNICATIONS

(communications are listed alphabetically by the last name of the presenting author)

CADMIUM INDUCTION OF GENE EXPRESSION IN SALAMANDER AND BIOMONITORING IN AN AGRICULTURAL LANDSCAPE

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Cd^{2+} is an important causative agent in several cancers. This metal can be found in nature in soils and wetlands, and can also be found in high concentrations in agricultural regions. Salamanders are ubiquitous throughout the Northern Plains and represent the most important vertebrate in ecosystems in terms of energy flow. Salamanders are also excellent model organisms for examining the relation of metal-induction of gene expression. We harvested tissue from salamanders in two settings: in natural areas associated with farmland and from salamanders grown in the lab at a range of Cd^{2+} dosages. We examined liver and tail cadmium content and correlated this with patterns of cadmium-induced gene expression using microarray analysis. We identified approximately 100 genes that were statistically and two-fold differentially expressed between control and cadmium treatments. These expression levels appear to be dosage-dependent. In addition, cadmium content increases during aging in wild salamanders, suggesting that this metal is bioaccumulated. Salamanders represent excellent biomonitors. Cadmium uptake is significant even at low dosage levels so long as environmental stressors are present (e.g., competition, predation).

PRELIMINARY ANALYSIS OF MICROARRAY GENOTYPES FROM AN AMERICAN INDIAN POPULATION

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The etiology of pre-eclampsia (PE) is unknown; but in addition to recognized environmental and clinical risk factors, inherited genetic factors have been demonstrated. Evidence for this includes increased risk of PE among offspring of those affected by PE, and by specific genetic variants that are associated with risk of PE (1,2,3). Recent advances in genetic technology have allowed the development of microarrays which can genotype many thousands of single nucleotide polymorphisms (SNPs) simultaneously at low cost. One of these is the ITMAT/Broad/CARe (IBCv1) microarray (4) which consists of nearly 50,000 SNPs in proximity to candidate genes and loci with potential pathophysiologic effects or other evidence of association with cardiovascular disease.

Objectives: Since population specific prevalences of variants and background genetic effects may influence risk in different communities, our aims were to: 1) determine the prevalence of these microarray SNPs within this American Indian community; and 2) to investigate which of these SNPs may have population prevalences that differ from a reference Caucasian population.

Methods: The Turtle Mountain Community College (TMCC) Genetics and Pre-eclampsia study has enrolled over 120 pre-eclampsia cases confirmed by chart review and 220 controls, matched on date of the index infant's birth. For this initial analysis, cases and control genotypes were combined to compute a provisional population prevalence (minor allele frequency (MAF)) of each SNP. The University of Pennsylvania genotyped 98 samples using the IBCv1 microarray; and the MAF for each of the TMCC SNPs was compared with the HapMap prevalence in the Caucasian population(5). The 95% confidence intervals (CI) for ranges of the TMCC estimated MAF were determined and compared with the 95% CI for the HapMap prevalence (assuming a sample size of 600 alleles). Those SNPs with 95% CI's that were not overlapping between the two populations were considered statistically significantly different, ie $p<0.05$. While about 5% of SNPs would be expected to differ between populations, given multiple testing and a $p=0.05$ criteria for significance, the use of ranges and evaluating the 95% CI from the most extreme values in each range is inherently much more conservative.

Results: Of the 48,905 SNPs providing results from the TMCC sample, only 45,154 could be matched with HapMap prevalence MAFs. Excluding those TMCC SNPs with a MAF of 0% yielded 35,846 SNPs for further analysis. The distribution of MAF prevalences among all SNPs in the TMCC sample is seen in the following table:

>0.0 and <10.0%	≥10.0 and <20.0%	≥20.0 and <30.0%	≥30.0 and <40.0%	≥40.0 and ≤50.0%
33.7% of SNPs	20.8% of SNPs	16.5% of SNPs	14.9% of SNPs	13.8% of SNPs

The following number of SNPs in each TMCC prevalence range was found to have a statistically significant different MAF prevalence than the comparison HapMap sample:

5% to 15%	15% to 25%	25% to 35%	35% to 45%	45% to 50%
1528	1399	946	529	589

Conclusions: The distribution of SNP prevalences appears biased toward SNPs with lower MAFs (eg 33.7% of SNPs have a prevalence less than 10%). This probably reflects a bias in the selection of SNPs for the IBCv1 microarray. Of the 35, 846 SNPs evaluated in this analysis, 13.9% appear to have statistically different population prevalences than the Caucasian population represented in the HapMap sample. This information will help guide the choice of SNPs and chromosomal loci to analyze in more detail.

