

THE BULLETIN

Mount Desert Island Biological Laboratory

Volume 45
2006



THE 2006 BULLETIN EDITORIAL COMMITTEE

Editor
Managing Editor

Dr. J.B. Claiborne
Michael P. McKernan

Dr. J.B. Claiborne, Chair

Dr. David Barnes

Dr. Raymond Frizzell

Dr. John Henson

Dr. Harmut Hentschel

Dr. Karl Karnaky

Dr. David Miller

Dr. Robert L. Preston

Dr. Alice Villalobos

Published by the Mount Desert Island Biological Laboratory
May 2006
\$10.00

THE BULLETIN

VOLUME 45, 2006

Mount Desert Island Biological Laboratory
Salisbury Cove, Maine 04672

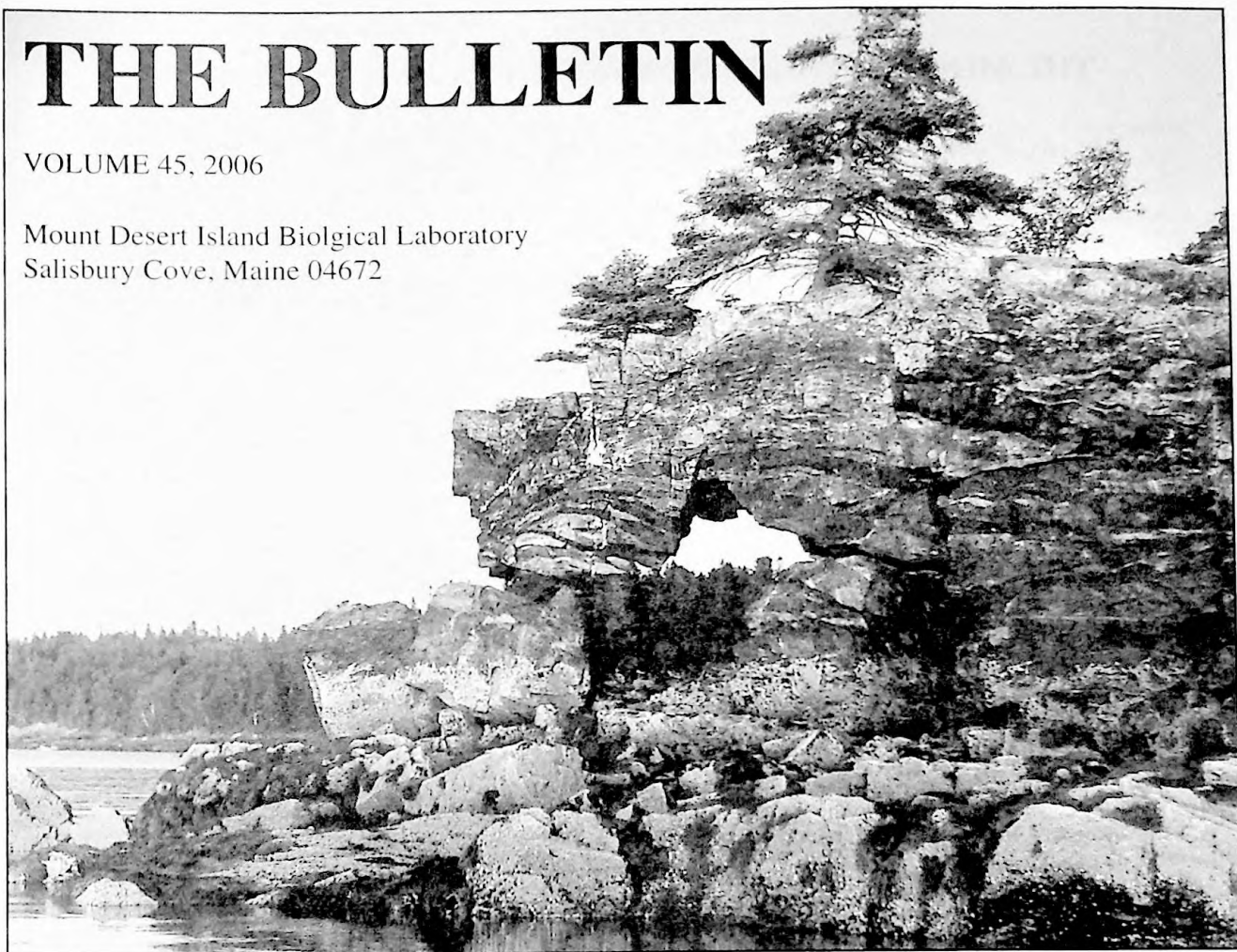


TABLE OF CONTENTS

Introduction	ii
Report Titles	vi
Reports	1-142
Officers and Trustees	143
Scientific Personnel	146
Summer Fellowship Recipients	153
Seminars, Workshops, Conferences, Courses	158
Publications	181
Author Index	184
Species Index	187
Keyword Index	188
Funding Index	190

THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

RESEARCH AND EDUCATION IN THE BIOLOGY OF MARINE ANIMALS

INTRODUCTION

The Mount Desert Island Biological Laboratory (MDIBL) is an independent, non-profit marine and biomedical research facility and international center for comparative physiology, toxicology and marine functional genomic studies. The Laboratory is located on the north shore of Mount Desert Island, overlooking the gulf of Maine about 120 miles northeast of the Portland near the mouth of the Bay of Fundy. The island, well known for Acadia National Park, provides a variety of habitats including shallow and deep saltwater, a broad intertidal zone, saltwater and freshwater marshes, freshwater lakes and streams, forests and meadows.

The Laboratory is among the oldest cold-water research facilities in the Eastern United States, and its unique site provides an outstanding environment for studying the physiology of marine and freshwater flora and fauna. During 2005, the scientific personnel included 86 doctoral level scientists (including 59 Investigators), plus 103 students, and technical staff, representing 56 institutions in 26 states, Australia, and Europe.

HISTORY AND ORGANIZATION

MDIBL was founded in 1898 at South Harpswell, Maine by J.S. Kingsley of Tufts University. The Wild Gardens of Acadia donated its present site at Salisbury Cove, and relocation was completed in 1921. The Wild Gardens of Acadia, a land-holding group headed by George B. Dorr and John D. Rockefeller, Jr., who was instrumental in the founding of Acadia National Park.

In 1914, the Laboratory was incorporated under the laws of the State of Maine as a non-profit scientific and educational institution. Founded as a teaching laboratory, MDIBL is now a center for marine research and education that attracts investigators and students from across the U.S. and around the world. Since the pioneering work of H.W. Smith, E.K. Marshall and Roy P. Forster on various aspects of renal and osmoregulatory physiology of local fauna, the Laboratory has become known worldwide as a center for investigations in electrolyte and transport physiology, developmental biology, electrophysiology and marine molecular biology.

The Mount Desert Island Biological Laboratory is owned and operated by the Board of Trustees and Members of the Corporation; at present, there are 378 members. Officers of the Corporation - Chair, Vice-Chair, Director, Secretary, Treasurer, Clerk - and an Executive Committee are elected from among the Trustees. The Chair and Executive Committee oversee and promote long-range goals of the Laboratory. The Director, with the aid of a full-time Administrative Director, staff and a Scientific Advisory Committee is responsible for implementing the scientific, educational and public service activities of the Laboratory.

NIEHS CENTER FOR MEMBRANE TOXICITY STUDIES

The Center for Membrane Toxicity Studies (CMTS), an NIEHS Marine and Freshwater Biomedical Sciences Center was established at the Mount Desert Island Biological Laboratory (MDIBL) in 1985. The purpose of this Center has been to involve a group of internationally recognized investigators, who are primarily experts in mechanisms of epithelial transport, to study the biological effects of environmental pollutants on cell and membrane transport functions. The primary emphasis of this research effort has been to elucidate the mechanisms of toxicity of environmental pollutants at the cellular and molecular level, using novel aquatic models developed at this laboratory.

The focus of the research programs of the Center has broadened in the last several years from the more narrow objective of identifying the molecular targets for the effects of heavy metals (or metal compounds) on cell functions, to include the effects of a broader range of environmental toxicants (including marine toxins) and the mechanisms by which the organism takes up and eliminates a wide range of xenobiotics and environmental pollutants. However, the concept that a "membrane lesion" accounts for the cellular toxicity of many environmental toxins still remains as a paradigm.

