

# Annual Report to Congress

## The Great Lakes Maritime Research Institute

*A National Maritime Enhancement Institute  
designated by  
The U.S. Department of Transportation, Maritime Administration*

November 2007

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# Mission Statement

**The Great Lakes Maritime Research Institute is dedicated to developing and improving economically and environmentally sustainable maritime commerce on the Great Lakes through applied research.**

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Institute*

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<b>16. Abstract</b> The Great Lakes Maritime Research Institute was established to pursue research efforts in marine transportation, logistics, economics, engineering, environmental planning, and port management. The consortium also draws on expertise in a wide range of other areas through affiliations with other Great Lakes universities. This is the second year of funded support. The research agenda was extended to fund nine major projects, while two universities joined GLMRI as affiliate universities. This report details the nine projects while discussing meetings, outreach and education, and other efforts undertaken in support of the mission.			
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- Phase II: Implementing the Great Lakes Maritime Information Delivery System*  
By Peter Lindquist (*University of Toledo*) *Tab 2*
- A Review of the Great Lakes Shipbuilding and Repair Capability – Past, Present and Future*  
By David J. Singer (*University of Michigan*) *Tab 3*
- The Effect of Long-Term Cold Storage on Biodiesel Blends*  
By Daniel Pope (*University of Minnesota Duluth*) *Tab 4*
- Structure of Bacterial Communities Associated with Accelerated Corrosive Loss of Port Transportation Infrastructure*  
By Randall Hicks (*University of Minnesota Duluth*) *Tab 5*
- Testing Relationships between Propagule Pressure and Colonization Success of Invasive Species*  
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- Multibeam Bathymetry Survey of the Duluth-Superior Harbor*  
By R. Douglas Ricketts and Nigel Wattrus  
(*University of Minnesota Duluth*) *Tab 7*
- Great Lakes Maritime Transportation K-12 Education Program for Teachers, Students and Communities, Year 2*  
By Joan Chadde (*Michigan Technological University*) *Tab 8*
- Environmental Effects of Marine Transportation: Develop and Environmental Management System Model*  
By Lynn Corson (*Purdue University*) *Tab 9*

# Overview and Background

This report provides a compilation of the completed work under the second funded year of the Great Lakes Maritime Research Institute (GLMRI) for the period of October 2006 through October 2007. Funding was provided through the U.S. Department of Transportation (US DOT), Maritime Administration (MARAD) that was appropriated by Congress in the Departments of Transportation, Treasury, and Housing and Urban Development, the Judiciary, District of Columbia, and Independent Agencies Act of 2006. This is the first of two years of effort funded against this specific appropriation totaling \$1,980,000.

During March 2004, the University of Minnesota Duluth (UMD) and the University of Wisconsin-Superior (UW-Superior) formed the consortium, the Great Lakes Maritime Research Institute. Federal funding to support the GLMRI was first received in May 2005. The Maritime Administration designated the GLMRI as a National Maritime Enhancement Institute (NMEI) on June 1, 2005.

\$750,000 was federally appropriated through the Transportation Act of 2005 (FY 05), specifically for Great Lakes research by an NMEI. This appropriation provided partial funding to support the research objectives in the Coast Guard and Maritime Transportation Act of 2004 authorizing a U.S. designated Great Lakes NMEI. A report detailing the effort funded by this appropriation is available on the GLMRI web site: [www.glmri.org](http://www.glmri.org).

## Consortium Partners

The transportation research centers of the **University of Wisconsin-Superior** and the **University of Minnesota Duluth** have, for several years, jointly pursued transportation and logistics research, public forums, and funding. In March 2004, these universities formally agreed to form a research consortium that would focus on Great Lakes maritime research.