Supported by NIH grant P20 RR016741 from the NCRR; and the University of Pennsylvania.

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THE MUSSEL FAUNA OF NORTH DAKOTA RIVERS

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Introduction - Mussels are one of the most threatened groups of animals in North America. It has been estimated that 71.1% of the North American mussel fauna was endangered, threatened, or of special concern and very little is known about the current distributions of mussels in North Dakota. The last thorough survey of North Dakota mussels was done by Dr. Alan Cvancara in the 1960's – 1970's. With the decreasing numbers of species and individuals occurring in many areas of the United States since that time period, it was worrisome that we did not know the condition of these organisms in North Dakota. In the summer of 2008 we undertook a three year project to survey North Dakota mussels in both a qualitative and quantitative manner.

Methods - In year one of the project we employed qualitative sampling in which we sampled 153 sites on 29 different rivers in the state. Our qualitative sampling was a timed search protocol in which we would most often deploy a 4 person crew who would search a stretch of a river for 30 minutes, giving an average of 2 person hours per site. All mussels collected where measured (length, width, and depth) and placed back in the water. Several individuals were kept as voucher specimens. In year two we took a subset of 30 previously sampled sites and returned for a quantitative sampling technique. This quantitative survey employed two types of quadrat sampling techniques. The first, a systematic sampling technique with multiple random starts, was applied to sites that were deemed "high density" (>50 mussels/hr found in timed searches). The second technique utilized an adaptive cluster method that is better suited for measuring the often patchy distribution of mussels at low densities. In year two we did further qualitative sampling around the state. In year three we did a combination of both qualitative and quantitative sampling. On completion of the project we had sampled 242 sites on 67 rivers in the state.

Results -The eastern part of the state still contains a healthy mussel population. While it is difficult to compare numbers to past searches, which were all qualitative, it seems the majority of the sites have as many or more species and individuals as past studies. We documented 15 species in the state with two new species records, the fragile papershell (*Leptodea fragilis*) and the Deertoe (*Truncilla truncata*). The highest diversity and numbers of individuals were found in the Sheyenne River with one site having 8 species and a density of 46.8 mussels/M^2. Some species have expanded their range (*Lampsilis cardium* - Plain pocketbook, *Quadrula quadrula* - Maple leaf, and *Ligumia recta*- Black sandshell) while others (*Strophitus undulates* - Creeper and *Potamilus ohiensis* - Pink papershell) look to have been extirpated from areas they used to inhabit. The western part of the state has historically had low mussel populations. Our surveys found very few western mussels.

Discussion - The Sheyenne River contains the most diverse and, in some places, the densest populations of mussels of any river in North Dakota. Other eastern rivers such as the Maple River and the Forrest River also had healthy populations. The lack of western mussels may be simply due to the constraints in the natural range of many mussels, however, our inability to find any in certain rivers may be cause for concern.

This project was funded by a State Wildlife Grant from the North Dakota Game and Fish Department

BACTERIAL POPULATION STRUCTURE AND DYNAMICS OF A GASIFICATION COOLING TOWER

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Introduction

The temporal dynamics of the archaeal and bacterial community composition of the Dakota Gasification Company's cooling tower in Beulah, ND was investigated using phylogenetic analysis of extracted rRNA genes. Dakota Gasification is unique in the United States in its endeavor to gasify coal and convert it to synthetic natural gas, and relies on these bacterial populations for their ability to degrade the organic contaminates found in the wastewater produced in the process. On occasion, the cooling tower population densities crash, effectively limiting hydrocarbon removal and waste reduction in cooling tower waste treatment.

Materials and Methods

Nucleic acids were extracted from Dakota Gasification's cooling tower water. Bacterial and Archaeal phylotypes (species) were identified and a community composition quantified using PCR amplified 16S rDNA. Phylogeny was inferred using Bayesian, maximum-likelihood and neighbor-joining algorithms.