Research Cores: The Center consists of two highly integrated research cores or themes consisting of:

- Signal Transduction and Ion Transport
- Xenobiotic Transport and Excretion

Investigators in the Signal Transduction and Ion Transport Core are examining the basic mechanisms concerning the cell's signaling response to changes in its external environment, particularly as related to environmental stress, heavy metal exposure, marine toxins and environmental estrogens. These signaling pathways often involve mechanisms of homeostasis of ion transport, pH and cell volume regulation. Investigators in the Core are interested in determining the fundamental mechanisms by which cells regulate their cell volume, maintain internal pH and secretory functions and how these processes are disturbed by environmental influences. Investigators in the Xenobiotic Transport and Excretion Core are examining the processes that are used by various epithelial tissues such as the liver and kidney to take up and excrete drugs and xenobiotics and other toxic compounds that enter from the environment and to study the effects of toxicants on this process. Investigators in this Core also interact with investigators working in the signal Transduction and Ion Transport Core.

Facilities Cores: The Center provides for five facility cores for Center investigators. These include:

- an Animal Core that is responsible for the acquisition, and maintenance of the many marine species available to investigators at this Center;
- an Instrumentation and Facilities Core that maintains the basic laboratory equipment that investigators would not otherwise be able to easily bring to the laboratory (a fully equipped cell culture and molecular biology facility, Marine DNA Sequencing Center, and an electrophysiology facility);
- a Cell Isolation, Culture and Organ Perfusion Core that provides isolated cells and tissues from marine species to Center investigators;
- an Imaging Core that maintains and operates a confocal fluorescent microscope as well as providing other imaging technology including epifluorescence and video-enhanced microscopy;
- a Bioinformatics Core that is the site of development of a national Comparative Toxicogenomics Database and webpage design. This core incorporates molecular data on marine sequences with a highly annotated database and provides comparative information with human genes of toxicologic interest.

All Center members and pilot recipients have free access to these core facilities. Non-Center members who utilize these facilities are charged appropriate fees.

Community Outreach and Education Program: The Center's outreach program involves community education on water monitoring programs. This is directed primarily at high school and college students in the immediate area of the laboratory. However, an extensive summer research educational program includes high school students from both regional and national sites, the latter emphasizing minority student education as well as college and postdoctoral fellowship training.

Pilot Projects: The Pilot Project Program provides support for investigators who are interested in pursuing a new project related to environmental toxicology in one or more of the Center's Research Cores. The purpose of these Pilot grants is to obtain preliminary data to facilitate new grant submissions. Grants are awarded competitively and successful applicants receive up to \$10,000/season.

APPLICATIONS AND FELLOWSHIPS

Research space is available for the entire summer season (June 1 - September 30) or a half-season (June 1 - July 31 or August 1 - September 30). Applications for the coming summer must be submitted by February 1st each year. Investigators are invited to use the year-round facilities at other times of the year, but such plans should include prior consultation with the *MDIBL* office concerning available facilities and specimen supply.

A number of fellowships and scholarships are available to research scientists, undergraduate faculty and students, and high school students. These funds may be used to cover the cost of laboratory rent, housing and supplies. Stipends are granted with many of the student awards. Applicants for fellowships for the coming summer research period are generally due in January.

For further information on research fellowships, please contact:

Dr. Patricia H. Hand
Administrative Director
Mount Desert Island Biological Laboratory
P.O. Box 35
Salisbury Cove, Maine 04672
Tel. (207) 288-3605
Fax. (207) 288-2130
phand@mdibl.org

Students should contact:

Michael McKernan
Director of Education and Conferences
mmckernan@mdibl.org

ACKNOWLEDGEMENTS

The Mount Desert Island Biological Laboratory is indebted to the National Institutes of Health and National Science Foundation and for substantial support. Funds for building renovations and new construction continue to permit the Laboratory to expand and upgrade its research and teaching facilities. Individual research projects served by the Laboratory are funded by private and government agencies, and all of these projects have benefited from the NSF and NIH grants to the Laboratory. For supporting our educational initiative, MDIBL acknowledges the National Science Foundation Research Experience for Undergraduates, Maine IDeA Network for Biomedical Research Excellence (NCRR/NIH), Cserr/Grass Foundation, Milbury Fellowship Fund, Northeast Affiliate of the American Heart Association, Cystic Fibrosis Foundation, Blum/Halsey Fellowship, Stanley Bradley Fund, Stan and Judy Fund, Adrian Hogben Fund, Bodil Schmidt-Nielsen Fellowship Fund, Maine Community Foundation, the Hearst Foundation, the Betterment Fund and many local businesses and individuals.

