

Trends in Tonnage: A Century of Lake Superior Shipping

A literature review by:

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Abstract

Over the past century, Lake Superior shipping has varied immensely. The product of our research is a dynamic cartographic visualization that presents tonnage, population, and historical data for seven Lake Superior ports and the Sault-Saint Marie Canals. The significance of shipping to the success or failure of port towns cannot be underestimated, and many factors including infrastructure, economy, and local resources impact the extent of ports' ability to export. By juxtaposing visual representation of tonnage and pertinent information such as historical context and population, one can discover reasons for the increases and decreases in shipping history, be them economically related or due to specific historical events. This interface allows users to explore shipping fluctuations and draw their own conclusions regarding the data through the use of a proportional symbol map and accompanying bar graphs.

Introduction

Lake Superior is one of the five Great Lakes in the United States and has shown to be a significant factor to the economies of many cities that live on the shores of the lake, especially cities with shipping ports. The cities and towns that play a large role in shipping from Lake Superior are Sault Ste. Marie Ontario, Canada, Sault Ste. Marie, Michigan, Duluth, Minnesota, Superior, Wisconsin, Two Harbors, Minnesota, Silver Bay, Minnesota, Taconite Harbor, Minnesota, Ashland, Wisconsin, Marquette, Michigan, and Thunder Bay, Ontario Canada. Three of these towns do not have working ports in them today but have been and still are vital pieces of Lake Superior shipping. Sault Ste. Marie, Canada and Sault Ste. Marie, Michigan are no longer port cities on Lake Superior but act as a gateway for ships to enter and leave the lake. The other town that has no port in it currently is Ashland, Wisconsin, which has not actually played an important factor in shipping on Lake Superior since 1965. So why, then, mention Ashland as a major city that plays into Lake Superior shipping if nothing shipping related actually occurs? Ashland is an important key in answering one of the many questions about Lake Superior shipping: how have historical and geographical factors within each of these port cities

affected the success or failure of each of these port cities? Throughout this literature review we will examine several historical events and geographical features that have played a role in each port city's economic success or failure. With this information along with tonnage and census data, we will create an interactive map that shows trends in economic success throughout time in the years between 1910-2010.

Major Shipping Cities and Towns on Lake Superior ***Sault Ste. Marie, Ontario, Canada/ Michigan***

Sault Ste. Marie, Ontario, Canada and Michigan today are made up of two canals that act as the gateway for ships into and out of Lake Superior, which makes it a vital cog in the Lake Superior shipping economy (Dickinson, 1981). The first of the two canals was built in Michigan in 1885. This canal was suitable for smaller shipments but was not able to accommodate the ever-growing ships passing through the lake. It was not until the turn of the century that the first set of canal upgrades occurred, overseen by the United States Army Corp of Engineers, that made the Michigan canal a more formidable passageway for larger ships (Passfield, 1990). Since the first upgrades at the Michigan canal took place, several other upgrades took place throughout the early parts of the 20th century to not only the Michigan canal but the Ontario canal as well. The Sault Ste. Marie Canal in Ontario was originally built towards the end of the 1700s to accommodate the French Fur Trade, but it was not until 1895 that this small canal was reconstructed to handle large ships (Dickinson, 1981). The Sault Ste. Marie Canal, or also known as the "Soo Canal or the "Soo Locks" has been important in expanding the shipping economy of Lake Superior since 1855 and will continue to be the most important factor in shipping goods throughout the rest of the Great Lakes, the rest of the United States, and around the World.

Duluth, Minnesota-Superior, Wisconsin

Since the induction of the Duluth-Superior port in 1852, no other port on Lake Superior has been able to match the tonnage or facilities provided by Duluth and Superior. In 1852, the idea of bringing railroads up to northern Minnesota enticed the United States government to explore the areas where Duluth and Superior are now located to establish settlements and shipping routes for increased economic profit (Duluth-Superior Metropolitan Interstate Council, 2005: 3). The Duluth-Superior area was an enticing area to explore and settle because of the natural harbors created by two sand spits that are parallel to both Duluth and Superior. Duluth's sand spit, Minnesota Point, is seven miles away from the city while Superior's sand spit, Wisconsin Point, is closer to the city than Duluth's sand spit (Cleef, 1912: 493). The proximity of the sand spits provided to be an economic advantage to Superior shipping until 1871, when the first railroad to Duluth was finished, connecting St. Paul to Duluth.

But it was not solely the railroad that gave Duluth the shipping advantage over Superior. Shortly after the railroad was built in Duluth, citizens decided to dredge a man-made harbor closer to the city. This new harbor was located at the other end of Minnesota Point, right next to the city. This new harbor, along with the new railroad, brought a majority of shipments to and from the Duluth side of the harbor instead of the Superior side. Although Superior sought for an injunction of the new harbor from the federal government, it was too late, and from the time of the induction of the new Duluth harbor until 1882, when Superior finished its first railway, Superior's economy suffered. (Duluth-Superior Metropolitan Interstate Council, 2005: 3). The new railroad brought some freight shipment back to Superior, but the city was never able to gain shipping and economic status over Duluth. This, however, was not because of something either city did

or even had much control over. Location on Lake Superior was the key factor in Duluth's success over Superior. By land alone, Superior should have been a city twice the population of Duluth. The aesthetic view from Duluth could not have been the only reason for Duluth's success. Superior's flat land makes it easier to build and transport on while the hills that make up Duluth make it expensive and difficult to build and transport. But because of Duluth's location on the lake and its proximity to resources, Duluth surpassed Superior economically (Cleef, 1912: 497-498).

Iron ore is located at Duluth's back door and Duluth is located at the nearest, best accessible point on the Lake. It is much easier and less expensive to bring the boats seven miles nearer Duluth, and let them carry the load back over those seven miles again and onto Sault Ste. Marie and the lower lakes than to let railroads carry ore seven miles to Superior. Superior has made up a lot of ore transportation because of improved rail through the city, mainly because of their flat land. Ultimately, though, Duluth has maintained its superiority over Superior because of the differences in distance as an iron ore shipping point. Even if Superior was able to access money and have created a cheaper way to transport via rail, it was too late for the city. Duluth, because of the mining businessmen and dockworkers, had established a bustling city because it was more aesthetically pleasing for the former and closer to work for the latter (Cleef, 1912: 499-500). So long as Duluth maintains its facilities, Superior will not be able to match the production of Duluth. But in the end, both ports are considered one and continue to be the leading port on all of Lake Superior, shipping their big three commodities of coal, iron ore, and grain, and more recently commodities like petroleum and wind turbine components (Duluth-Superior Metropolitan Interstate Council, 2005: 3).

Because the Duluth-Superior port is so large and transports the largest percentage of tonnage on Lake Superior, it is easy to assume that compiling data on this port would be so simple because there will be more information than possibly all of the other ports combined. But just because there is a plethora of information available does not mean it is easy to compile relative and informative literature. The abundance of data about the towns of Duluth and Superior, their harbors, their geographies, and their infrastructures made finding resources easy, yes, but also made finding the correct data that much more difficult. Put nicely by Mick Healey and Ruth Healy (2010), “Researchers rarely read books from cover to cover and they read relatively few articles in their entirety. Like you, they do not have the time. They are practiced at evaluating references in a few minutes by skimming the abstracts, executive summaries, publisher’s blurbs, contents pages, indexes, introductions, conclusions and subheadings” (32). The utilization of abstracts and reviews was so vital to sound literary research because, according to Mick Healey and Ruth Healy (2010), “Abstracts give a clearer idea of the contents of articles” (24).

