

**THE  
BELOIT  
BIOLOGIST**



**Volume 29**

**2010**

# THE BELOIT BIOLOGIST

## Editor

Ken Yasukawa

## Editorial Review Board

Aaron B. Berdanier

Marion F. Fass

Demetrius P. Gravis

Kathryn M. S. Johnson

John R. Jungck

Carol Mankiewicz

## The Cover

Flash, the original common snapping turtle (*Chelydra serpentina*) mascot of the Biology Department, graces the cover of Volume 29 of *The Beloit Biologist*.

## Aims and Purposes

*The Beloit Biologist* publishes original papers and critical reviews on all aspects of biology. *The Beloit Biologist* aims to bring unity to the study of biology, to emphasize the formation and testing of hypotheses, and to provide senior biology and biochemistry majors at Beloit College the opportunity to publish the results of their original research and literature reviews.

## Instructions to Authors

All manuscripts and their illustrations should be submitted electronically. All submissions become the property of *The Beloit Biologist*; the Editor reserves the right to keep an electronic copy of each manuscript submitted for publication. Submissions should be e-mailed to The Editor, *The Beloit Biologist*, Beloit College, Department of Biology. Papers are submitted with the understanding that they are subject to editorial revision and that they are contributed to this journal only. One proof will be sent to the author, who should correct and return it to The Editor within 24 h. Specific instructions for manuscript preparation should be acquired from The Editor before the manuscript is submitted for consideration. Failure to comply with these instructions will result in the return of the manuscript to the author and a subsequent delay in consideration for publication.

## Letter from the Editor

The papers published in *The Beloit Biologist* represent partial fulfillment of the requirements for the Biology and Biochemistry majors at Beloit College. These papers, usually written in a biology or biochemistry major's final year, provide a professional experience for its student authors. Each student works closely with a Biology Department faculty member and is required, in part, to write a paper for submission to *The Beloit Biologist*, to review papers submitted by other student authors, and to revise his or her paper in response to comments and suggestions of the faculty mentor, two reviewers, and The Editor. The student authors learn to write clearly and carefully, to criticize the writings of others, and to accept and use constructive criticism.

The faculty members of the Department of Biology and the Program in Biochemistry are extremely proud of their majors in the Class of 2010. We have watched these students grow and learn during the past four years, and they will leave Beloit College with strong liberal arts backgrounds in science. We have no doubt that our students will be successful, and we hope that they look back fondly on their college experiences. I encourage you to take the time to read the papers that our students have written. I am sure that you will be as impressed as we are proud.

The Editor salutes the authors who successfully contributed to Volume 29 of *The Beloit Biologist*.

**Ken Yasukawa, Editor**

**THE BELOIT BIOLOGIST**  
**VOLUME 29**  
**2010**

**TABLE OF CONTENTS**

---

<b>Protection at a price? Ant interactions with pollinators on the aspen sunflower (<i>Helianthella quinquenervis</i>)</b> JOSHUA M. DAVENDONIS	1
<b>The mechanisms and effects of eelgrass decline in eutrophic estuaries</b> HEATHER E. MCGEE	9
<b>Lymphoid tissue-specific expression of IgG3 in isolator piglets</b> DANA DIERINGER, NANCY WERTZ AND J. E. BUTLER	18
<b>454 transcriptome annotation and gene detection in a nonmodel species</b> KATHERINE GEIST	27
<b>Identifying single nucleotide polymorphisms that may account for population differences in sensitivity to chemotherapy</b> TANISHKA ARMBRISTER, PETER O'DONNELL AND EILEEN DOLAN	38
<b>ADCC activity as a factor in sex differences in HIV-1 disease progression</b> SHANNA DELL, JOYCE IWEMA AND LINDA BAUM	45
<b>Identification of SNPs within the cytochrome b5 and cytochrome b5 reductase promoter regions in human breast tissue</b> ANNY NGUYEN, KEELIA RHOADS, JAMES SACCO AND LAUREN TREPANIER	50
<b>Activation of human eosinophils by cytokines and immobilized immunoglobulin G (IGG)</b> GEETHIKA FERNANDO	61
<b>The effects of the invasive liana <i>Celastrus orbiculatus</i> on the composition and abundance of native communities in the Indiana Dunes National Lakeshore</b> KATHARINE R. KANGAS	68