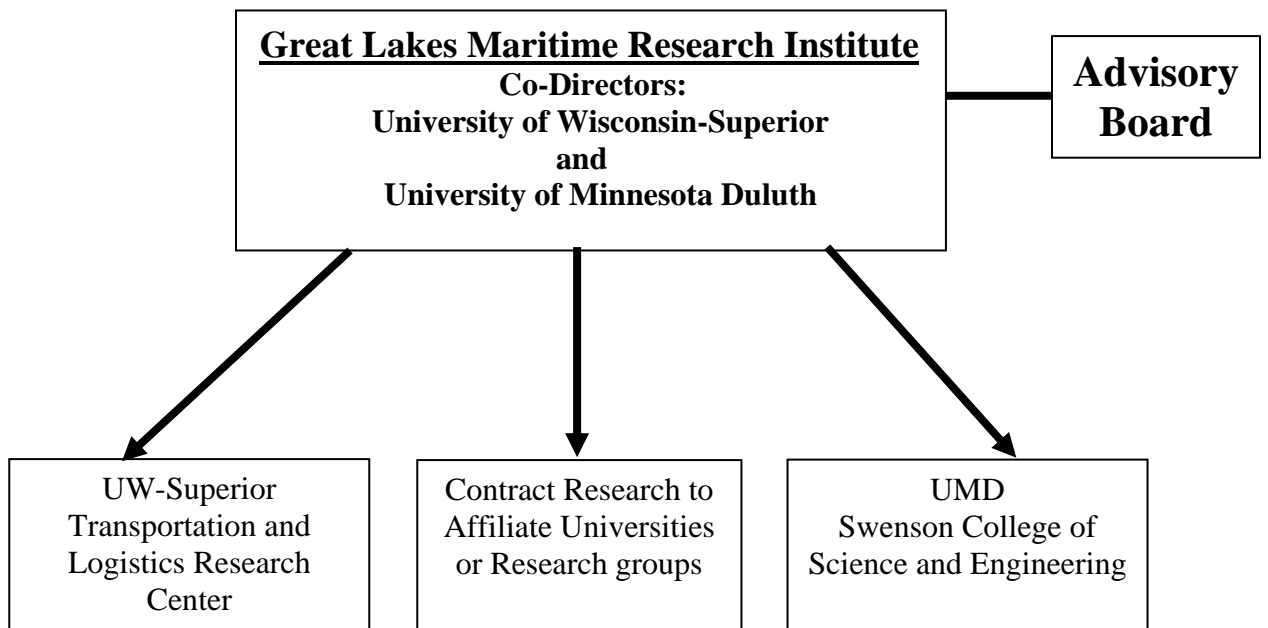
The two universities are located in the largest ports on the Great Lakes, the Twin Ports of Duluth, Minnesota, and Superior, Wisconsin. The communities have been a transportation hub for over 150 years. In addition to the maritime industry, the Twin Ports are serviced by four class 1 railroads, is the terminus of the longest pipeline in North America, is the headquarters to over thirty trucking companies, have an international airport and is home to the largest single engine airplane manufacturer in the U.S. The Twin Ports have a U.S. Coast Guard (USCG) Marine Safety Unit and is the home port for the new USCG Cutter *Alder*. The Twin Ports are also a Port of Entry with the U.S. Customs Office and The Immigration and Naturalization Service.

The Great Lakes Maritime Research Institute combines the strengths of two universities and their academic and research expertise. This dynamic combination provides a program area with tremendous breadth as a National Maritime Enhancement Institute serving the Great Lakes Region. The University of Wisconsin-Superior and the University of Minnesota Duluth have formally joined together to pool the considerable resources available to the two institutions to continue and expand

Great Lakes maritime research. The universities have a history of supporting each other in the area of transportation research.

The consortia that forms the GLMRI draws staff from two universities with experts in marine transportation, logistics, economics, engineering, technology, computer management, management, marine environmental, planning, geography, and port management. The consortium can also draw on expertise in a wide range of other areas including air and rail transportation management, operations research, mathematics, and social sciences. Both universities are members of federally nominated University Transportation Centers: UW-Superior is an affiliate member of the University of Wisconsin-Madison's National Center for Freight and Infrastructure Research and Education; and UMD is an affiliate member of the University of Minnesota's Center for Transportation Studies.