Two Harbors, Minnesota

The area of Two Harbors, Minnesota saw its beginning in 1883 when the Minnesota Iron Company contracted the building of a railroad from town to the Vermilion Iron Range to the two separate harbors that, today, make up the town of Two Harbors. Before this, the region occupied by what is not the town Two Harbors had only one inhabitant. However, with the prospect of profit from shipping iron ore, the area began to burst into life, and in 1884 the Two Harbors port loaded its first ship with iron ore. By 1885, the area became Two Harbors when the two bays, Agate Bay and Burlington Bay, were joined together to formally create the town. By 1895, Two Harbors’ iron ore export reached over two million tons. This was thirty times as much

shipped in 1884. Today, Two Harbors acts as one of the main ports for the loading of Iron Ore, after the Duluth-Superior Port (Smith, 1983: 79).

The expansion of iron ore shipping in Two Harbors was a key factor in the increase of population of the town, which more than doubled in five years (Smith, 1983: 80). With this increase in tonnage, there was demand for better and bigger dock facilities. By 1910 there were docks to accommodate ore, coal, and lumber. These larger docks allowed for Two Harbors to keep up, economically with the other Lake Superior ports of the era, allowing the town to grow in population and economy. Not only has the increase in docks assisted the growth and success of the town of Two Harbors, but the physical geography of Two Harbors has also contributed to its success as a port. Because of Two Harbors' clay bottom on Lake Superior, it was easier for ships to set anchor in the town for however long they needed to be there. This clay surface of Lake Superior off the shores of Lake Superior was the main reason that the Minnesota Iron Company decided to bring rail to Two Harbors. The Company knew that the clay bottom located off the shores of Two Harbors would provide as an economic shipping advantage over the rocky shores and lake bottoms of any other possible shipping harbor in area (Smith, 1983: 78).

Just as with the Port of Duluth-Superior, and nearly every other Lake Superior port, Two Harbors saw its beginning as not only a port, but a city, once rail was built for the purposes of shipping. This demonstrates the importance of rail to not only Two Harbors, but also every other port city on Lake Superior. While rail is an important factor to Two Harbor's success, the combination of clay lake bottoms and its proximity to ore mines, along with rail, allows Two Harbors to thrive as a port city on Lake Superior. So long as Two Harbors can keep up with the increasing size of ships, the increasing

demand, and port facilities, the town of Two Harbors will remain a viable port city on Lake Superior.

Silver Bay, Minnesota

The small town of Silver Bay, Minnesota is a town that shows the reliance on exactly one commodity: taconite. Silver Bay is reliant on taconite because that is what the town was planned and built for. Silver Bay was a planned town that was created by the Reserve Mining Company, now known as Northshore Mining Company, in 1954 to process taconite (Bay Historical Society, 2013). Although taconite had been discovered in 1871, it did not become important until high-grade ore was becoming exhausted. Even then it was not economically viable to mine, process, and ship taconite because of the three mining taxes imposed on miners. The royalty and occupation tax are acceptable taxes, but the third tax, the ad valorem tax, made it too expensive to mine taconite. The ad valorem tax was a property tax on ore reserves in the ground and also taxes certain portions of ore shipped. Because of the difficulty and high expense to excavate taconite, the ad valorem tax made it too expensive to explore taconite mining. But in 1941, the Minnesota State Legislature enacted the Taconite Law, designed to make taconite mining economically feasible by making taconite exempt from the ad valorem tax. Shortly thereafter, mining companies started creating taconite mines and looking for areas that could ship the commodity (Kohn & Specht, 1958: 529-530; 532).

The area of what is now the town of Silver Bay was chosen for two reasons: because of the area's location on Lake Superior and the proximity of the area to the taconite mines in Babbitt, Minnesota. Babbitt was also a planned town created at the same time by the Reserve Mining company and also serves one purpose: to mine taconite. Because these are planned towns that were created for the mining and

processing of taconite, it is simple to assume that the towns would serve that one purpose and provide no stability for families to live successful lives. But the Reserve Mining Company knew the threat of the possibility of creating a ghost town, so they established and paid for local facilities such as schools and churches, among other things, to make citizens feel welcome (Kohn & Specht, 1958: 532-533).

Although the Reserve Mining Company created a stable town with a community feel, the city is still mainly dependent on the production of taconite. This is because there is only one railroad that goes to Silver Bay, which is owned by the Reserve Mining Company, from here on out, called the Northshore Mining Company, that only transports taconite from Babbitt. The port of Silver Bay is also owned by the Northshore Mining Company and ships just one commodity: Taconite. So long as taconite remains a relevant commodity and not exhausted, the Northshore Mining Company and the town of Silver Bay will continue to succeed. But that seems unlikely, considering that Silver Bay was dubbed the “Taconite Capitol of the World” in 1964 (Bay Area Historical Society, 2013).

Taconite Harbor, Minnesota

Taconite Harbors, prior to the 1950s, was solely a port with no town, with just a railroad built by the Eerie Mining Company. But in 1957, the Eerie Mining Company, who shipped taconite pellets from Taconite Harbor, brought pre-constructed houses to the area to provide housing for port terminal workers and their families (Wurzer, 2008: 24). During the decade of the 1950s, taconite extraction and shipment was on the rise because of the Taconite Law that exempted taconite mining from the ad valorem tax, which led to Taconite Harbor and the Eerie Mining Company to boom. Since that time, taconite would be mined from Hoyt Lakes, Minnesota and be sent to Taconite harbor via the only railroad leading to Taconite Harbor (Kohn and Specht, 1958: 533).

Throughout the 1950s and into the 1980s, Taconite Harbor was expanding as both a town and a port. But by the early 1980s, while taconite shipment was still viable and on the rise in the town, the citizens of Taconite Harbor began to leave. The citizens of Taconite Harbor found it difficult to live in the town because of the noisy railroad cars and the air pollution from the taconite dust (Wurzer, 2008: 23). Because of the increasing number of citizens and dockworkers leaving Taconite Harbor, the Eerie mining company had to cut its workforce by nearly 100 people in 1982. By 1986, only 21 families remained in Taconite Harbor, all of which worked on the Taconite Harbor port, and were told that they would have to leave by the Eerie Mining Company because they no longer found it economically viable to play landlord for a dying town. Since the final families left the now unincorporated town of Taconite Harbor, the area consists only of a power plant, housing foundations, and an abandoned basketball court. Because of the proximity of Taconite Harbor to the taconite mines in Hoyt Lakes and the fact that a mining company created the area, Taconite Harbor is nearly a duplicate of Silver Bay's shipping economy and has the same factors that make the port successful. The only difference is population success. If the Eerie Mining Company had taken a page out of the Northshore Mining Company's playbook, there may be a properly managed town there today. But instead, Taconite Harbor is, in every sense of the definition, a ghost town (Forgotten Minnesota, 2012).

Ashland, Wisconsin

Shipping began shortly after 1877 when the first rail line reached Ashland. Two more rail lines connected to Ashland by the year 1889. These railroads lead Ashland to build three iron ore docks, which allowed for easy transfer of iron ore from the Gogebic Range, just 40 miles away from Ashland. Prior to the railroads connecting Ashland to the

Gogebic Range, there was not easy way to transport ore to Ashland, making shipping an unviable source of economy for the city. But once the prospect of rail was brought to Ashland, businessmen knew that shipping would play a major role in the town's economy. This led to several rail companies to fight over who would be able to build a rail line from the Gogebic Range to Ashland. The Wisconsin Central Railroad Company eventually won the battle to build the rail and completed its first tracks in 1877. This not only allowed for ore to rise in shipment from the Ashland port, but lumber from the Upper Peninsula of Michigan as well (Dodd, 1944: 190).