REPORT TITLES

Invited Review

- Kinne, Rolf K.H. Molecular comparative physiology of sodium-solute cotransport systems1

Ionic Regulation

- Puffer, A., Meschter, E., Goldstein, L., and Musch, M. Membrane trafficking factors are involved in the hypotonic activation of the taurine channel of the little skate (*Leucoraja erinacea*) ...11
- Bradley, M., Maltz, E., Childers, J., DeBerge, M., Preston, R., Kidder, G., and Petersen, C. The effects of ion concentration of sperm motility in the estuarine fish, *Fundulus heteroclitus*12
- Djurisic, M., and Forbush, B. Regulation of NKCC2 expression in the gut of *Fundulus heteroclitus* on change in salinity15
- Park, D., and Forbush, B. The delay in secretion on stimulation of the rectal gland of the dogfish shark, *Squalus acanthias*, is largely due to the delay in NKCC1 activation16
- Sato, J.D., Ryder, P., Patel, S., Chapline, M.C., Karlson, K., and Stanton, B.A. Site-directed mutagenesis of cDNA for serum and glucocorticoid-regulated kinase (SGK) from *Fundulus heteroclitus*17
- Kelley, C., Decker, S., Ratner, M., Epstein, M., and Forrest, J.N., Jr. Gastric inhibitory peptide, glucagon, and serotonin are potent chloride secretagogues in the rectal gland of the skate (*Leucoraja erinacea*) but not the shark (*Squalus acanthias*)19
- Beltz, E., Peters, A., Poyan Mehr, A., Motley, W., Telles, C., Decker, S., and Forrest, J.N., Jr. Expression of shark (*Squalus acanthias*) TASK-1 potassium channel in *Xenopus* oocytes20
- Decker, S., Poyan Mehr, A., Butterworth, M., Frizzell, R., and Forrest, J.N., Jr. Capacitance measurements of electrically isolated membranes of *Squalus acanthias* rectal gland primary culture monolayers23
- Cleemann, L., Belmonte, S., Solvadottir, A.E., Andreasen, G., Pihl, M.J., and Morad, M. Bimodal adrenergic regulation of Na-Ca exchanger in Ca-buffered native ventricular myocytes from the spiny dogfish shark (*Squalus acanthias*)25
- Day, R.M., Janowski, E., Movafagh, S., Heyrana, K., Lee, J., Nagase, H., Kraev, A., Roder, J.D., Williams, S.A., Kiilerich-Hansen, K., Cleemann, L., and Morad, M. Cloning and functional expression of the cardiac Na(+)-Ca(2+) exchanger of the spiny dogfish shark (*Squalus acanthias*) ...29

Comparative Biochemistry and Molecular Biology

- Havird, J.C., Choe, K.P., and Evans, D.H. The evolution of cyclooxygenase in ancestral chordates33
- Havird, J.C., Galardi-Este, O., Kreh, R.L., Choe, K.P., and Evans, D.H. The gill of the killifish, *Fundulus heteroclitus*, expresses two different EP1 receptors35
- Frederich, M., O'Rourke, M., and Towle, D. Is AMP activated protein kinase expression in *Cancer irroratus* a better signal for temperature stress than HSP70?37