The faculty and administrators of the GLMRI have had a long-term involvement with the maritime industry including shippers, carriers, ports and government agencies. The consortium is committed to improving the maritime system of the Great Lakes and the United States.



# Advisory Board

The following organizations make up the GLMRI Advisory Board:

- The Great Lakes Commission
- The St. Lawrence Seaway Development Corporation (SLSDC)
- The Maritime Administration
- The Society of Naval Architects and Marine Engineers (SNAME)
- The American Great Lakes Ports Association
- The U.S. Coast Guard
- The Lake Carriers' Association
- The U.S. Army Corps of Engineers (USACE)

The current representation to the Advisory Board is listed below:

Dr. Thomas Huntley  
Commissioner and former Chairman, Great Lakes Commission  
Duluth, MN 55812

Mr. Craig Middlebrook  
Deputy Administrator, St. Lawrence Seaway Development Corporation  
Washington, DC 20590

Ms. Doris J. Bautch  
Director, Maritime Administration, Great Lakes Gateway  
Schaumburg, IL 60173

Mr. Al Horsmon  
Chairman, Society of Naval Architects and Marine Engineers, Great Lakes/Great Rivers Section  
Three Rivers, MI 49093

Mr. Adolph Ojard  
Chairman, American Great Lakes Ports Association  
Duluth, MN 55802

Commander Gary Croot  
U.S. Coast Guard, Marine Safety Unit  
Duluth, MN 55802

Mr. James H.I. Weakley  
President, Lake Carriers' Association  
Cleveland, OH 44113

Lieutenant Colonel William Leady  
District Engineer, U.S. Army Corps of Engineers, Detroit District  
Detroit, MI 48266

The third annual meeting of the Advisory Board was held on September 27, 2007, in Duluth, Minnesota, at the Lake Superior Marine Museum. An update was presented on the current projects and outreach activities, along with announcing the selection of the research projects for the coming year. Each of the Advisory Board members provided an update on maritime issues impacting their organization along with any other factors that would involve or support a team approach to further the research areas under GLMRI.

## University Research Affiliations

Universities in the Great Lakes region with expertise in the research focus areas were offered affiliations to partner in applicable areas. Researchers and other relevant affiliate assets from the affiliated universities are included as part of the research portfolio of the GLMRI, and the affiliate may serve as project researchers based on submitted proposals in response to an annual Request for Proposals. Research affiliates are encouraged to leverage GLMRI resources in efforts to secure independent and joint funding opportunities for Great Lakes maritime research. During the past year, two additional universities joined the list of affiliate universities, The University of Findlay (Ohio) and Rochester Institute of Technology (New York). Current affiliates are listed below, along with the assigned university representative.

Great Lakes Maritime Academy  
Admiral John Tanner  
1701 East Front Street  
Traverse City, MI 49686

Michigan Technological University  
Dr. William Sproule  
Dept. of Civil and Environmental Engineering  
1400 Townsend Drive  
Houghton, MI 49931

University of Michigan  
Dr. Armin Troesch  
Dept. of Naval Architecture and Marine Engineering  
2600 Draper  
Ann Arbor, MI 48109

Purdue University  
Mr. Rick Evans  
Assistant Director, Industrial/Foundation Administration  
Young Hall  
302 Wood Street  
West Lafayette, IN 47907-2108

Purdue University North Central  
Dr. Keith Schwingendorf  
Dean, College of Science  
1401 S. US Hwy 421  
Westville, IN 46391

University of Toledo  
Dr. Mark Vonderembse / Mr. Rich Martinko  
Director, Intermodal Transportation Institute  
2801 W. Bancroft St.  
Toledo, OH 43606