Since the induction of the first rail in 1877 up until the 1930s, the Ashland shipping economy was booming. But in the 1930s, two factors caused the Ashland port to bust. The combination of the Great Depression and a mismanagement of the iron ore mines in the Gogebic Range did not make it viable for many of the Gogebic mines to remain open. So as the mines in the Gogebic were extracted past its limits and closed down, Ashland's shipping economy began to falter. Even with the decrease in ore shipments from Ashland, the town might have been able to get by with lumber shipments from the port. But as with the Gogebic mines, the forests of the Upper Peninsula and parts of Ashland that were used to ship lumber were mismanaged and soon disappeared, which caused Ashland's shipping economy to come almost to a halt (Wisconsin Central). Beginning in the mid-1930s, the Ashland docks began to close down and, in 1965, the final dock in Ashland was closed, leaving Ashland's port vacant (Adams, 2012). In the end, mismanagement, coupled with the untimeliness of the Great Depression, caused Ashland's shipping economy to disappear. If these factors had been different, it seems likely that the town would be as viable of a port as any other on Lake Superior.

Marquette, Michigan

The very first dock built specifically for iron ore trade on all of Lake Superior was in Marquette in 1857 and remained the only ore dock on Lake Superior until 1976.

Several docks and railways have been built in and through the city of Marquette since 1857, but in recent history, many of those docks have been abandoned or torn down because a lack of economic success. But there has been one dock in Marquette that has proven to be a successful dock in Marquette, and that is the Cleveland-Cliffs dock. The Cleveland-Cliffs dock was the first dock built in Marquette in 1857 and was constructed by the Cliffs Natural Resources Company, formerly known as Cleveland-Cliffs. The Cleveland-Cliffs Dock has been, and remains the most successful dock in Marquette and is the second most successful ore dock on Lake Superior, after the ore dock in Superior, Wisconsin (Marquette Maritime History).

Marquette, mainly because of the Cleveland-Cliffs dock, has remained a viable port on Lake Superior through proper management and infrastructure changes to accommodate the ever-growing ships that pass through the harbor. Marquette will always hold a place in Lake Superior shipping and is not likely to falter in the future because of their proximity to iron ore mines, which are also owned by the Cliffs Natural Resources Company. So long as Cliffs Natural Resources can produce iron ore from the Marquette Iron Range and have it shipped from the Marquette harbor, it is difficult to believe that the Marquette dock will falter in the near future (Marquette Maritime History).

Thunder Bay, Ontario, Canada

Thunder Bay has had a long history that can be dated back to French fur trade. But it was not until the early 1800s that the area of Thunder Bay was permanently settled as the two separate towns of Port Arthur and Fort William, the latter acting as a main post

for the Hudson Bay Company which furthered the trade, transportation, and connections to and from the town. It was not until 1970 when the towns of Port Arthur and Fort William were combined to create the city of Thunder Bay, but large cargo shipping can be traced to more than seventy years prior. In the late 1800s and early 1900s, one commodity was to Thunder Bay what Iron Ore was to Duluth, and that commodity was the grain. Grain was, and still is, the booming commodity that influences Thunder Bay's port because of the areas proximity to grain prairies in the Thunder Bay area (Baumhofer, 1993: 42-44). Ever since the year 1883, when the first cargo of grain was shipped from what is now the city of Thunder Bay, the city has been a juggernaut of grain trade throughout the world (Porrirt, 1918: 345).

As well as Thunder Bay's proximity to grain, they have a geographic advantage that makes the port so important for trade throughout Canada, the Lower Great Lakes, and throughout the world. Thunder Bay is at the head of Lake Superior and has an optimal location for Canada to transport cargo to Thunder Bay and vice versa as well as its optimal shipping routes throughout the lakes and to the ocean (Porrirt, 1918: 356).

Edward Porrirt (1918) summed up Thunder Bay's potential nicely, saying:

Better than in any other city in Canada, it is possible at Port Arthur and Fort William to feel the pulse of trade- to watch the incoming of the grain trains, the outgoing steamers laden with grain, the movement of freight westward, and the tide of immigration into the four western provinces ... (357).

This geographic location and advantage could dub Thunder Bay as the "Gateway to the West." Those who came to build rail and other feats of infrastructure believed that Thunder Bay would become the Chicago of Canada but instead it became Canada's

Duluth (Porritt, 1918: 348). But having the shipping prowess of Duluth is not such a bad thing, right? So long as Thunder Bay can maintain stable grain production from year-to-year and keeps shipping commodities such as potash and petroleum, the city will maintain its status as the Duluth of Canada and the “Gateway to the West” (Baumhofer, 1993: 43).

Conclusion

Lake Superior shipping is not only important to the cities surrounding the Lake, but to the rest of the United States and the World, thanks to the canals at Sault Ste. Marie. Through our analysis and examination of each Lake Superior port’s history we were able to deduce what we believe the most important factors to shipping prowess on Lake Superior are. We believe that railroad connectivity has been, and still is, the most important factor in the success of every single Lake Superior port. We also have noticed, though, that the importance of these railroads is only important when the tracks lead to somewhere important, and in this case, it is primarily iron ore. The proximity of each port city to iron ore has played another large role in the success of each port. While all of the Lake Superior ports have good rail connectivity and are in a close proximity to their top commodity shipped, we noted that mismanagement of resources could cause a whole port and/or its city to falter. This is demonstrated through Ashland and its mismanagement of resources during the Great Depression and in Taconite Harbor and its mismanagement of its housing units, which drove people away. With all of this information we have provided, we plan to create an interactive map that will demonstrate the success or failure of each port. Our map will include tonnage and census data as a way to show economic success at each port city, with a summary of each port city’s major events that we believe have played into the success or failure of each city. Through this map, we hope to

correlate certain events in time with tonnage and populations to determine times when the ports were most or least successful. This interactive map will not only allow use to come up with conclusions, but whoever is looking at the map as well.

Methodology

Process:

The creation of our interactive will be completed through the successful implementation of these processes: textual and archival analysis of primary and secondary source data, a usability oriented multi-stage development strategy. The substance of any interactive map is its data. Acquiring the many components of this largely historic data required significant textual and archival analysis. The first of our three main foci in this area is the compilation and analysis of the general historical and contemporary background information of these port cities. The histories of each port are essential for the user to contextualize the demographic and cargo statistics shown on the map. In addition to the port summaries, we've gathered historic and contemporary photos of each of the ports. The most essential component of our analysis is the demographic and tonnage figures for the Lake Superior ports sizable enough to merit inclusion. The tonnage data, the number of tons of cargo shipped by port each year, serves as the independent variable in this analysis. These historic tonnage figures were compiled manually and electronically from annual reports of the Lake Carriers Association and cargo records maintained by the port authorities of Duluth, Thunder Bay, and the Cleveland-Cliffs Mining Company. The second and dependent variable in our analysis is the population of the port cities. All of this was acquired electronically through the United States and Canadian Census websites.

All of the data we collected, everything from multiple paragraph long port summaries to image file path names to the latitude and longitude coordinates of the cities, was collected in a single spreadsheet. Using JavaScript to access and manipulate the information within the spreadsheet, we were able to use it to organize and structure our content, as well as collaborate remotely on revisions and during data collection.

Before we reached that stage (or any stage) of the development, we had a preliminary interface design and a general interaction strategy. After sufficient evaluation of the proposed interface and the requisite amount of data collection we began the development process. For this interactive we used two JavaScript APIs, which are libraries of pre-written JavaScript designed to extend complex functionality. The first API we employed was Mike Bostock's Data Driven Designs scalable vector graphics library, a powerful library designed specifically for data visualization, which we implemented to draw the interactive bar charts.

The second API we chose to use was Vladimir Agafonkin's Leaflet, a lightweight, tile-based, and mobile-friendly web-mapping utility. With Leaflet we were able to use a custom base map tile-layer generated using the web-based Tile-Mill. The custom base map allowed us to include the limited railway data we had access to, it also allowed us to only include labels relevant to our map and to add the bathymetry layer to the lakes. All of the technologies mentioned so far are non-proprietary or "open source" offerings, allowing mainstream online cartographic functionality to be implemented freely (Batty, 2010, 417). Once we had a mostly functional interactive, we evaluated the functionality of the interface and made the changes that most improved usability with the least amount of code restructuring. The final step of our process was "polishing" the appearance of the site by making changes to the websites CSS.