Results and Discussion

The phylogenetic analysis of the extracted rRNA genes from randomly selected bacterial clones revealed communities consisting primarily of Gram-negative species from the β-proteobacteria and γ-proteobacteria phyla. The majority of bacterial clones shared 98% identity with *Comamonas denitrificans*. THe minor portion of the bacterial population exhibited close relationships with *Oligella urethralis* (93% identity), *Pusillimonas noertemannii* (94% identity) and the genus *Psuedomonas*. Though phylogenetic analysis revealed significant species diversity, there were three important characteristics shared throughout the populations. These shared traits were dissimilatory nitrate reduction (denitrification), the capacity to exploit a multitude of complex organic molecules as a source of carbon, and tolerance for elevated concentrations of heavy metals; all of which are characteristics shared with microbial communities found in activated sludge. These similarities allowed for the development of simple crash recovery procedures including strain purchase and reintroduction, species cultivation and repopulation, and on-site cultivation and storage for future use. The archaeal diversity within the community was restricted to the genus *Methanobrevibacter* and comprised a minor portion of the community.

We investigated the functional relationship between ammonia oxidation and nitrate reduction within this community by assaying for the presence or absence of bacterial and archaeal ammonia oxidation (*amoA*).

CONSTITUTION OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Founded 1908, Official State Academy 1958

ARTICLE I - *Name and Purpose*

Section 1. This association shall be called the NORTH DAKOTA ACADEMY OF SCIENCE.

Section 2. The purpose of this association shall be to promote and conduct scientific research and to diffuse scientific knowledge.

ARTICLE II - *Membership*

Membership in the Academy shall be composed of persons who share the stated purpose of the Academy and who are active or interested in some field of scientific endeavor.

ARTICLE III - *Council*

The officers of the Academy shall be a President, a President-Elect, and a Secretary-Treasurer. The Council, consisting of the officers, the retiring President, and three elected Councilors, shall be responsible for the fulfillment of the scientific and business obligations of the Academy.

ARTICLE V - *Dissolution and Limits of Action*

Section 1. In the event of dissolution of the Academy, any remaining assets shall be distributed to organizations organized and operated exclusively for education and scientific purposes as shall at the time qualify as exempt organizations under Section 501(c) (3) of the Internal Revenue Code of 1954.

Section 2. No substantial part of the activities of the Academy shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the Academy shall not participate in or intervene in, any political campaign on behalf of any candidate for public office.

Section 3. No part of any net earnings shall inure to the benefit of, or be distributable to, Academy members or officers, or other private persons, except that the Academy may authorize the payment of reasonable compensation for services rendered.

ARTICLE VI - *Amendments*

Section 1. This Constitution may be amended at any annual Business Meeting of the Academy by a two-thirds vote. Proposed amendments shall be submitted in writing to the Secretary-Treasurer who shall send them to the members at least two weeks before the meeting at which such amendments are to be considered.

Section 2. Bylaws may be adopted or repealed at any regular business meeting by a two-thirds vote.

BYLAWS

BYLAW 1. *Meetings*

Section 1. *Scientific Meetings*. The Academy shall hold at least one annual scientific meeting each year at a time and place determined by the Council. Other scientific meetings, regional, state, or local, may be held at times and places determined by the Council. The Council shall establish regulations governing the presentation of papers at Academy sessions. Such regulations shall be made available to members at least three months before any meeting at which they are to apply.

Section 2. *Business Meetings*. A Business Meeting of the membership shall be scheduled at the regular, annual scientific meeting of the Academy. Ten percent of the active members shall constitute a quorum at the annual business meeting.

Section 3. *Special Meetings*. Special meetings shall be called by the President upon the request of ten percent of the active members and require twenty percent of the active members for a quorum. Notice of the time and place of such meetings shall be sent to all members of the Academy at least four weeks in advance of the meeting. Only matters specified in the call can be transacted at a special meeting.

Section 4. *Procedure*. Parliamentary procedures to be followed in all business meetings shall be those specified in "Standard Code of Parliamentary Procedure" by Alice F. Sturgis.

BYLAW 2. *Financial*

Section 1. *Fiscal year*. The fiscal year shall run concurrently with the calendar year from January 1 to December 31.

Section 2. *Dues and Assessments*. The annual dues and assessments may be changed from time to time by the Council, subject to approval by a two-thirds vote of the members at an annual Business Meeting. These dues are payable by January 31 for the current fiscal year or by the Annual North Dakota Academy of Science Meeting for those registering for the meeting

Section 3. *Supporting Members*. Council shall maintain a program to encourage members to voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

Section 4. *Sustaining Members*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

Section 5. *Audit and Reports*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year. The Secretary-Treasurer shall report on the financial affairs of the Society, including the results of an annual audit, as may be requested by the Council.

BYLAW 3. *Membership*

Section 1. *Membership Categories*. Classes of membership shall include the following: (a) Regular, (b) Student, (c) Emeritus, (d) Honorary, (e) Supporting, (f) Sustaining, and (g) Lifetime Members.