---

# PROTECTION AT A PRICE? ANT INTERACTIONS WITH POLLINATORS ON THE ASPEN SUNFLOWER (*HELIANTHELLA QUINQUENERVIS*)

By JOSHUA M. DAVENDONIS

Beloit College  
Department of Biology  
Beloit, WI 53511

**Abstract.** The purpose of extrafloral nectar production in the aspen sunflower, *Helianthella quinquenervis* (Asteraceae), has been previously explained as mediating a number of facultative plant-ant mutualisms. In these specialized relationships, the plant provides the ants with a food source rich in amino acids. The ants in turn defend this food source, conferring upon the aspen sunflower protection from seed-parasitizing tephritid flies. The relationships among ants, herbivores, and pollinators have not been rigorously investigated, however. I tested the hypothesis that extrafloral nectar production in the aspen sunflower maximizes ant protection from herbivores and minimizes their interactions with pollinators. I also tested the hypothesis that different ant species had varying effects on these relationships by altering species-specific ant abundances on the aspen sunflower. Despite a twofold increase in treatment-influenced aggressive ant abundance in this system, I detected no effect on either herbivory or pollinator visits. This experimental evidence suggests that future hypotheses concerning extrafloral nectar production in the aspen sunflower system should include elements of both protection and distraction.

**Key Words:** Ant-plant mutualism; Aspen sunflower; Distraction hypothesis; Extrafloral nectar; *Helianthella quinquenervis*; Herbivory; Pollinator; Protection hypothesis

# THE MECHANISMS AND EFFECTS OF EELGRASS DECLINE IN EUTROPHIC ESTUARIES

By HEATHER E. MCGEE

Beloit College  
Department of Biology  
Beloit, WI 53511

**Abstract.** Eelgrass (*Zostera marina*) is an important primary producer in estuarine environments around the world. Lately, populations of eelgrass have been declining, often in conjunction with increased anthropogenic nitrogen loads. I address the hypothesis that high nutrient loads cause algal blooms that block light from eelgrass beds, causing eelgrass populations to decline. The resulting shift in primary producer assemblage affects the ecosystem by decreasing eelgrass habitat, increasing net production and altering biogeochemical cycles. In many studies, macroalgal blooms were the indirect cause of eelgrass decline, but effects of eutrophication on eelgrass and estuaries as a whole vary greatly among locations. Although some management strategies, such as monitoring, may help identify at-risk eelgrass beds, there are no universally effective and feasible methods to prevent eelgrass loss in eutrophic systems. Therefore, management methods should be based on the unique characteristics of the estuary of concern.

**Key Words:** Eelgrass; Estuarine production; Eutrophication; Macroalgal blooms; Nitrogen loading; *Zostera marina*

# LYMPHOID TISSUE-SPECIFIC EXPRESSION OF IgG3 IN ISOLATOR PIGLETS

By DANA DIERINGER<sup>1</sup>, NANCY WERTZ AND J. E. BUTLER

Department of Microbiology  
University of Iowa College of Medicine  
Iowa City, IA 52242

**Abstract.** Recently, the IgG3 isotype of antibody was discovered to comprise 50% of IgG in ileal Peyer's patches (IPP), lymphoid follicle aggregations within the ileum mucosal membrane, of newborn isolator piglets. We hypothesize IgG3 is antigen-independent, expressed mainly in IPP and functioning as part of the pig's early immune response machinery. We quantified IgG3 transcription in isolator piglet lymphoid tissues from piglets colonized with intact IPP [CC], with resected IPP [IPP-], and piglets maintained germfree [GF]. IgG3 expression is dependent on both tissue and treatment type. We observed that in CC piglets, IgG3 expression diminished in the mesenteric lymph node (MLN), but was maintained in IPP- piglets. Conversely, IgG3 expression in the tracheobronchial lymph node (TBLN) was maintained in CC piglets, but decreased in IPP- animals. We suggest that IPP serves as an antigen conduit for the MLN that normally results in an antigen-driven adaptive immune response and promotes isotype switching that does not favor IgG3. IPP may also be a source of IgG3 expressing cells that migrate to the TBLN. Electrophoretic separation of the CDR3 regions to assess clonal diversity demonstrated that antigen exposure increases CDR3 diversity. These preliminary results emphasize that IPP are important regulators of piglet IgG3 diversity and modulate the pattern of tissue-specific IgG3 expression.