Cutler, C. Cloning of aquaporin 1 gene homologues in the dogfish shark (<i>Squalus acanthias</i>) and hagfish (<i>Myxine glutinosa</i>)	40
Cutler, C. Cloning of an aquaporin 9 gene orthologue from the hagfish (<i>Myxine glutinosa</i>)	42
Choe, K.P., Stidham, J., and Evans, D.H. Progress towards a method of targeted protein knockdown in <i>Fundulus heteroclitus</i>	44
Baldwin, J.L., Petersen, C.W., Preston, R.L., and Kidder, G.W. Aerobic and submerged development of embryos of <i>Fundulus heteroclitus</i>	45
Ballatori, N., Henson, J.H., Seward, D.J., Cai, S.Y., Runnegar, M., Fricker, G., Miller, D.S., and Boyer, J.L. Plasma membrane polarity of cultured skate (<i>Leucoraja erinacea</i>) hepatocytes undergoing in vitro morphogenesis	47
Diamanduros, A.W., Foster, M.C., Luchini, G., Lanier, C., and Claiborne, J.B. Nucleotide repeats in gill NHE3 of longhorn sculpin (<i>Myoxocephalus octodecimspinosus</i>)	49
Cai, S.Y., Xiong, L., Ballatori, N., and Boyer, J.L. Retinoids are conserved ligands for the farnesoid X receptor, FXR	50
Congdon, C.B., Fizer, C.W., Smith, N.W., Gaskins, H.R., Aman, J., Nava, G.M., and Mattingly, C. Initial results for GAMI: A genetic algorithms approach to motif inference	52
Harmel, N., Djuricic, M., and Forbush, B. The placement of chondrichthyes within the vertebrate phylogenetic tree	53
Weber, G.J., and Zon, L.I. Transcribing the missing hemangioblast: single embryo gene expression profiling in cloche embryos at the 5 somite stage	55
Elmore, L., Kapinova, E., Sircar, S., Sircar, S., and Holt, S. Characterization of telomerase function in cell lines from Japanese medaka	58
Henson, J., Bayne, C., Cheung, D., Henson, R., Czechanski, A., and Forest, D., Parton, A., and Barnes, D. Characterization of cell morphology, motility, cytoskeletal organization and gene presence in long-term cultures derived from sea urchins of the genus <i>Strongylocentrotus</i>	60
Schachat, F., Song, L., Koob, T.J., and Long, J.H. Myosin heavy chain expression in the specialized embryonic tail appendage of the skate, <i>Leucoraja erinacea</i>	63
Comparative Physiology	
Evans, D.H., Kreh, R.L., and Choe, K.P. Are the branchial vessels in the longhorn sculpin, <i>Myoxocephalus octodecimspinosus</i> , tonically dilated by nitric oxide?	66
Evans, D.P., Kreh, R.L., and Choe, K.P. The effects of PGE ₂ on cardiovascular parameters in the longhorn sculpin, <i>Myoxocephalus octodecimspinosus</i>	68
Long, J., and Hamilton, R. Induced responses of seaweeds to herbivory	69
Evans, D.H., Kreh, R.L., and Choe, K.P. The effects of external dilution on cardiovascular parameters in the longhorn sculpin, <i>Myoxocephalus octodecimspinosus</i>	70
Serrano, L., and Henry, R. Short-term salinity-induced changes in branchial carbonic anhydrase activity and mRNA expression in the blue crab, <i>Callinectes sapidus</i>	71
Lowenstein, M., Jillett, N., and Henry, R. Down-regulation of carbonic anhydrase activity in the gills of the euryhaline green crab, <i>Carcinus maenus</i> , during acclimation from low to high salinity	74