Section 2. *Eligibility and Procedure for Membership*. Candidates for membership, except Sustaining Member, may be proposed by any regular or emeritus member of the Academy by submitting the candidate's name to the chairman of the Membership Committee.

(a) *Regular Members*. Any person who is active or interested in some field of scientific endeavor shall be eligible for regular membership. A majority vote of Council shall elect to regular membership.

(b) *Student Members*. Any student who is an undergraduate or graduate student in some field of science shall be eligible for student membership. A majority vote of Council shall elect to regular membership.

(c) *Emeritus Members*. Any member in good standing upon formal retirement is eligible for emeritus membership. A majority vote of Council shall elect to emeritus membership.

(d) *Honorary Member*s. The Academy may recognize, by awarding honorary membership, any person (nonmember or member) who has in any way made an outstanding contribution to science. It shall be the responsibility of the Membership Committee to be aware of individuals whom it would be fitting for the Academy to honor in this fashion. A two-thirds vote of members attending the annual business meeting shall elect to honorary membership.

(e) *Supporting Members*. Regular or student members may voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

(f) *Sustaining Associates*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

(g) *Lifetime Members*. Any regular member in current good standing for at least one year may become a Lifetime Member by paying an assessment equal to 18 times the current annual dues in one lump sum or in two equal payments over the current and following year.

Section 3. *Privileges of Membership*.

(a) Voting at the annual business meeting is permitted of regular and emeritus members.

(b) Members of all categories may attend business meetings of the Academy.

(c) The Secretary-Treasurer and members of Council must be regular members in good standing.

(d) Regular, student, and emeritus members may submit abstracts or communications for scientific meetings of the Academy.

(e) Emeritus and Honorary Members shall be exempt from payment of dues.

(f) A Sustaining Member is provided a display area at the annual scientific meeting of five linear feet per $50 donation up to a maximum of 20 linear feet.

(g) Every member in good standing shall receive a printed copy or an electronic copy (if available and of equal or lesser cost than the printed copy) of the annual *Proceedings of the North Dakota Academy of Science*, the form to be determined by the member.

(h) Special offices such as Historian may be created by the unanimous vote of the regular members at the annual Business Meeting.

(i) All student research participants shall receive a properly inscribed certificate.

Section 4. *Forfeiture of Membership*.

(a) *Nonpayment of dues*. Members shall be dropped from the active list on 31 November following the nonpayment of dues during the membership year commencing the previous 1 December. A member may return to the active list by paying the current year dues.

(b) *Expulsion for Cause*. Membership may be terminated for conduct injurious to the Academy or contrary to the best interests of the Academy. The accused member shall be given an opportunity for a hearing before the Council. If a majority of the Council votes to expel the member, the action must be ratified by at least two-thirds of the members present at the next annual business meeting of the Academy. An expelled member shall forfeit all paid dues and assessments.

BYLAW 4. *Duties and Responsibilities of the Council and Council Members*

Section 1. *Council*. The Council shall meet, at the call of the President, at least twice a year. The Council shall:

(a) be the governing board of the Academy, responsible only to the membership.

(b) arrange for programs, approve committee appointments, be responsible for the fiscal affairs of the Academy, and transact such business as necessary and desirable for function and growth of the Academy.

(c) determine the location of the annual meeting three years in advance.

(d) annually appoint an Academy representative to the National Association of Academies of Science and to Section X (General) of the American Association for the Advancement of Science.

(e) shall appoint and may compensate a Secretary-Treasurer.

(f) shall appoint and may compensate an Editor of the PROCEEDINGS and other publications.

(g) shall be empowered to charge a publication fee of authors on a per page basis.

(h) shall control all activities of the Academy including grant applications.

Section 2. *President*. The President shall preside at meetings of the Council and over the annual business meeting of the Academy at the close of the regular term office. The President shall vote only to break a tie. Unless otherwise specified, the President shall, with the approval of the Council, appoint members to serve on Standing Committees and *ad hoc* Committees, designate the chair of each Committee, and appoint representatives to other organizations. The President serves as Coordinator of the Local Arrangements Committee for the annual meeting that occurs at the end of the President's term.

Section 3. *President-Elect*. The President-elect shall be considered a vice president and shall serve as such in the absence of the President.

Section 4. *Past-President*. The retiring President shall serve as Past-President and chair of the Nominating Committee. The Past President shall serve ex officio on those committees designated by the President and shall serve in the absence of the President and President-elect.