Interactive Map

The success of an interactive map is dependent upon the effectiveness of the interface to facilitate the needs of the user, which may vary based upon the context with which this interactive is used. The predominantly narrative aim of this interactive is telling the story behind Lake Superior's port towns and cities through the spatial representation of tonnage and demographic data, contextualizing the raw data with the history of the shipping and mining industry to which they are so inextricably linked. To effectively create this user experience I've chosen to implement the following interactive functions (Figure 1), which I've framed within Roth's "Taxonomy of Cartographic Interaction Primitives" (Roth, 2011, 86)

Interaction Operators:

Sequence

The timeline slider function provides an indicator of temporal context and allows for the timescale to be easily and quickly adjusted, as well as viewed at variable rates. VCR buttons allow for one-click viewing of entire animation with the play button, while the interactive Sault Saint Marie tonnage graph allows for precise year selection through click or dragging of a hidden "slider" element.

Retrieve

The retrieve function is first invoked when a user hovers the mouse over a proportional symbol, this will bring up a pop-up window, which displays the name of the port and the annual tonnage received that year. If the user clicks on the proportional symbol the information window at the bottom of the frame will be populated with the bulk of our text information and a picture if they select the image view.

Re-symbolization

When a user clicks one of the proportional symbols that particular symbol is highlighted to indicate that a particular port has been selected and the corresponding bar

in the tonnage graph is highlighted to create association between the two data representations. The user can also re-symbolize the bar graph by selecting one of the radio buttons, which will allow the user to select the commodity to be represented by the proportional symbol. Furthermore, the demographic data, which is subject to the restraints of bivariate representation (the class breaks), can be expressed in full detail.

Additional Operators

Retrieve

Additional information regarding our sources, methodologies, and process will be compiled in a separate page, which will be accessible by clicking on the “About” button. If the user is interested in viewing our dataset they can click on the “Data”, which will bring up a download a window and give them an option of downloading the spreadsheet tonnage data being represented by the interactive.

A successful experience with our interface will allow the user to explore the spatial and temporal trends in Lake Superior shipping, comparing them with trends in the region’s demography, as well as putting them into their respective historical and cultural contexts. Accordingly, this map would occupy the three dimensional space between synthesis and presentation within MacEachren’s Cartography Cubed Model (Figure 2) space classification (Perkins, 2010, 355), as the audience is intended to be public, the interaction level is lower and the data relations are less known.

Cartographic Decisions:

Bivariate Proportional Symbols

To show both the changes in volume of tonnage and the population of the ports we chose to encode both variables into a single symbol. The size of the proportional symbol is scaled by the tonnage figures when applicable. Zero tonnage values are represented by squares, this design inclusion is necessary to maintain visibility of the

population data visual variable and to allow accessibility to the port content window information. The population information is encoded in the color of the symbol, based on a five class, single hue, sequential color scheme generated using Cynthia Brewer's ColorBrewer utility. The breaks for the population scale range from less than 4,000 to greater than 16,000. These breaks were selected to better represent the variation in the populations of the more numerous small lake port towns.

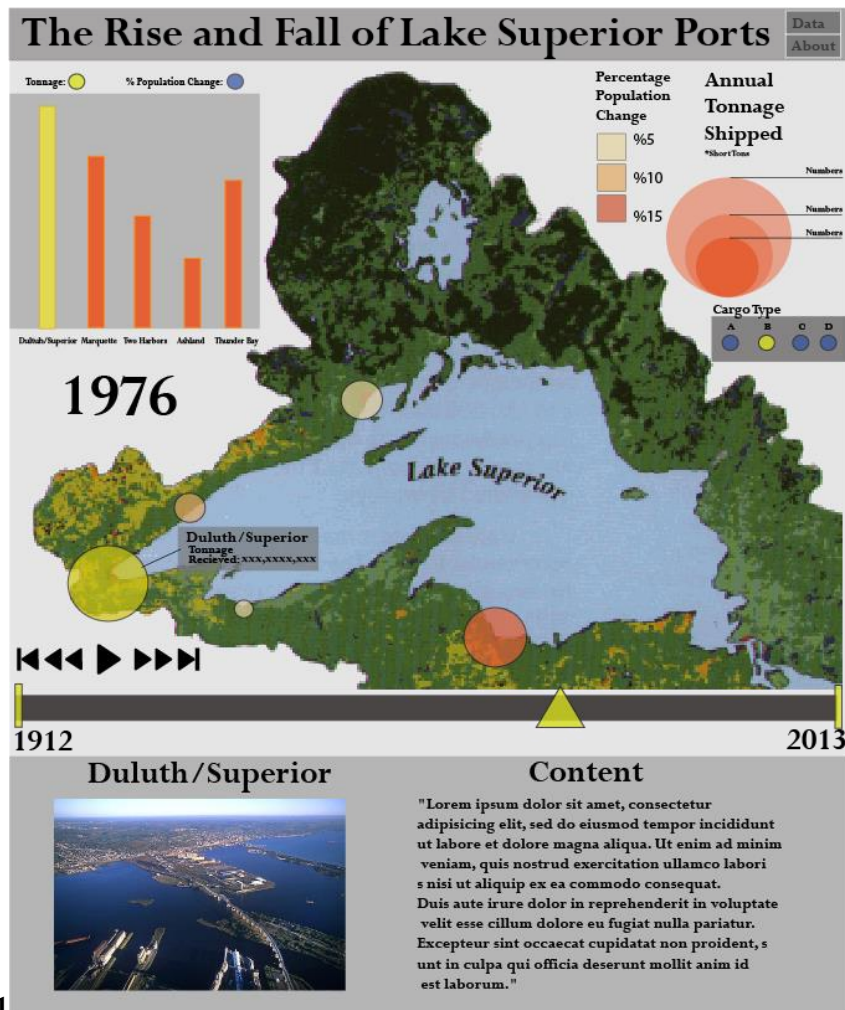
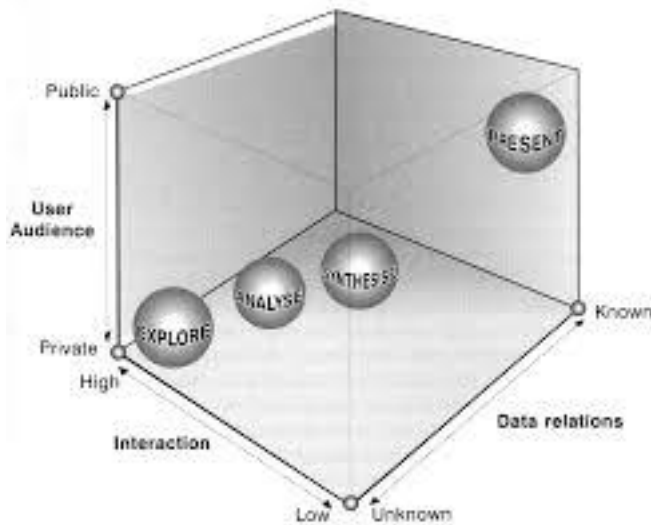


