Great Lakes Shipping

Joan Chadde, Western U.P. Center for Science, Math & Environmental Education
Michigan Technological University, Houghton, MI
Email: jchadde@mtu.edu
Website: www.wupcenter.mtu.edu

Many thanks to the Duluth Seaway Port Authority for the photos,
and to Dale Bergeron, MN Sea Grant, and Glen Nekvasil, Lake Carriers Association for the data.
Duluth-Superior to Atlantic Ocean
2,342 miles (3,769 kilometers)
Less than a week’s sailing time
Great Lakes-St. Lawrence Seaway System Connects to the World

Duluth-Superior to Northern Europe  15 days
Spain  15 days
Italy/North Africa  18 days
CARRIERS
The Modern “Laker”

**Largest Laker:** 1,013 feet (309 meters) Paul R. Tregurtha

**Capacity:** 68,000 metric tons

- 65 U.S. Lakers (includes 13 “1,000-footers”)
- 89 Canadian Vessels: 740 feet (225.5 meters)
- Can last up to 100 years in the Great Lakes;
- Cannot fit through Welland Canal to reach the ocean.
The U.S. Laker Size Evolution 1888-1978

- 1888: 308’
- 1900: 497’
- 1910: 600’
- 1942: 639’
- 1952: 767’
- 1972: 858’
- 1978: 1000’

Section Added (1970s)
## Transportation Efficiencies

<table>
<thead>
<tr>
<th>Class 10 Ore Vessel</th>
<th>Jumbo Railcar</th>
<th>Large Semi-Truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>62,400 Tons per ship</td>
<td>100 Tons per rail car</td>
<td>26 Tons per truck</td>
</tr>
</tbody>
</table>

To carry 62,400 tons requires:

- 1 Ore Vessel = 624 Rail cars = 2,400 Trucks
SIZE equals cargo volume, speed & efficiency

A 1000-foot Laker carrying 65,000 tons is equivalent to:
- A 5.6-mile Unit Train
- 2,167 Trucks, Bumper-to-Bumper for 24.6 Miles!

One ocean-going ship is equivalent to:
- 3.4-mile Unit Train
- 1,250 Trucks, Bumper-to-Bumper for 14.2 Miles
Ocean Ships ("Saltie")

Maximum size: 740 feet (225.5 meters) x 78 feet (23.8 meters)
Avg. capacity*: 19,000 metric tons
  25,000 metric tons new Seaway class
  *at Seaway draft (26 feet, 3 inches, or 8 meters)
Last 30 years in the ocean
Great Lakes - St. Lawrence Seaway System

~ The Soo Locks at Sault Ste. Marie, MI & Canada ~

Operated toll-free by U.S. Army Corps of Engineers
(open March 15-January 15 each year)

Poe Lock is the only lock that can accommodate 1000’ ships
LAKER SEASON ~ on Lake Superior  10-months
Soo Locks open March 25 - Jan. 15

OCEAN-GOING SEASON ~ 9-month
Seaway Locks (Montreal/Lake Ontario & Welland Canal)
open early April, close end December
Cargo
Great Lakes Shipping Routes
The BIG THREE
Cargoes on the Great Lakes
(in order by volume)

1. Iron ore
2. Coal
3. Limestone (aggregate and fluxstone)

Other Cargoes
Sand
Grain: wheat, corn, soybeans (in order by volume)
General cargo (wind mill blades, etc.).
Top 3 Cargoes out of Duluth-Superior (2006):

No. 1 Coal
No. 2 Iron Ore
No. 3 Grain

Total tonnage: 41.7 million metric tons (mmt):
Iron Ore 16.7 mmt, Coal 18.8 mmt, Grain 2.8 mmt
Minnesota mines produce 70% of U.S. iron ore.

Duluth-Superior Port ships ~17 mmt of iron ore per year to U.S. and Canadian ports.

Iron ore pellets are loaded at 10,000 tons per hour at Burlington Northern’s Dock in Superior, WI.
Shipping Routes: Iron Ore

KEY TO MOVEMENT ON THE GREAT LAKES
Iron Ore Pellets
Limestone
Eastern Coal
Western Coal

Click on commodity to see trade patterns
17 million tons of western coal per year are loaded at Midwest Energy Terminal at a rate of 10,000 tons per hour.

The low sulfur coal, mined in Montana and Wyoming, is brought to Superior by the 123-car unit trains and loaded onto vessels for delivery to public utilities and other users in the U.S. and Canada.
Shipping Routes: Eastern Coal

KEY TO MOVEMENT ON THE GREAT LAKES
Iron Ore Pellets
Limestone
Eastern Coal
Western Coal

Click on commodity to see trade patterns
Commodities - Grain

Grain is #3 in total port tonnage shipped out of Duluth, averaging 4 million tons per year.

Grain dominates the overseas trade. More than 95% of Duluth-Superior’s grain is exported via the St. Lawrence Seaway.