Section 5. *Secretary-Treasurer*. The Secretary-Treasurer shall:

(1) Assist Council in carrying on the functions of the Academy including the receipt and disbursement of funds under the direction of Council.

(2) Manage the Academy Offices under Council's general supervision.

(3) Serve as Managing Editor of the *Proceedings of the North Dakota Academy of Science*.

(4) Prepare a summary of the most recent audit and a report of the Academy's current financial status. This information shall be shared with the membership at the annual business meeting and published in the PROCEEDINGS following the business meeting.

(5) Perform all other duties of the Secretary-Treasurer listed in the Bylaws.

(6) Serve as archivist and be responsible for all official records, archives, and historic material which shall be in reposit with the Secretary-Treasurer.

BYLAW 5. *Appointment, Nomination and Election of Members of Council*

Section 1. *Eligibility for Office*. All candidates for election or appointment to the Council must be regular members in good standing. Nominees for President-elect must be members who reside within easy commuting distance of the site of the annual meeting selected by the Council that occurs when the President-elect serves as President.

Section 2. *Nomination Procedures*. The Nominating Committee shall be responsible for all nominations to elective office, shall determine the eligibility of nominees, shall ascertain that nominees are willing to stand for office, and shall be required to advance to the Secretary-Treasurer at least two names for each open position as needed. Academy members shall have been encouraged to suggest nominees to the committee prior to the Committee submitting its report.

Section 3. *Election Procedures*. Election shall be by secret mail ballot. The Secretary-Treasurer shall prepare a printed ballot that bears all names submitted by the Nominating Committee, that contains a brief biography of each candidate, and that has space for write-in candidates for each office. This ballot is to be mailed to all members no later than 1 November. Each member wishing to vote must return the marked ballot in a sealed signed envelope to the Secretary-Treasurer postmarked not more than thirty days after the ballots were mailed out to members. The President shall appoint tellers, who shall count the ballots that have been received by the Secretary-Treasurer and the tellers shall present the results in writing to the President. A plurality of the votes cast shall be necessary to elect and in the case of a tie vote, the President shall cast the deciding vote. The results of the election shall be announced at the annual Business Meeting.

Section 4. *Term office*. A President-Elect shall be elected annually by the membership and the following years shall succeed automatically to President and Past President to constitute a three-year nonrenewable term. Three Councilors shall be elected by the membership to three-year, non-renewable terms on a rotating basis. All elected Council members shall take office at the end of the next annual Business Meeting following election and shall continue until relieved by their successors. Council is empowered to appoint and compensate a Secretary-Treasurer to successive three-year terms that commence with the beginning of the fiscal year.

Section 5. *Removal from office or position.* If for any reason any elected member of Council is unable to fulfill his/her duties, the Council member may be removed from office by two-thirds vote of Council. If for any reason the Secretary-Treasurer is unable to fulfill his/her duties, the Secretary-Treasurer may be relieved of all duties by a majority vote of Council.

Section 6. *Interim vacancies*. Should a vacancy occur in the Presidency, the Council by a majority vote shall appoint a member of the Academy able to coordinate the next annual meeting to fill the unexpired term. A retiring interim President shall succeed automatically to Past President. Should a vacancy occur in the Presidency-elect, the Council shall reassess and change the location of the coinciding annual meeting as necessary and then call for a special election by mail ballot. An interim vacancy in the Past-Presidency shall be filled by the most recently retired Past-President able to fill the duties of the Past-President. Persons appointed to fill the unexpired term of Secretary-Treasurer are expected to remain in the position for a minimum of three years. A vacancy in the office of Councilor shall be filled by a majority vote of Council until the following election at which time the interim Councilor may stand for a full three year nonrenewable term.

BYLAW 6. *Committees*

Section 1. *Standing Committees*. Standing committees shall include but not be limited to, the following: Editorial, Education, Denison Award, Necrology, Nominating, Resolution, Membership, and Audit Committees. The President shall appoint members of committees other than the Nominating and Audit Committees.

Section 2. *Editorial Committee*. The Editorial Committee shall consist of three regular members appointed to three year terms. The duties are explained in BYLAW 7 (Publications).

Section 3. *Education Committee*. The Education Committee shall consist of five regular members and two high school teachers appointed to five year terms. The Education Committee shall work with high school students and teachers in the state, in visitation programs, Science Talent Search programs, and other programs to stimulate an interest in science by the youth of the state. It shall operate the Junior Academy of Science program and administer the AAAS high school research program.