Figure 1
Figure 2

Source: *Key Methods In Geography*, page 354, Figure 22.2



References

- Adams, B. 2012. On Wisconsin: City salvages history from what was once world's largest ore dock. *Wisconsin State Journal*. 23 September.
- Baumhofer, J.A. 1993. *Where the Boats Are*. St. Paul, MN. pp.42-46
- Ballert, A. 1957. Commerce of the Sault Canals. *Economic Geography* 33(2), pp.135-148.
- Batty, M. 2010. Using Geographical Information Systems .In *Key Methods in Geography*, ed. Nicholas Clifford, Shaun French, & Gill Valentine, 408-422. SAGE Publications.
- Bay Area Historical Society. *The History of Silver Bay*. Retrieved October 11, 2013, from <http://www.silverbay.com/history.htm>
- Boyle, J. 2012. LS&I Railroad ore dock in Marquette reaches milestone. *The Mining Journal*. 7 March.
- Cleef, E. 1912. A Geographic Study of Duluth, Part II. *Bulletin of the American Geographical Society*, 44(7), pp.493-506.
- Dickinson, J. 1981. *To Build a Canal: Sault Ste. Marie, 1853-1854 and After*. Published by Ohio State University Press, 1981.
- Dodd J. M. 1944. Ashland Then and Now. *The Wisconsin Magazine of History* 28(2), pp.188-196.
- Duluth-Superior Metropolitan Interstate Council. 2005. *Duluth Land Use Plan*. pp.1-6

- Healey, M., & Healey, R. 2010. How to Conduct a Literature Search. In *Key Methods in Geography*, ed. Nicholas Clifford, Shaun French, & Gill Valentine, 16-34. SAGE Publications.
- Kohn, C., & Specht, R. 1958. The Mining of Taconite, Lake Superior Iron Mining District. *Geographical Review*, 48(4). pp.528-539.
- Miller, G. (1914). Some Geographic Influences of the Lake Superior Iron Ores. *Bulletin of the American Geographical Society*, 46(12). pp.881-916.
- Minnesota Geological Survey, & Green, J. C. (1982). *Geologic Map of Minnesota, Two Harbors Sheet: Bedrock Geology*. Minnesota Geological Survey, University of Minnesota.
- Passfield, R. 1990. Technology in Transition: The "Soo" Ship Canal, 1889-1985. *Technology and Culture*, 31(4), pp.880-881.
- Passi, P. (2008, February 15). Lake superior cargo demand increases as capacity drops. *McClatchy - Tribune Business News*. Retrieved from <http://search.proquest.com.ezproxy.library.wisc.edu/docview/462387058?accountid=465>
- Perkins, C. 2010. Mapping and Graphicacy. In *Key Methods in Geography*, ed. Nicholas Clifford, Shaun French, & Gill Valentine, 350-370. SAGE Publications.
- Porritt, E. 1918. Canada's National Grain Route. *Political Science Quarterly*, 33(3), pp.344-377.
- Posekany, L. 1958. *Report on Minnesota taconite plant : report*. [Madison, Wis.?: Wisconsin Conservation Dept.
- Primmer, G. (1937). Railways at the Head of Lake Superior. *Economic Geography*, 13(3), pp.269-280.
- Roth, R. (2011). *Interacting with maps: The science and practice of cartographic interaction*. . (Unpublished doctoral dissertation, State University of Pennsylvania).
- Scott, J. F. 1978. *Two Harbors Waterfront Economic Development Program : Two Harbors, Minnesota*.
- Smith, D. L. 1983. *Two harbors 100 years: A pictorial history of two harbors, minnesota and surrounding communities*. Dallas, TX: Taylor Publishing Company. pp.78-84.
- Tunell, G. (1896). Lake transportation and the iron-ore industry. *Journal of Political Economy*, 5(1), pp.23-39.

Wurzer, C. 2008. *Tales of the Road: Highway 61*. St. Paul, MN: Minnesota Historical Society. pp.22-26.

Zanko, M. L. M. (2007). *The Economics and Logistics of Transporting Taconite Mining and Processing Byproducts (Aggregate): Minnesota and Beyond*.

Appendix

Code

JS:

```
var map;
var csvData
var markersArray = [0,1,2,3,4,5,6];
var chartArray = [0,1,2,3,4,5,6];
var popArray=[0,1,2,3,4,5,6];
var timestamp = 1910;
var scaleFactor1 = .00005;
var popUpHtml;
var timer;
var timerInterval = 1300;
var csvData = [];
var saltyArray = [];
var clicked = false;
var loaded = false;
var markersLayer1;
var expressed = "ore";
var margin_left = 70,
margin_right = 30,
margin_top = 10,
margin_bottom = 55;
var popMargin_left = 60,
popMargin_right = 30,
popMargin_top = 10,
popMargin_bottom = 55;
var saltyMargin_left = 50,
saltyMargin_right = 60,
saltyMargin_top = 30,
saltyMargin_bottom = 30;
var chartWidth = 375 - margin_left - margin_right;
var chartHeight = 213 - margin_top - margin_bottom;
var popChartWidth = 362 - popMargin_left - popMargin_right;
var popChartHeight = 213 - popMargin_top - popMargin_bottom;
var saltyChartWidth = 600 - saltyMargin_left - saltyMargin_right;
var saltyChartHeight = 200 - saltyMargin_top - saltyMargin_bottom;
var chart = d3.select("#chart").append("svg")
.attr("width", chartWidth + margin_left + margin_right)
.attr("height", chartHeight + margin_top + margin_bottom)
.append("g")
.attr("transform", "translate(" + margin_left + "," + margin_top + ")");
var salty = d3.select("#salty").append("svg")
```

```

.attr("width", saltyChartWidth + saltyMargin_left + saltyMargin_right)
.attr("height", saltyChartHeight + saltyMargin_top + saltyMargin_bottom)
.append("g")
.attr("transform", "translate(" + margin_left + "," + margin_top + ")");
var pop = d3.select("#pop").append("svg")
.attr("width", chartWidth + margin_left + margin_right)
.attr("height", chartHeight + margin_top + margin_bottom)
.append("g")
.attr("transform", "translate(" + margin_left + "," + margin_top + ")");
var barClick = false;
var imgOrText= false;
var initialMouse = false;
var iconClick;
var defaultText = "The Lake Superior commerce has played an essential role in the development and
the continued economic viability of its port cities. Use the interactive proportional symbol map and
charts to manipulate the time series and commodities being displayed. As you examine the data,
explore the visual and spatial patterns in tonnage and demographic data, consider the relationships in
the data and the broader implications of changes."

```

```

window.onload= initialize();

```

```

function initialize(){

```

```

    setMap();

```

```

};

```

```

function processArray(){

```

```

    d3.csv("data/tonnage4.csv",function(d){

```

```

        csvData = d.map(function(d){

```

```

            var color;

```

```

            if(d.pop > 16000){

```

```

                color = "#08519c"

```

```

            }

```

```

            else if(d.pop > 12000){

```

```

                color = "#3182bd"

```

```

            }

```

```

            else if(d.pop > 8000){

```

```

                color = "#6baed6"

```

```

            }

```

```

            else if(d.pop > 4000){

```

```

                color = "#eff3ff"

```

```

            }

```

```

            else{

```

```

                color = "#bdd7e7"

```

```
}
```

```
return {  
  id: +d.id,  
  latitude: +d.latitude,  
  longitude:d.longitude,  
  year: +d.year,  
  port:d.port,  
  label : d.label,  
  ore:+d.ore,  
  coal:+d.coal,  
  grain:+d.grain,  
  other:+d.other,  
  text: d.text,  
  population:+d.pop,  
  color: color,  
  img: "img/"+d.links,  
  desc: d.desc,  
  credit: d.credits
```

```
}
```

```
});  
createMarkers();  
});  
}
```

```
function clock(){  
  $('#clock').html( timestamp);
```

```
};
```

```
function animateMap(){  
  timer = setInterval(function(){  
    step();  
  }, timerInterval );
```

```
};
```

```
function changingLegend(){
```

```

timer = setInterval(function(){
changeLegend();

}, timerInterval2 );
}

function createMarkers(){

var r = 10;
var i =0;

var markersArray1 = [];
for(obj in csvData){
if(csvData[obj].port == "saultstmarie"){
saltyArray.push(csvData[obj])
}
}
if(csvData[obj].year == timestamp){

if(csvData[obj].port != "saultstmarie"){
chartArray[i] = csvData[obj]
}
popArray[i] = csvData[obj];
var lat = csvData[obj].latitude;
var lng = csvData[obj].longitude;
var markerStyle1 ={
radius: r,
color: csvData[obj].color,
fillOpacity: ".5",
fillColor: csvData[obj].color
};
var markerStyle2 ={
color: csvData[obj].color,
fillOpacity: ".5",
fillColor: csvData[obj].color,
weight: 5
};

if(csvData[obj][expressed]== 0){

marker = L.polygon([
[(lat+.06),(lng+.2)],
[(lat-.06),(lng+.2)],
[(lat-.06),(lng-.2)],
[(lat+.06),(lng-.2)]

],markerStyle2)
}
else{
marker = L.circleMarker([lat,lng],markerStyle1);
}
}
}