University of Wisconsin-Madison  
Dr. Teresa M. Adams  
Director, National Center for Freight and Infrastructure Research and Education  
1415 Engineering Drive, Rm 2205  
Madison, Wisconsin 53706

The University of Findlay  
Mr. Mark Alliman  
School of Environmental and Emergency Management  
1000 North Main Street  
Findlay, OH 45840

Rochester Institute of Technology  
Dr. James J. Winebrake  
Department of STS/Public Policy  
92 Lomb Memorial Drive  
Rochester, NY 14623

The annual meeting of the affiliate universities was held in conjunction with the Advisory Board meeting, on Friday, September 28, 2007, at the Lake Superior Marine Museum in Duluth, Minnesota. In addition to the GLMRI program update, each of the current researchers provided a brief presentation of their ongoing work. The annual meeting provides an opportunity for members of the maritime community along with the current researchers to share ideas and provide input to the projects. This has proven to be a positive venue for technical and resource exchange.

# Research Focus for FY 07

The selections for the research and outreach activities for the efforts detailed in this report were completed in the summer and fall of 2006. The call for proposals was released on April 5, 2006, with the proposals due to GLMRI by June 30, 2006. An extended review was completed with award notifications released in October 2006. Eighteen proposals from the affiliated universities and the two host-universities were received requesting over \$1.4 million. A review process that included outside reviewers from MARAD made the final selections. The following projects were supported with a detailed report included as a separate tab:

- Part II: Hydrodynamic Optimization Testing of the Ballast-Free Ship Design (University of Michigan) – Tab 1
- Phase II of implementing the Great Lakes Maritime Information Delivery System (University of Toledo) – Tab 2
- A review of the Great Lakes shipbuilding and repair capability – Past, present and future (University of Michigan) – Tab 3
- The Effect of Long-Term Cold Storage on Biodiesel Blends (University of Minnesota Duluth) – Tab 4
- Structure of Bacterial Communities Associated with Accelerated Corrosive Loss of Port Transportation Infrastructure (University of Minnesota Duluth) – Tab 5
- Testing Relationships between Propagule Pressure and Colonization Success of Invasive Species (University of Minnesota Duluth and the University of Wisconsin-Superior's Lake Superior Research Institute in cooperation with the Northeast Midwest Institute's Great Ships Initiative) – Tab 6
- Multibeam Bathymetry Survey of the Duluth-Superior Harbor (University of Minnesota Duluth) – Tab 7
- Great Lakes Maritime Transportation K-12 Education Program for Teachers, Students and Communities, Year 2 (Michigan Technological University) – Tab 8

Later in the year, a seed project was awarded to Purdue University to do an initial study toward developing an environmental management system model. An update is provided in Tab 9.



# Research Focus for FY 08

The annual call for proposals was released to the consortium and affiliate universities on April 5, 2007, with a due date of June 4, 2007. The review process from proposal receipt to award announcements took two months. We held to a tight agenda, while still including a thorough review involving external expertise.

The FY 2008 suggested research focus topics include:

- Evaluate short sea shipping market opportunities on the Great Lakes
- Evaluate export and import markets for foreign trade between ports on the Great Lakes and foreign ports such as those located in Europe and Africa
- Evaluate the environmental benefits of waterborne transportation in the Great Lakes region and assist in developing sustainable solutions to the environmental effects of maritime transportation and port operations
- Analyze the methods and effects of taxes and fees imposed on Great Lakes shipping
- Evaluate the state of shipbuilding and repair bases on the Great Lakes and the impact to the industry and national security
- Analyze the origin-to-destination flow of freight in the Great Lakes
- Analyze the economic viability of establishing transshipment facilities and intermodal for ocean-going and intra-lake cargoes on the Great Lakes, which may include the evaluation of 12-month operations of the locks and shipping lanes
- Evaluate new vessel designs for domestic and international shipping on the Great Lakes
- Develop new products and technologies to enhance port security and port operations
- Provide education and outreach activities to the public on Great Lakes maritime shipping, port security and intermodal operations
- Identify ways to improve the integration of the Great Lakes Marine Transportation System (MTS) into the national transportation system
- Examine the potential of expanded seasonal operations on the Great Lakes MTS
- Identify ways to include intelligent transportation applications into the Great Lakes MTS
- Analyze the effects and impacts of aging infrastructure and port corrosion on the Great Lakes MTS