**Key Words:** Antibody repertoire; Innate immunity; Isolator piglet; IgG3; Ileal Peyer's patches; Spectratype

## 454 TRANSCRIPTOME ANNOTATION AND GENE DETECTION IN A NONMODEL SPECIES

By KATHERINE S. GEIST<sup>2</sup>

Department of Botany  
University of Wyoming  
Laramie, WY 82071

**Abstract.** Lodgepole pine (*Pinus contorta*) is one of the most ecologically important tree species in the Rocky Mountains, yet its genome has been insufficiently studied. To develop a genomic resource for lodgepole pine and to facilitate the identification of gene-based markers, 454 pyrosequencing has produced more than 500,000 expressed sequence tag (EST) sequences that were assembled with software (SeqMan Ngen: DNASTAR, Inc., Madison WI). To annotate and characterize this transcriptome, I wrote custom Perl pipelines and filters, performed sequence similarity searches (NCBI-BLAST: NCBI, Bethesda, MD) to known proteins, and identified the distribution of gene functions in the transcriptome with gene ontology software (Blast2Go: Centro de Investigación Príncipe Felipe, Valencia, Spain). I detected over 17,000 unique genes in these 454 data, which may represent as much as 69% of the lodgepole pine transcriptome, and identified transcriptionally-active LTR retrotransposons in 6.2% of the raw 454 data. This 454 transcriptome represents a substantial genomic resource for lodgepole pine, and is now being used to produce gene-based markers for the study of the adaptive trait of serotiny, or fire-stimulated seed release from cones.

**Key Words:** 454 pyrosequencing; BLAST; *De novo* assembly; Gene annotation; Lodgepole pine; Next-generation sequencing; *Pinus contorta*; Rocky Mountains

---

<sup>1</sup> Current address: Beloit College, Program in Biochemistry, Beloit, WI 53511.

<sup>2</sup> Current address: Beloit College, Department of Biology, Beloit, WI 53511.

# IDENTIFYING SINGLE NUCLEOTIDE POLYMORPHISMS THAT MAY ACCOUNT FOR POPULATION DIFFERENCES IN SENSITIVITY TO CHEMOTHERAPY

By TANISHKA ARMBRISTER<sup>1</sup>, PETER O'DONNELL AND EILEEN DOLAN

Division of Biological Sciences  
University of Chicago  
Chicago, IL 60601

**Abstract.** Platinating agents, the category of drugs to which cisplatin and carboplatin belong, stimulate cell death by facilitating the formation of platinum DNA adducts. Although structural analogues, the dose-limiting toxicities of carboplatin and cisplatin differ considerably and are experienced by 30-50% of patients. The impact of platinum-related toxicity has been shown to differ among persons of different ethnicities. This pilot study was designed to validate 'platinum toxicity susceptibility' single nucleotide polymorphisms (SNPs) generated from a genome-wide association study of well-genotyped lymphoblastoid cell lines (LCLs) in Chinese from Denver (CHD). We believe that genetic differences in the form of SNPs may explain differences in sensitivity among populations. CHD LCLs were exposed to clinically relevant drug concentrations of each platinum drug. The phenotype of interest, cell viability, was quantified for each cell line by determining the 50% inhibitory concentration (IC<sub>50</sub>; Cisplatin, mean = 3.6  $\mu$ M, range = 6.0  $\mu$ M. Carboplatin, mean = 18.2  $\mu$ M, range = 14.9  $\mu$ M). For every candidate SNP, the IC<sub>50</sub> values for each CHD cell line were associated with its genotype. Of the candidate SNPs from the original Asian cohort, in the CHD, 15 were genotyped for cisplatin and 7 for carboplatin. At most loci, there was limited genotypic diversity in the small sample size ( $n = 12$ ,  $n = 13$ ). This information may eventually be used to alleviate the life-threatening consequences of chemotherapeutic toxicity by determining the genetic factors that influence a person's susceptibility to chemotherapeutic toxicity.

**Key Words:** Carboplatin; Cisplatin; Chemotherapy; Cytotoxicity

## ADCC ACTIVITY AS A FACTOR IN SEX DIFFERENCES IN HIV-1 DISEASE PROGRESSION

By SHANNA DELL<sup>1</sup>, JOYCE IWEMA AND LINDA BAUM

Department of Immunology/Microbiology  
Rush University Medical College  
Chicago, IL 60612

**Abstract.** Sex is an important variable in HIV-1 disease progression; women with the same viral load as men progress to AIDS and death more rapidly. Antibody-dependent cell-mediated cytotoxicity (ADCC) activity is a reliable indicator of antibody response against HIV. The aim of this study is to examine the relationship between ADCC activity and sex. HIV-specific ADCC activity was determined using a <sup>51</sup>Cr release assay for 32 HIV-positive males from the Multicenter Aids Cohort Study (MACS) and 32 HIV-positive females from the Women's Inter-agency HIV Study (WIHS). All subjects were at similar stages of disease progression. These subjects were compared to five HIV seronegative men and five HIV seronegative women. A difference was observed in ADCC activity between HIV-positive subjects and seronegative subjects, but there was no difference in ADCC activity between sexes. This lack of difference suggests that the difference in HIV disease progression between males and females is not a result of ADCC activity.

**Key Words:** Antibody-dependent cell-mediated cytotoxicity; HIV-1 viral load; MACS; WHIS

---

<sup>1</sup> Current address: Beloit College, Program in Biochemistry, Beloit, WI 53511.