```

```

}
marker.feature = csvData[obj];
markersArray[i] = marker
i++

}
}
if(loaded == false){
chartArray.splice(3,1)
drawChart();
drawSaltyChart();
drawPopChart();

}
chartArray.splice(3,1)
loaded = true
markersLayer1 = L.featureGroup(markersArray);
markersLayer1.addTo(map);

markersLayer1.eachLayer(function (layer){
onEachFeature(layer);

})

};
function onEachFeature(layer){
console.log(barClick)
console.log(clicked)

var area = layer.feature[expressed] * scaleFactor1;

if(area > 0){
var radius = Math.sqrt(area/Math.PI);
layer.setRadius(radius);
}
if(layer.feature.port== "SaultStMarie"){
popUpHtml1 ="<b>Year:</b>"+ " "+timestamp+"</br>"+
"<b>City:</b>"+ " "+layer.feature.label+"</br>"+
"<b>Metric tonnage shipped:</b>"+ " "+ "through the St.Mary's River Canal<br>" +
"<b>Population:</b>"+ " "+numberWithCommas(layer.feature.population)
}
if(expressed== "other"){
popUpHtml1 ="<b>Year:</b>"+ " "+timestamp+"</br>"+
"<b>City:</b>"+ " "+layer.feature.label+"</br>"+
"<b>Metric tonnage of "+expressed+" "+ "commodities shipped:</b>"+ " "+
"+numberWithCommas(layer.feature[expressed]) + " <br>"+
"<b>Population:</b>"+ " "+numberWithCommas(layer.feature.population)

```

```

}
else{
popUpHtml1 ="<b>Year:</b>" + " "+timestamp+"</br>" +
"<b>City:</b>" + " "+layer.feature.label+"</br>" +
"<b>Metric tonnage of "+expressed+ " shipped:</b>" + " "+
numberWithCommas(layer.feature[expressed]) + " <br>" +
"<b>Population:</b>" + " "+numberWithCommas(layer.feature.population)
}

```

```

if(area > 0){

```

```

layer.bindPopup(popUpHtml1,{
offset:new L.Point(0,-radius)

```

```

});

```

```

}
else{
layer.bindPopup(popUpHtml1,{
offset: new L.Point(4,-6)
});
}

```

```

layer.on({
mouseover: function(){
if (clicked == false&&barClick==false){

```

```

layer.openPopup();
this.setStyle({ radius: radius, color:"#6da0bb"})
$(".bar").css("fill","silver")
$("#"+this.feature.port).css("fill","#6da0bb")
$("#pop"+this.feature.port).css("fill","#6da0bb")

```

```

}
},
click: function(){

```

```

if(clicked == false&& barClick ==false){

```

```

if(imgOrText ==true){
$("#desc").show()
}

```

```

this.setStyle({ radius: radius, color:this.feature.color})
layer.openPopup();
this.setStyle({ radius: radius, color:"#6da0bb"})
$("#"+this.feature.port).css("fill","#6da0bb")
$("#pop"+this.feature.port).css("fill","#6da0bb")
$("#title").text(this.feature.label);

```

```

$("#textWindow").text(this.feature.text)
$("#pic").attr("src",this.feature.img)
$("#desc").text(this.feature.desc)
$("#credit").text(this.feature.credit)

clicked = true;
iconClick = layer;

}
else{

iconClick.setStyle({ color:iconClick.feature.color})
layer.closePopup();
this.setStyle({ radius: radius, color:this.feature.color})
$(".bar").css("fill", "silver")
$(".pop").css("fill", "silver")

$("#title").html("Trends in Tonnage:<br>A Century of Lake Superior Shipping");
$("#textWindow").html(defaultText)
$("#pic").attr("src", "img/default.jpg")
$("#credit").text("credit")
clicked = false;
barClick = false;

$("#desc").hide()

}

},

mouseout: function(){
if (clicked == false&& barClick== false){
layer.closePopup();
$(".bar").css("fill", "silver")
$(".pop").css("fill", "silver")

this.setStyle({ radius: radius, color:this.feature.color})
}

},

}

)

};

function step(){

```

```

clock();
if(timestamp < 2010){
timestamp ++;
}
else{
timestamp = 2010;
}
updateLayers();
updateSlider();

};
function stopMap(){
clearInterval(timer);

};
function jump(t){
timestamp = t;
updateLayers();
updateSlider();

};

function sequenceInteraction(){
var chartClick = false
$("#ore").tooltip().click(function(){
expressed = "ore";
updateLayers()
});
$("#grain").tooltip().click(function(){
expressed = "grain"
updateLayers()
});
$("#coal").tooltip().click(function(){
expressed="coal"
updateLayers()
});
$("#other").tooltip().click(function(){
expressed="other"
updateLayers()
});
$(".pause").tooltip().hide();
$(".play").tooltip().click(function(){
$(".pause").show();
$(".play").hide();
animateMap();
});
$(".pause").click(function(){
$(".pause").hide();
$(".play").show();
stopMap();

})

```

```

$(".step").click(function(){
step();
});
$(".step-full").click(function(){
jump(2010);

});

$(".back").click(function(){
if(timestamp > 1910){
timestamp--;

}
updateLayers();
updateSlider();

});
$(".back-full").click(function(){
jump(1910);

})

$("#temporalSlider").slider({
min:1910,
max: 2010,
aimate: "fast",
step:1,
slide: function(e, ui){
stopMap();
timestamp = ui.value;
updateLayers();

}
});

$(".leaflet-control-container").hide();
$("#chartView").tooltip().click(function(){
if(chartClick == false){
$("#pop").fadeIn()
$("#chart").fadeIn()
$("#map").css("width","58%")
map.invalidateSize()
map.options.minZoom= 6;
map.setZoom(6);
$("#chartView").tooltip( "option","content","Click to view the map in a larger window");
$("#chartView").val("Map View")

chartClick = true;

```

```

}
else{
$("#pop").hide()
$("#chart").hide()
$("#map").css("width","100%")

map.invalidateSize();
map.options.minZoom = 7;
map.setZoom(7);

$("#chartView").val("Chart View")
$("#chartView").tooltip( "option","content", "Click to view dynamic tonnage and population bar
graphs");
chartClick = false;
}

});
$("#imageView").click(function(){
console.log(imgOrText)
if(imgOrText == false){

$("#imageView").val("View Text")
$("#textWindow").fadeOut();

$(".photo").fadeIn();

$("#imageView").tooltip( "option","content", "Click to view port descriptions in content window")
imgOrText = true

if(clicked == true || barClick == true){
console.log("fuck this")
$("#desc").show()
}
else{

$("#desc").hide()
}
}

else{
$("#desc").hide()
$("#imageView").val("View Image")
$(".photo").fadeOut();
$("#textWindow").fadeIn();
$("#imageView").tooltip( "option","content", "Click to view port pictures in content window")
imgOrText = false
}
}).tooltip()

$("#salty").tooltip().mouseover(
)