Section 4. *Denison Awards Committee*. The Denison Awards Committee shall consist of six regular members appointed to three year terms. The Denison Awards Committee shall have as its prime duty the judging of student research and paper competitions, both undergraduate and graduate, and any other similar competitions. The committee shall also maintain the criteria to be used in the judging and selection of papers, such criteria to be circulated to prospective competitors.

Section 5. *Necrology Committee*. The Necrology Committee shall consist of three regular members appointed to three year terms. The Necrology Committee shall report to the annual meeting on those deceased during the preceding year. Obituaries may be included in the minutes of the annual meeting and/or published in the Proceedings.

Section 6. *Nominating Committee*. The Nominating Committee shall consist of the five most recent past-presidents. The major duties of the Nominating Committee are listed in BYLAW 5 (*Appointment, Nomination and Election of Members of Council*). The Nominating Committee will also administer the selection process, develop a separate funding source for a monetary award, and develop, for Executive Committee approval, the criteria for the North Dakota Academy of Science Achievement Award.

Section 7. *Resolution Committee*. The Resolution Committee shall consist of three regular members appointed to three year terms. The Resolution Committee shall prepare such resolutions of recognition and thanks as appropriate for the annual meeting. Further, the Committee shall receive suggested resolutions for the membership and transmit such resolutions and the Committee recommendation to the membership.

Section 8. *Membership Committee*. T he Membership Committee shall consist of unlimited numbers of regular members appointed annually.

Section 9. *Audit Committee*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year.

Section 10. *State Science Advisory Committee*. The State Science Advisory Committee (SSAC) shall consist of five regular or emeritus members appointed to four year terms. The SSAC shall serve to direct questions of a scientific nature to the appropriate expert as requested, shall inform regional granting agencies and state and national science policymakers of its expertise and availability and shall counsel those agencies and persons upon their request. The SSAC shall adhere in particular to the guidelines described in Article V, Section 2 of the Constitution.

Section 11. *Ad hoc Committees*. The President may appoint such additional committees as may be needed to carry out the functions of the Academy. Ad hoc committees serve only during the tenure of the president who appointed them. Reports of ad hoc committees shall be presented to Council or to the annual meeting.

BYLAW 7. *Publications*

Section 1. *Editorial Committee*. Three regular members are appointed to the Editorial Committee for renewable three year terms. The Editorial Committee shall develop and recommend the Academy publication program and policies to the Council. It will assist the Editors of each official publication in reviewing manuscripts for those publications that include the *Proceedings*. Chairs of symposia will review manuscripts written for relevant symposia.

Section 2. *Managing Editor*. The Secretary-Treasurer shall serve as the

Section 3. *Editor*. Editors shall serve three year terms. The Editors shall edit all official publications of the Academy including the *Proceedings*.

BYLAW 8. *Memorial Fund*

The Council of the Academy shall establish a J. Donald Henderson Memorial Fund and administer this fund so that the proceeds will be used to promote science in North Dakota.

BYLAW 9. *Fiscal Year*

The fiscal year of the North Dakota Academy of Science, for the purpose of financial business, shall be 1 January to 31 December.

BYLAW 10. *Achievement Award*

The Academy establishes the North Dakota Academy of Science Achievement Award to be given periodically to an Academy member in recognition of excellence in one or more of the following:
a. Nationally recognized scientific research.
b. Science education.
c. Service to the Academy in advancing its goals.
The Nominating Committee will administer the selection process, will develop a separate funding source for a monetary award, and will develop, for Council approval, the criteria for the award.

BYLAW 11. *Research Foundation*

The **North Dakota Science Research Foundation** is established as an operating arm of the Academy. The purposes of the Foundation are:
(1) to receive funds from grants, gifts, bequests, and contributions from organizations and individuals, and (2) to use the income solely for the making of grants in support of scientific research in the State of North Dakota. Not less than 50% of the eligible monies received shall be placed in an endowment from which only the accrued interest shall be granted.

The foundation shall be responsible for soliciting the funds for the purposes described. The Foundation funds shall be in the custody of the Secretary-Treasurer of the Academy and shall be separately accounted for annually. The Foundation Board of Directors shall be comprised of five members of the Academy, representing different disciplines. Members shall be appointed by the President of staggered five year terms. The chairperson of the Board shall be appointed annually by the President. The Board shall be responsible for developing operating procedures, guidelines for proposals, evaluation criteria, granting policies, monitoring procedures, and reporting requirements, all of which shall be submitted to the Executive Committee for ratification before implementation.