- Establish and maintain a model Great Lakes MTS database
- Identify market opportunities for, and impediments to, the use of United States-flag vessels in trade with Canada on the Great Lakes

A total of 20 proposals were received from nine of the eleven consortium and affiliate universities, requesting over \$1.3 million. An initial review was performed by the staff and co-directors. External reviewers were selected based on the content of the proposal. Maritime experts participated from the Maritime Administration, U.S. Coast Guard and Great Lakes' Port Authorities. Proposals were prioritized, and a funding plan was developed with the constraints of the available resources. Proposers were notified of the decisions regarding their individual requests, along with a summary of the reviewer feedback. Since many of the projects were offered a lesser dollar amount than their request, the proposers were asked to provide an updated work plan and budget to allow for the reduced funding.

The following projects were awarded during the timeframe of this report:

- Great Lakes Maritime Education Program for K-12 Teachers, Students and Communities (Michigan Technological University)
- Application of an Environmental Management System “Model” to Examine Port and Tenant Operations and Provide a Tool to Small Public Port Authorities for Enhancing Environmental Initiatives (Purdue University)
- Intermodal Freight Transport in the Great Lakes: Development and Application of a Great Lakes Geographic Intermodal Freight Transport Model (Rochester Institute of Technology)
- Further Development and Optimization of the Ballast-Free Ship Design Concept (University of Michigan)
- Erie Pier Process Re-Use Cost and Market Analysis (University of Minnesota Duluth)
- Year 2: Building Sustainable Solutions to the Issues of Ballast Water Treatment: Testing Relationships Between Propagule Pressure and Colonization Success of Invasive Species (University of Minnesota Duluth and University of Wisconsin-Superior with The Great Ships Initiative under the Northeast Midwest Institute)
- Development and Succession of Microbial Communities Associated with Corroding Steel Pilings in the Duluth-Superior Harbor (University of Minnesota Duluth)
- Shipboard Testing of B-20 (University of Minnesota Duluth)
- The Great Lakes Maritime Information Delivery System: A Resource for the Regional Analysis of Intermodal Freight Flows in the Great Lakes Region (Phase III) (University of Toledo)

# Special Projects and Other Cooperative Efforts

## Finland Cooperative Research Exchange

In June, Dr. Stewart traveled to Finland to meet with researchers at the VTT Technical Research Centre of Finland. He spent time with the research center to exchange ideas and to consider joint research projects. GLMRI is working to bring Finnish researchers to the United States to discuss their research and move toward developing a cooperative research exchange program. Dr. Stewart was also able to tour many of the ports and marine transportation facilities on his visit, to learn about Finland's transportation initiatives. Dr. Stewart provided an update on this visit to members of the Maritime Administration and the St. Lawrence Seaway Development Corporation.

As a part of this initiative, **Dr. Jorma Ryttonen**, research director of maritime and port operations for the Merikotka Research Institute in Kotka, Finland, was the invited speaker for the GLMRI annual fall meetings. He provided a presentation on the work that is being done in Finland and the Baltic region on maritime initiatives. During his visit with GLMRI, Dr. Ryttonen met with the researchers of Great Ships Initiative at the Research Development Testing and Evaluation facility in Superior, Wisconsin, as part of this research exchange. Dr. Ryttonen also spent a day with maritime business leaders from the Port of Duluth-Superior. He also visited one of the GLMRI affiliate universities, Michigan Technological University, as an extension of this research exchange.