```

```
};  
  
function updateSlider(){  
    $("#temporalSlider").slider("value", timestamp);  
  
}
```

```
function setMap(){  
  
    var primary = L.tileLayer("http://a.tiles.mapbox.com/v3/tomcox333.h1dfs9k9/{z}/{x}/{y}.png");  
    map= L.map("map",{  
        center: new L.LatLng(47.5, -88.3),  
        zoom: 7,  
        minZoom: 7,  
        maxZoom:9,  
        maxBounds:([[45.5,-95.5],[49.3931,-81.6]]),  
        layers:[primary]  
    });  
    var basemaps = {  
        "Primary": primary  
    };  
  
    L.control.layers(basemaps).addTo(map)  
    processArray();  
    clock();  
    sequenceInteraction();  
    $("#pop").hide();  
    $("#chart").hide();  
    $(".photo").hide();  
  
};
```

```
function updateLayers(){  
  
    markersLayer1.clearLayers();  
    barClick = false;  
    clicked = false;  
    createMarkers();  
    redrawChart();  
    redrawPopChart();  
    redrawSaltyChart();  
    $("#title").html("Trends in Tonnage:<br> A Century of Lake Superior Shipping");  
    $("#textWindow").text("");  
    $("#pic").attr("src", "img/default.jpg");  
    $("#desc").hide();
```

```

$("#credit").text("credit");

clock();

};

function drawChart(){

var data = chartArray;
var data1 = popArray;

var a = [];
var b = [];
var c = [];
for (i in data){

b[i] = data[i].label
a[i] = data[i][expressed]
}

var max = d3.max(a.map(function(array) {
return array;
}));
for (i in data1){
c[i] = data1[i].port
}
var x1 = d3.scale.ordinal()
.domain(b.map(function(d,i){return b[i]}))
.rangeRoundBands([0, chartWidth], .05)

var y = d3.scale.linear()
.range([chartHeight, 0])
.domain([0,(max)])
.nice([0,(max)])

var xAxis = d3.svg.axis()
.scale(x1)
.ticks(5)

var yAxis = d3.svg.axis()
.scale(y)
.orient("left")
.ticks(5)
chart.append("g")
.attr("class", "xaxis")
.attr("id", "xx")
.attr("transform", "translate(0," + chartHeight + ")")
.call(xAxis)
.selectAll("text")

```

```
.attr("y", "12")
.attr("x", 6)
.attr("dy", ".1em")
.attr("transform", "rotate(30)")
.style("text-anchor", "start");
```

```
chart.append("g")
.attr("class", "yaxis")
.call(yAxis)
.append("text")
.attr("transform", "rotate(-90)")
.attr("y", 6)
.attr("dy", ".71em")
.style("text-anchor", "end")
.attr("id", "texter")
.text(capitaliseFirstLetter(expressed));
```

```
chart.selectAll(".bar")
.data(data)
.enter().append("rect")
.attr("class", "bar")
.attr("x",function(d){return x1(d.label)+6})
.attr("y",function(d){return y(d[expressed])})
.attr("width",20)
.attr("height",function(d){ return (chartHeight-.5)-y(d[expressed])})
.attr("label",function(d){return d.label})
.attr("city",function(d){return d.city})
.attr("year",function(d){return d.year})
.attr("id",function(d){return d.port})
.text(function(d){return y(d[expressed])})
.on("mouseover",function(d){if(barClick == false&& clicked == false){for(var i = 0; i < c.length;
i++){
if(d.port == c[i]){
markersArray[i].setStyle({color:"#6da0bb"})
markersArray[i].openPopup();
$("#"+d.port).css("fill","#6da0bb")
$("#pop"+d.port).css("fill","#6da0bb")
}
}}})
.on("mouseout",function(d){if(barClick == false&& clicked == false){for(var i = 0; i < c.length;
i++){
if(d.port == c[i]){
markersArray[i].setStyle({color:d.color})
markersArray[i].closePopup();
$("#"+d.port).css("fill","silver")
$("#pop"+d.port).css("fill","silver")
}
}}})
.on("click",function(d){if(barClick == false&& clicked ==
```

```

false){$("#"+d.port).css("fill","#6da0bb"),$("#pop"+d.port).css("fill","#6da0bb"), barClick = true;
for(var i = 0; i < c.length; i++){
  if(imgOrText == true){
    $("#desc").show()
  }
  if(d.port == c[i]){

    markersArray[i].setStyle({color:"#6da0bb"})
    markersArray[i].openPopup();
    iconClick = markersArray[i]
    $("#title").text(d.label);
    $("#textWindow").text(d.text);
    $("#pic").attr("src",d.img)
    $("#desc").text(d.desc)
    $("#credit").text(d.credit)

  }}else{
    $(".pop").css("fill","silver")
    $(".bar").css("fill","silver")
    barClick = false;
    clicked = false;

    $("#desc").hide()

    for(var i = 0; i < c.length; i++){
      markersArray[i].setStyle({color:markersArray[i].feature.color})
      if(d.port == c[i]){
        markersArray[i].setStyle({color:d.color})
        markersArray[i].closePopup();
        $("#title").html("Trends in Tonnage:<br> A Century of Lake Superior Shipping");
        $("#textWindow").html("The Lake Superior commerce has played an essential role in the
development and the continued economic viability of its port cities.Use the interactive proportional
symbol map and charts to manipulate the time series and commodities being displayed. As you
examine the data, explore the visual and spatial patterns in tonnage and demographic data, consider
the relationships in the data and the broader implications of the changes.")
        $("#pic").attr("src","img/default.jpg")

      }}})

}
function redrawChart(){
  var data = chartArray;
  var a = []
  for (i in data){

    a[i] = data[i][expressed]

  }
  var max = d3.max(a.map(function(array) {
  return array;

```

```

    });

    var y = d3.scale.linear()
    .range([chartHeight, 0])
    .domain([0,max]);

    var yAxis = d3.svg.axis()
    .scale(y)
    .orient("left")
    .ticks(5)
    data = chartArray;
    chart.selectAll(".bar")
    .data(data)
    .transition()
    .duration(1000)
    .attr("y",function(d,i){return y(d[expressed])})
    .attr("height",function(d,i){return (chartHeight-.5)- y(d[expressed])})
    .attr("year",function(d){return d.year})
    .text(function(d){return d[expressed];});
    chart.select(".yaxis").transition().duration(10).call(yAxis)
    chart.select("#text").text(capitaliseFirstLetter(expressed))

```

```

}

```

```

function drawSaltyChart(){

```

```

    data = saltyArray;
    var a = []
    var b = []
    var c = []
    for (i in data){

```

```

        a[i] = data[i][expressed]
        b[i] = data[i].year
    }

```

```

}

```

```

for(var j = 0; j < b.length;j++){

```

```

    if(b[j]%10 == 0 ){

```

```

        c[j]=b[j]
    }
}

```

```

var sorter = c.sort()

```

```

sorter = sorter.slice(0,11)