Loading grain, General Mills, Duluth
Spring wheat and durum wheat are largest % of total grain, but also ship corn, soybeans, barley, oats, rye, canola, peas, sunflower seeds, white wheat and winter wheat the port’s elevators.
Top 10 Grain Destinations:

1) CANADA
(FOR TRANSSHIPMENT)
2) ALGERIA
3) ITALY
4) BELGIUM
5) SPAIN
6) NETHERLANDS
7) TUNISIA
8) UNITED KINGDOM
9) VENEZUELA
10) PORTUGAL

COUNTRY TOTAL: 28
Limestone is Duluth’s No. 1 inbound cargo (about 2.5 million tons annually).

Used for iron ore pellet production, sugar-beet processing and chemical and agricultural purposes.
Salt arrives from Great Lakes ports for farms, homes, and de-icing winter streets and roadways.

Unloading salt, Cutler-Magner Dock, Duluth
The U.S. cruise vessel *Grande Caribe*, a 183-foot, 100-passenger vessel, conducted four Western Great Lakes Tours in 2005 through American Canadian Caribbean Line (ACCL) [www.accl-smallships.com](http://www.accl-smallships.com)

ACCL’s *Grande Mariner* also operated in the Great Lakes.
The Economic Impact of Maritime Transportation

Maritime impact on U.S. economy:
$2 Trillion per year ($2,000,000,000,000)

[$1 out of every $5 spent in the U.S. economy relates to maritime transportation]
Great Lakes-St. Lawrence Seaway provides dramatic economic benefits to the region:

**Cost of Original Construction:** $470 million US dollars

**Annual Economic Contribution Today:**
- Personal Incomes: $4.3 billion US dollars
- Transportation: $3.4 billion US dollars
- Fed/State/Local Taxes: $1.3 billion US dollars
For More Information

Joan Chadde  
Western U.P. Center for Science, Math & Environmental Education  
Michigan Technological University  
Tel: 906-487-3341  
Email: jchadde@mtu.edu  
Website: http://wupcenter.mtu.edu/education/great_lakes_maritime/index.htm  
OR wupcenter.mtu.edu

Glen G. Nekvasil, Vice President Corporate Communications  
Lake Carriers' Association  
Phone: (216) 861-0592  
Email: nekvasil@lcaships.com  
Web: www.lcaships.com
Uninvited Cargo:
The Challenge of Controlling Invasive Species
Ship Ballast vs Cargo
Big Boats can (and do) roll over!

**Transverse Stability**
*Stiff
*Easy
*Tender

**Longitudinal Stability**
*Hogging
*Sagging
A 1,000 foot laker is much like a tippy canoe. It is essential that it be properly loaded with cargo to distribute the weight. It can “list” dangerously to one side and tip over, in much the same way a canoe would.

Improper loading can cause a vessel to “hog” creating a convex curve in the hull, or “sag” creating a concave curve in the hull.

 Properly-Loaded Ship 

 Improperly-Loaded Ship

HOGGING Load

SAGGING Load
<table>
<thead>
<tr>
<th>VOLUMES:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Cargo Ship</td>
<td>2,000 m³</td>
<td>528,000 gal</td>
</tr>
<tr>
<td>VLCC (Ocean Tanker)</td>
<td>200,000+ m³</td>
<td>52,840,000 gal</td>
</tr>
<tr>
<td>Rate of Exchange</td>
<td>5,000 m³/hr</td>
<td>1,321,000 gal/hr</td>
</tr>
</tbody>
</table>

**Ballast:** Any solid or liquid used to change the Draft or Trim, to regulate stability, or maintain stress loads.

[Ballast volumes and distribution are different for different kinds of ships]
Some basic terms:

• No cargo: Ship *in* ballast

• Partial cargo: Ship *with* ballast

• Fully loaded with cargo: Ship *NOBOB*, or No Ballast on Board
Invasive Species Control

1992 Ballast Voluntary Exchange Now Mandatory!
Invasions of Exotic Species Are No Small Matter!

- Economic damage due to invasive species is estimated at $137 billion annually.

- 180 exotic species of plants and animals have entered the Great Lakes ecosystem from a variety of sources. The primary pathway is maritime commerce.

- The Great Lakes Regional Collaboration has identified invasive species as a critical concern that must be addressed for the health of the Great Lakes.

- This is a WORLDWIDE PROBLEM AND CONCERN! U.S. ships transport exotic species to Europe and Asia, and foreign vessels bring exotic species to the Great Lakes.
The Response

• Shippers have adopted the ocean “swish and spit” strategy for ballast to be exchanged in the Great Lakes. Now it has become mandatory practice, but this is not a solution.

• Numerous strategies are being explored by the shipping industry and academic institutions world wide:
  – New filtering systems
  – Chemical treatment
  – Mechanical processing
  – Risk based load identification (Black Sea area)
  – New ship designs
  – Incentives and disincentives for compliance

• Federal and State Legislation has been passed or is pending, thought not well coordinated.
Environmental Impact of a Modal Shift
Minnesota Department of Transportation: 1991

• A shift entirely to trucks would cause a 709% increase in exhaust emissions annually; if rail is used where possible, total emissions would jump by 470%.

• Shifting 24.7 million tons of cargo from vessel to rail would consume an additional 14 million gallons of fuel and generate 4,321 tons of carbon monoxide, hydrocarbons and nitrogen.

• Using trucks, to shift just 1 million tons of cargo would increase fuel consumption by 3.4 million gallons of fuel and generate 570 tons of air pollution.