# IDENTIFICATION OF SNPS WITHIN THE CYTOCHROME B5 AND CYTOCHROME B5 REDUCTASE PROMOTER REGIONS IN HUMAN BREAST TISSUE

By ANNY NGUYEN<sup>1</sup>, KEELIA RHOADS, JAMES SACCO AND LAUREN TREPANIER

Department of Medical Sciences  
School of Veterinary Medicine and Center for Molecular and Environmental Toxicology  
University of Wisconsin—Madison  
Madison, WI 53706

**Abstract.** Cytochrome *b*<sub>5</sub> (b5) and cytochrome *b*<sub>5</sub> reductase (b5R) are enzymes involved in the detoxification of arylamine carcinogens within the body. We examined human breast tissues for the presence of single nucleotide polymorphisms (SNPs) in the promoter region of the cytochrome *b*<sub>5</sub> (CYB5A) and cytochrome *b*<sub>5</sub> reductase (CYB5R3) genes. Our ultimate goal is to determine if these SNP mutations impair CYB5A and CYB4R3 expression and thus inhibit proper detoxification of carcinogenic hydroxylamines. We found one novel and nine previously reported SNPs within CYB5A; many were located in either the enhancer or the Exon 1 region. In general, promoter sequences can influence transcription and exon sequences can influence the structure and function of the encoded protein. Therefore, we predict that our enhancer SNPs will reduce CYB5A and CYB5R3 expression while exon SNPs will reduce the activity of these enzymes. Though this prediction is consistent with previous studies that analyzed enhancer and exon SNPs, future experiments are still required in order to demonstrate that this is also true for our breast tissue samples. The understanding of the correlation between SNPs and b5 and b5R detoxification capability could be useful in future molecular epidemiologic studies of breast cancer risk.

**Key Words:** Cytochrome *b*<sub>5</sub>; Cytochrome *b*<sub>5</sub> reductase; Carcinogen; 4-ABP; Hydroxylamine; Breast tissue; Single nucleotide polymorphisms (SNPs)

# ACTIVATION OF HUMAN EOSINOPHILS BY CYTOKINES AND IMMOBILIZED IMMUNOGLOBULIN G (IGG)

By GEETHIKA FERNANDO

Beloit College  
Department of Biology  
Beloit, WI 53511

**Abstract.** Eosinophils are implicated prominently in allergic diseases and the host's response to parasitic infections. Eosinophils may be activated by immunoglobulins (IgG), lipid mediators and cytokines. I examined the potential for IgG, present in the airway surface liquid to activate eosinophils. Incubating eosinophils in tissue culture wells pre-treated with 1–100 µg/ml human IgG stimulated concentration-dependant superoxide production by eosinophils. The results demonstrated that IgG may contribute to the activation of eosinophils that occlude the air-way cavity in eosinophil-associated disorders such as asthma.

**Key Words:** Asthma; Eosinophil activation; Superoxide production; Lactoferrin; Interleukin-13; Interleukin-4

---

<sup>1</sup> Current address: Beloit College, Program in Biochemistry, Beloit, WI 53511.

# THE EFFECTS OF THE INVASIVE LIANA *CELASTRUS ORBICULATUS* ON THE COMPOSITION AND ABUNDANCE OF NATIVE COMMUNITIES IN THE INDIANA DUNES NATIONAL LAKESHORE

By KATHARINE R. KANGAS

Beloit College  
Department of Biology  
Beloit, WI 53511

**Abstract.** Invasive plants change abundance and diversity of native species in a community by competing for resources, changing soil composition, and proliferating effectively under a range of conditions. The invasive Oriental bittersweet (*Celastrus orbiculatus*) is rapidly spreading through the Indiana Dunes National Lakeshore (INDU). I set up plots in locations throughout INDU that contained *C. orbiculatus* (YC), and plots near them that did not contain *C. orbiculatus* (NC). Abundance was measured as percent cover for each species present and plot types were compared for significant differences in species richness (S), evenness (E) and diversity (D) at each location. A significant increase in abundance was found at Marquette Trail. Significant differences in E and D were observed at Marquette Trail and Furnaceville, and significant differences in S, E, and D were found at Mineral Springs. Without environmental data (e.g. soil composition, pH, canopy openness), it is hard to make conclusive statements about these results. With knowledge of prior disturbance history at each location, effects of invasion and site degradation can be estimated. *C. orbiculatus* has been known to have detrimental effects on other plant communities, and should be monitored in INDU. General public awareness should be raised about the dangers of invasive plants.

**Key Words:** Abundance; *Celastrus orbiculatus*; Oriental bittersweet; Indiana Dunes; Invasive; Species richness; Community composition