Schiffer, M., Hentschel, D.M., Liebsch, F., Boehme, L., and Haller, H. Targeting of podocyte specific genes in zebrafish (<i>Danio rerio</i>) using morpholinos	76
Long, J.H. Jr., Engel, V., Combie, K., Koob-Emunds, M., and Koob, T.J. A target for biomimetics and synthetic biology: The notochord of the Atlantic hagfish, <i>Myxine glutinosa</i>	78
Epstein, F.H., Hessler, K., Spokes, K., Lalemand, L., and Silva, P. Effects of tempol on chloride secretion stimulated by vasoactive intestinal peptide in rectal gland of <i>Squalus acanthias</i>	82
Epstein, F.H., Hessler, K., Spokes, K., Lalemand, L., and Silva, P. Interaction among protein kinases during chloride secretion by rectal gland of <i>Squalus acanthias</i>	84
Althoff, T., and Kinne, R.K.H. A new sodium-D-glucose cotransporter in <i>Squalus acanthias</i> intestine	87
Cheruvu, P.K., Gale, D., and Aird, W.C. <i>Myxine glutinosa</i> (hagfish): A model for early endothelium	88
Sandeman, D., Mellon, D., and Beltz, B. Pilot studies of the neurotoxic effects of chlorpyrifos on the green crab	91
Epstein, F.H., Sighinolfi, C., Hessler, K., Spokes, K., Hays, R., Silva, P. Further evidence that protein kinase C mediates stimulation of the secretion of chloride by CNP in the rectal gland of <i>Squalus acanthias</i>	95
Hays, R., Epstein, F.H., Hessler, K., Spokes, K., Lalemand, L., and Silva, P. The effect of temperature on the secretion of chloride by the rectal gland of <i>Squalus acanthias</i>	97
Luquet, C., Genovese, G., and Towle, D. Hsp70 mRNA expression in the South American rainbow crab, <i>Chasmagnathus granulatus</i> , after acclimation to low and high salinity	99
Preston, R.L., Flowers, A.E., Lahey, B.C., McBride, S.R., Petersen, C.W., and Kidder, G.W. Measurement of the desiccation of <i>Fundulus heteroclitus</i> embryos in controlled humidities	101
Beltz, B., Tlusty, M., Benton, J., and Sandeman, D. Omega-3 fatty acids influence the rate of adult neurogenesis in the lobster, <i>Homarus americanus</i>	104
Miles, D.R.B., Crockett, E.L., and Hassett, R.P. Relationship between antioxidant potential and sodium pump activity in <i>Platorchestia plantensis</i>	107
MacIver, B., Karim, Z.S., Zeidel, M.L., Cutler, C.P., and Hill, W.G. Partial functional characterization of an aquaporin 3 ortholog from the European eel, <i>Anguilla anguilla</i>	109
Hartline, D., Burdick, D., Mitchell, E., and Beltz, B. Neurons of the copepod, <i>Calanus finmarchicus</i> exhibiting immunoreactivity to serotonin and crustacean hyperglycemic hormone	112
Edwards, S.L., and Claiborne, J.B. NHE2 expression in the rectal gland of the spiny dogfish, <i>Squalus acanthias</i>	113
Henry, R. A carbonic anhydrase repressor is localized in the sinus gland of the eyestalk in the euryhaline green crab, <i>Carcinus maenus</i>	115
Villalobos, A.R.A., Higgins, J., Vosburgh, B., and Renfro, J.L. Trimethylamine oxide decreases stress induction of Hsp70 and organic acid transport by isolated choroids plexus of the dogfish shark, <i>Squalus acanthias</i>	117

Tomana, M., Parton, A., and Barnes, D. Analysis of leucocytes from <i>Leucoraja erinacea</i> by flow cytometry	119
--	-----

Molecular Toxicology and Xenobiotic Transport

Conrad, G.W., Conrad, A.H., Martyanov, I.N., and Klabunde, K.J. Ability of invertebrates and algae to colonize biocidal nanoparticles	121
Gutmann, H., Drewe, J., and Miller, D.S. Insulin regulation of organic anion transport across the choroid plexus of dogfish shark, <i>Squalus acanthias</i>	124
Shaw, J.R., Gabor, K., Hand, E., Stanton, S., Thibodeau, R., Barnaby, R., Karlson, K., Sato, D., Hamilton, J.W., and Stanton, B.A. Effects of glucocorticoid-receptor inhibition and arsenic on seawater acclimation	125
Karnaky, K., Daniels, J., Davis, M., Jones, L., Swenson, K., and Miller, D.S. MRP2-like transport model system from cricket, <i>Acheta domesticus</i> , malpighian tubules	126
Genovese, G., Regueira, M., Lo Nostro, F., Da Cuna, R., Maggese, C., Luquet, C., and Towle, D. cDNA sequencing of vitelline envelope protein and gene expression in <i>Cichlasoma dimerus</i> (<i>Teleostei perciformes</i>) induced by xenoestrogens	127
Nava, G.M., Aman, J., Ospina, J.H., Congdon, C.B., Mattingly, C., and Gaskins, H.R. Genomic and cis-regulatory analyses of <i>Ciona intestinalis</i> phase II genes: glutathione s-transferases	129
Straub, P.F., Higham, M.L., Phoel, W.C., and Deshpande, A. Progress towards a <i>Pseudopleuronectes americanus</i> liver microarray	133
Cai, S.Y., Nguyen, T., Lee, J.Y., Ballatori, N., and Boyer, J. Bile salts are weak modulators of <i>Fxr</i> , <i>Bsep</i> , <i>Ostα</i> and <i>Ostβ</i> gene expression in isolated hepatocytes from <i>Leucoraja erinacea</i> , the little skate	137
Mattingly, C.J., Rosenstein, M.C., Davis, A.P., Forrest, J.N. Jr., and Boyer, J.L. The comparative toxicogenomics database (CTD): A public resource for building chemical-gene networks	139