GLMRI is planning to expand this research exchange to other public outreach venues, such as the Great Lakes Marine Community Day event in Cleveland, Ohio, in February 2008.

## Student Competition

GLMRI is developing an initiative to incorporate students and build an interest in Great Lakes maritime commerce. As a first step for this initiative, we will work with the GLMRI affiliates and Advisory Board members to build an agenda and focus for the competition. We anticipate launching the competition in the fall of 2008. As of the writing of this report, a project is underway to support a senior design project through the University of Michigan's Naval Architecture and Marine Engineering Department, in partnership with the Duluth Seaway Port Authority, to design a vessel to accommodate the potential markets for slab steel from northeastern Minnesota.

## Great Lakes Maritime Academy

As an affiliate member of GLMRI, the Great Lakes Maritime Academy (GLMA) has teamed with GLMRI for furthering their training outreach. As in 2006, GLMA incorporated a stop to the Port of Duluth-Superior on their annual cadet training voyage in May 2007. The two organizations co-sponsored a reception and harbor cruise for community and university leaders to expose the participants to the GLMA cadet program. GLMA's training ship the *State of Michigan* was also opened for public tours. GLMRI Assistant Director Carol Wolosz and Associate Researcher Stacey Carlson joined the *State of Michigan* on their voyage from Duluth to Sault Ste. Marie, Michigan.

As a research component to the visit, GLMA was able to take on a biodiesel fuel blend, as a step in utilizing renewable fuels for maritime applications.

## **Canadian Initiatives**

GLMRI staff members met with Canadian government representatives in conjunction with The Trade, Transportation and Asia-Pacific Gateway and Corridor symposium held in Superior, Wisconsin, on April 20, 2007. Representatives from the west coast ports of Prince Rupert and Vancouver provided updates on their development efforts to build the shipping and rail intermodal hubs that would ultimately lead to the Midwest US. Potential opportunities abound for the Great Lakes region in shipping and commerce.

Also, Dr. Stewart and Carol Wolosz are working to develop a research affiliation and exchange with a Canadian Great Lakes university.

## **Outreach and Education**

### **Advertisements and Marketing Materials**

One of the key components to any organization is communication. GLMRI distributes quarterly reports to the stakeholders and sponsors, but we also are looking to expand the interest in GLMRI's research results. Over the past year, GLMRI has advertised in periodicals, such as *Great Lakes/Seaway Review* and *Lake Superior Magazine*; we have prepared materials such as brochures, and hardcopies and CDs of the research reports; and we have expanded our website.

To enhance networking opportunities, GLMRI has participated as a sponsor to many conferences and activities where there is a tie to the GLMRI mission, such as the 2007 Ohio Conference on Freight, and the International Symposium and Workshop on Global Supply Chain, Intermodal Transportation and Logistics.

### **Extension Education and Outreach Support**

Through a cooperative arrangement, Minnesota Sea Grant supported education and outreach efforts for GLMRI. Staff members developed materials, updated brochures, built display boards and redesigned the web site to provide information dissemination and marketing to GLMRI stakeholders. Dale Bergeron, maritime extension educator, worked with researchers and media to develop articles, papers, and presentations. He also served on numerous committees to develop programs and coordinate studies and plans for furthering sustainable maritime commerce on the Great Lakes.

## **Outreach Events, Presentations and Participation**

Over the year, the GLMRI Co-Directors, staff members and researchers participated on behalf of GLMRI and/or have made presentations on the benefits of short-sea shipping and other research projects to various audiences. A list of the key presentations is provided below:

The 2<sup>nd</sup> Annual GLMRI Advisory Board meeting. Duluth, MN. October 6, 2006

The 2<sup>nd</sup> Annual GLMRI Affiliate Universities meeting. Duluth, MN. October 7, 2006