The Foundation shall present a written and oral report to the membership of the Academy at each annual meeting, and the Secretary-Treasurer shall present an accompanying financial report.

BYLAW 12. *Affiliations*

The Academy may affiliate itself with other organizations which have purposes consistent with the purposes of the Academy. Such affiliations must be approved by the Council and by a majority of those attending a regularly scheduled business meeting of the membership.

BYLAW 13. *Indemnification*

Section 1. Every member of the Council or employee of the North Dakota Academy of Science shall be indemnified by the Academy against all expenses and liabilities, including counsel fees, reasonably incurred or imposed upon him/her in connection with any proceedings to which he or she may be made part, or in which he or she may become involved, by reason of being or having been a member of the Council, or employee at the time such expenses are incurred, except in such cases wherein the member of the Council or employee is adjudged guilty of willful misfeasance or malfeasance in the performance of his or her duties. Provided, however, that in the event of a

settlement of the indemnification herein shall apply only when the Council approves such settlement and reimbursement as being for the best interests of the Academy. The foregoing right of indemnification shall be in addition to and not exclusive of all other rights to which such members of the Council or employee may be entitled.

ACADEMY OFFICERS AND COMMITTEES

Executive Committee Membership
President
Past-President
President-Elect
Secretary-Treasurer (three-year term)
Councilors (three-year terms)

President
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President-Elect
Mike A. Davis
Environmental Scientist
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Ronald Jyring (2010-2013)
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Vacant

COMMITTEES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Executive Committee*
Editorial Committee*
Education Committee*
Denison Awards Committee*
Necrology Committee*
Nominating Committee*
Resolution Committee*
Membership Committee*
North Dakota Research Foundation Board of Directors*
Historian*

*indicates available openings

PAST PRESIDENTS AND THE LOCATIONS

OF THE ANNUAL MEETING OF THE NORTH DAKOTA ACADEMY OF SCIENCE

1909	M A Brannon	Grand Forks
1910	M A Brannon	Fargo
1911	C B Waldron	Grand Forks
1912	L B McMullen	Fargo
1913	Louis VanEs	Grand Forks
1914	A G Leonard	Fargo
1915	W B Bell	Grand Forks
1916	Lura Perrine	Fargo
1917	A H Taylor	Grand Forks
1918	R C Doneghue	Fargo
1919	H E French	Grand Forks
1920	J W Ince	Fargo
1921	L R Waldron	Grand Forks
1922	Daniel Freeman	Fargo
1923	Norma Preifer	Grand Forks
1924	O A Stevens	Fargo
1925	David R Jenkins	Grand Forks
1926	E S Reynolds	Fargo
1927	Karl H Fussler	Grand Forks
1928	H L Walster	Fargo
1929	G A Talbert	Grand Forks
1930	R M Dolve	Fargo
1931	H E Simpson	Grand Forks
1932	A D Wheedon	Fargo
1933	G C Wheeler	Grand Forks
1934	C I Nelson	Fargo
1935	E A Baird	Grand Forks
1936	LR Waldron	Fargo
1937	J L Hundley	Grand Forks
1938	P J Olson	Fargo
1939	ED Coon	Grand Forks
1940	J R Dice	Fargo
1941	F C Foley	Grand Forks
1942	F W Christensen	Fargo
1943	Neal Weber	Grand Forks
1944	E A Helgeson	Fargo
1945	W H Moran	Grand Forks
1946	J A Longwell	Fargo
1947	A M Cooley	Grand Forks
1948	R H Harris	Fargo
1949	R B Winner	Grand Forks
1950	R E Dunbar	Fargo
1951	A K Saiki	Grand Forks
1952	Glenn Smith	Fargo
1953	Wilson Laird	Grand Forks
1954	C O Clagett	Fargo
1955	G A Abbott	Grand Forks
1956	H B Hart	Jamestown
1957	W E Comatzer	Grand Forks
1958	W C Whitman	Fargo
1959	Arthur W Koth	Minot
1960	H J Klosterman	Fargo
1961	Vera Facey	Grand Forks
1962	J F Cassel	Fargo
1963	C A Wardner	Grand Forks
1964	Fred H Sands	Fargo
1965	P B Kannowski	Grand Forks
1966	Paul C Sandal	Fargo
1967	F D Holland, Jr	Grand Forks
1968	W E Dinusson	Fargo
1969	Paul D Leiby	Minot
1970	Roland G Severson	Grand Forks
1971	Robert L Burgess	Fargo
1972	John C Thompson	Dickinson
1973	John R Reid	Grand Forks
1974	Richard L Kiesling	Fargo
1975	Arthur W DaFoe	Valley City
1976	Donald R Scoby	Fargo
1977	Om P Madhok	Minot
1978	James A Stewart	Grand Forks
1979	Jerome M Knoblich	Aberdeen, SD
1980	Duane O Erickson	Fargo
1981	Robert G Todd	Dickinson
1982	Eric N Clausen	Bismark
1983	Virgil I Stenberg	Grand Forks
1984	Gary Clambey	Fargo
1985	Michael Thompson	Minot
1986	Elliot Shubert	Grand Forks
1987	William Barker	Fargo
1988	Bonnie Heidel	Bismark
1989	Forrest Nielsen	Grand Forks
1990	David Davis	Fargo
1991	Clark Markell	Minot
1992	John Brauner	Grand Forks
1993	John Brauner	Jamestown
1994	Glen Statler	Fargo
1995	Carolyn Godfread	Bismark
1996	Eileen Starr	Valley City
1997	Curtiss Hunt	Grand Forks
1998	Allen Kihm	Minot
1999	Joseph Hartman	Grand Forks
2000	Mark Sheridan	Moorhead, MN
2001	Ron Jyring	Bismark
2002	Jody Rada	Grand Forks
2003	Richard Barkosky	Minot
2004	Anna Grazul-Bilska	Fargo
2005	Holly Brown-Borg	Grand Forks
2006	Andre Delorme	Valley City
2007	Chris Keller	Minot
2008	Van Doze	Grand Forks
2009	Birgit M Prüβ,	Fargo
2010	Paul W. Lepp	Minot
2011	Lyle Best	Belcourt

MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2010

President Lepp convened the annual business meeting at Minot State University in Minot, North Dakota on April 23, 2010 at 4:10 PM. President Lepp welcomed all and thanked them for their attendance.

The first order of business was to approve the minutes of the previous business meeting from the April 2009 annual meeting in Minot, North Dakota. The motion to approve was advanced by Christopher Beachy of MSU and seconded by Joseph Hartman of UND. The motion passed unanimously.

There was no old business to complete.

Christopher Beachy of MSU nominated Mike Davis of the ND department of transportation, Bismarck for the position of President-Elect. Christopher Keller seconded the motion. Mike Davis accepted the nomination. The motion passed unanimously.

Christopher Keller of MSU nominated Paul Lepp of the MSU for the position of Secretary-Treasurer. Christopher Beachy seconded the motion. Paul Lepp accepted the nomination. The motion passed unanimously.

Christopher Beachy of MSU nominated Ron Jyring of Bismarck State College for the position of Councilor. Joseph Hartman of UND seconded the motion. Ron Jyring accepted the nomination. Similarly, Christopher Keller of MSU nominated Christopher Beachy of MSU for the position of Councilor. Paul Lepp seconded the motion. Christopher Beachy accepted the nomination. Both motions passed unanimously.

President Lepp indicated that not having full access to the financial records the Academy he was unsure of the financial situation. He indicated that he would distribute an updated financial report to all members in the near future. In addition, he stated that he did not appear to have a complete record of the current membership and asked those in attendance to help complete the membership rolls.

Lyle Best from Turtle Mountain Community College volunteered for President-Elect in 2010. He was nominated and elected without opposition by voice vote.

Meeting statistics: 62 Registered attendees
25 Professionals
7 Graduate Students
28 Undergraduate Students
2 Vendors

We had 6 professional talks, 7 Denison graduate student talks and 15 Denison undergraduate student talks. The Denison Awards were presented by President Lepp. The award winners were:

Denison Undergraduate Award			Denison Graduate Award		
2nd runner-up	Jacob Mertes	$100	2nd runner-up	Brian Nelson	$100
1st runner-up	Tina Wise	$150	1st runner-up	Karew Schumaker	$150
Winner	Bruce Felts	$200	Winner	Gunjan Dhawan	$200

President Lepp (Minot State University) officially ended his duties as President by introducing Lyle Best (Turtle Lake Community College). Lyle Best discussed preliminary plans for the Academy's 103rd Annual Meeting, over which he will preside in Belcourt in 2011.

The business meeting was adjourned at 4:26 PM

Respectfully submitted,
Paul Lepp, Secretary-Treasurer

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