Data Workshop II, University of Toledo. Toledo, OH. November 7, 2006

Carol Wolosz provided a GLMRI overview to The Marine Transportation System National Advisory Council (MTSNAC). Jacksonville, FL. December 5-6, 2006

USACE Great Lakes Stakeholders' Meeting. Cincinnati, OH. December 7, 2006

Transportation Research Board (TRB), Marine Committees, and Poster Session (provided sponsorship for the Wisconsin reception). Washington, D.C. January 14-18, 2007

Office visits with MARAD and SLSDC Administrators and Congressional Offices. Washington, D.C. January 15-16, 2007

Presentation on maritime research areas to the Labovitz School of Business and Economics. University of Minnesota Duluth. February 14, 2007

Mississippi Valley Transportation Coalition Meeting. Dearborn, MI. February 26-27, 2007

Great Lakes Marine Community Day. Cleveland, OH. February 27-28, 2007

Dr. Stewart presented two papers at the Society of Naval Architects and Marine Engineers, Great Lakes/Great Rivers Section meeting. Cleveland, OH. March 1, 2007

Carol Wolosz attended the USACE Stakeholders Meeting. Cleveland, OH. April 3, 2007

UW-Superior hosted a seminar on Trade, Transportation and the Asia-Pacific Gateway and Corridor. Superior, WI. April 20, 2007

Dr. Stewart presented a paper on options available to establish more stringent standards of ballast water to the TRB Committee on the St. Lawrence Seaway. Toronto, ON. May 6-7, 2007

Carol Wolosz presented a GLMRI update to MTSNAC. Chicago, IL. May 8-10, 2007

Stacey Carlson attended the TRB Annual Harbor Safety Committee Conference. Chicago, IL. May 9-11, 2007

Stacey Carlson, Dale Bergeron, and Sharon Moen participated in the River Quest educational program coordinated by the Duluth Seaway Port Authority. Duluth, MN. May 16-18, 2007

Dr. Stewart, Dr. Vonderembse (U of Toledo), Dr. Lindquist (U of Toledo), and Ms. Joan Chadde (Michigan Tech) presented their research at the International Association of Great Lakes Research. State College, PA. May 28-31, 2007.

Dr. Stewart presented an update on the Great Lakes Observing System to the Duluth/Superior Harbor Technical Advisory Committee (HTAC). Superior, WI. June 6, 2007

Stacey Carlson attended the TRB Summer Conference. Chicago, IL. July 6-9, 2007

Program updates were presented to congressional offices, the Maritime Administration and the St. Lawrence Seaway Development Corporation. Washington, D.C. July 16-17, 2007

Dr. Stewart took an observation trip on the M/V Edwin Gott from Two Harbors, MN to Gary, IN, July 20-25, 2007

Great Lakes Maritime Transportation Teachers Institute. Duluth, MN/Superior WI. July 30-August 3, 2007

Dr. Stewart made presentations on Great Lakes Shipping and Carbon Tax Credits at the SNAME sectional meeting. Marinette, WI. September 21, 2007

The 3rd Annual GLMRI Advisory Board meeting. Duluth, MN. September 27, 2007

The 3rd Annual GLMRI Affiliate Universities meeting. Duluth, MN. September 28, 2007

## Future Plan for GLMRI – Beyond this Grant

In the second year of formal research, GLMRI projects have developed to a level where there are extended results, and an increase to the depth of focus. Over this past year, each of the research efforts was able to include additional outreach initiatives such as articles, presentations, proceedings, and project workshops. We are quickly becoming the model in developing regional maritime research and commerce enhancements through teaming initiatives and partnerships. As we move GLMRI into the future, we are looking to continue to address Great Lakes maritime focused topics, and build our program to develop strategic initiatives with a long range impact on maritime commerce including port activities, marine environmental issues, and intermodal connections. We will continue to seek academic affiliates throughout the entire Great Lakes region, and will strengthen our ties to private industry and government agencies involved in Great Lakes maritime issues.