```

```

console.log

```

```

var max = d3.max(a.map(function(array) {

```

```
return array;
});

var x1 = d3.scale.ordinal()
.rangeBands([22, saltyChartWidth-13], .1)
.domain(b.map(function(d,i){return b[i]}))
var x2 = d3.scale.ordinal()
.rangeBands([-12, saltyChartWidth], .1)
.domain(sorter.map(function(d,i){return sorter[i]}))
```

```
var y = d3.scale.linear()
.range([saltyChartHeight, 0])
.domain([0,max+5000000])
```

```
var xAxis = d3.svg.axis()
.scale(x2)
```

```
var format =d3.format(",.9d")
var yAxis = d3.svg.axis()
.scale(y)
.orient("left")
.ticks(5)
.tickFormat(format)
```

```
salty.append("g")
.attr("class", "xaxis")
.attr("id", "xx")
.attr("transform", "translate(12,140)")
.call(xAxis);
```

```
salty.append("g")
.attr("class", "yaxis")
.call(yAxis)
.append("text")
.attr("transform", "rotate(-90)")
.attr("y", 6)
.attr("dy", ".71em")
.style("text-anchor", "end")
.text("Total Tonnage");
```

```
salty.select('.yaxis').select('.tick').select('text')
```

```
salty.selectAll(".bar")
.data(data)
.enter().append("rect")
.attr("x",function(d){return x1(d.year)})
.attr("y",function(d){return y(d[expressed])})
```

```
.attr("width",5.5)
.attr("height",function(d){ return (saltyChartHeight-.9)-y(d[expressed])})
.attr("label",function(d){return d.year})
.attr("id",function(d){return d.year})
.attr("class","salty")
.on("click",function(d){timestamp = d.year,updateLayers(),updateSlider()});
```

```
$("#"+timestamp).css("fill","#6da0bb")
salty.select("g")
```

```
}
function redrawSaltyChart(){
$(".salty").css("fill","silver")
$("#"+timestamp).css("fill","#6da0bb")
```

```
}
function drawPopChart(){
var data = popArray;;
var a = []
var b = []
for (i in data){

b[i] = data[i].label
a[i] = data[i].population
}

var max = d3.max(a.map(function(array) {
return array;
}));
```

```
var x1 = d3.scale.ordinal()
.domain(b.map(function(d,i){return b[i]}))
.rangeRoundBands([0, popChartWidth], .05)
```

```
var y = d3.scale.linear()
.range([popChartHeight, 0])
.domain([0,(max)])
.nice([0,(max)])
```

```
var xAxis = d3.svg.axis()
.scale(x1)
.orient("bottom")
.ticks(5);
```

```
var yAxis = d3.svg.axis()
.scale(y)
.orient("left")
.ticks(10)
```

```
pop.append("g")
```

```

.attr("class", "xaxis")
.attr("id", "xx")
.attr("transform", "translate(0," + popChartHeight + ")")
.call(xAxis)
.selectAll("text")
.attr("y", "12")
.attr("x", 6)
.attr("dy", ".1em")
.attr("transform", "rotate(30)")
.style("text-anchor", "start");

```

```

pop.append("g")
.attr("class", "yaxis")
.call(yAxis)
.append("text")
.attr("transform", "rotate(-90)")
.attr("y", 6)
.attr("dy", ".71em")
.style("text-anchor", "end")
.attr("id", "texter")
.text("Population");

```

```

pop.selectAll(".pop")
.data(data)
.enter().append("rect")
.attr("class", "pop")
.attr("x",function(d){return x1(d.label)+6})
.attr("y",function(d){return y(d.population)})
.attr("width",20)
.attr("height",function(d){ return (chartHeight-.9)-y(d.population)})
.attr("label",function(d){return d.label})
.attr("city",function(d){return d.city})
.attr("year",function(d){return d.year})
.attr("id",function(d){return "pop"+d.port})
.attr("population",function(d){return d.population})
.text(function(d){return d.population})
.on("mouseover",function(d){if(barClick == false&& clicked == false){for(var i = 0; i < b.length;
i++){
if(d.label == b[i]){
markersArray[i].setStyle({color:"#6da0bb"})
markersArray[i].openPopup();
iconClick = markersArray[i]
$("#"+d.port).css("fill","#6da0bb");
$("#pop"+d.port).css("fill","#6da0bb")
}
}
}
})
.on("mouseout",function(d){if(barClick == false&& clicked == false){for(var i = 0; i < b.length;
i++){
if(d.label == b[i]){

```

```

markersArray[i].setStyle({ color:d.color})
markersArray[i].closePopup();
$("#"+d.port).css("fill","silver")
$("#pop"+d.port).css("fill","silver")
}
}})
.on("click",function(d){if(barClick == false&& clicked ==
false){$("#"+d.port).css("fill","#6da0bb"),$("#pop"+d.port).css("fill","#6da0bb"), barClick =
true,click = false; for(var i = 0; i < b.length; i++){

if(d.label == b[i]){

if(imgOrText == true){
$("#desc").show()
}

markersArray[i].setStyle({ color:"#6da0bb"})
markersArray[i].openPopup();
$("#title").text(d.label);
$("#textWindow").text(d.text);
$("#pic").attr("src",d.img)
$("#desc").text(d.desc)

$("#credit").text(d.credit)

}}else{$("#.pop").css("fill","silver"),$("#.bar").css("fill","silver"),barClick = false,clicked = false
for(var i = 0; i < b.length; i++){
console.log(markersArray[i].feature.color)
markersArray[i].setStyle({ color:markersArray[i].feature.color})
if(d.label == b[i]){
markersArray[i].setStyle({ color:d.color})
markersArray[i].closePopup();
$("#title").html("Trends in Tonnage:<br>A Century of Lake Superior Shipping");
$("#textWindow").html("The Lake Superior commerce has played an essential role in the
development and the continued economic viability of its port cities.Use the interactive proportional
symbol map and charts to manipulate the time series and commodities being displayed. As you
examine the data, explore the visual and spatial patterns in tonnage and demographic data, consider
the relationships in the data and the broader implications of the changes.")
$("#pic").attr("src","img/default.jpg")
console.log(imgOrText)

$("#desc").hide()

}

}
}})

```

```

$("#timestamp").css("fill","#6da0bb")
$

}
function redrawPopChart()
{

var data = popArray;
var a = []
for (i in data){

a[i] = data[i].population

}

var max = d3.max(a.map(function(array) {
return array;

}
))

var y = d3.scale.linear()
.range([popChartHeight, 0])
.domain([0,max])
.nice([0,(max)]);

var yAxis = d3.svg.axis()
.scale(y)
.orient("left")
.ticks(5)

pop.selectAll(".pop")
.data(data)
.transition()
.duration(1000)
.attr("y",function(d){return y(d.population)})
.attr("height",function(d){return (popChartHeight-9)-y(d.population)})
.attr("year",function(d){return d.year})
.attr("population",function(d){return d.population})
.text(function(d){return d.population})
.call(yAxis)

}
function capitaliseFirstLetter(string)
{

```

```

return string.charAt(0).toUpperCase() + string.slice(1);
}
function numberWithCommas(x) {
return x.toString().replace(/\B(?=(\d{3})+(?!\d))/g, ",");
}

```

HTML:

```

<!DOCTYPE HTML> <html>
<head>

<meta http-equiv="Content-type" content="text/html;charset=UTF-8">
<meta http-equiv=Content-Type content="text/html; charset=windows-1252">
<title>Lake Superior Shipping | 100 Years</title>
<link rel="stylesheet" href="CSS/style.css" />
<link rel="stylesheet" href="CSS/jquery-ui.css"/>
<link rel="stylesheet" href="library/jquery-ui/css/custom-theme/jquery-ui-1.10.1.custom.css"/>
<link rel="stylesheet" href="CSS/leaflet.css"/>

<!-- [if lte IE 8]>
<link rel="stylesheet" href="css/leaflet.ie.css"/>
<![endif]-->
</head>
<body>

<!--div for the map-->
<div id = "container">

<div id = "author">Tom Cox, Tim Rooney, Kelly Abplanalp, Sunny Nguyen 2013</div>

<div id = "map"></span>
<div id = "legend"></div>
<div id = "clock"></div>
<div id = "vcr-controls2"></div>
<div id = "controls">
<input id = "chartView" type="button" value="View Chart" title="Click to view dynamic tonnage and
population bar graphs"></input>
<input type="button" value="View Image" id="imageView" title="Click to view pictures in content
window"></input>
<input type="radio" class = "radio" id="ore" name="radio" checked=checked'autocomplete="off"
title="Select to view metric tonnage of taconite ore exported">Ore</input>
<input type="radio" class = "radio" id="grain" name="radio" autocomplete="off" title="Select to view
metric tonnage of grain exported">Grain</input>

```

```
<input type="radio" class="radio" id="coal" name="radio" autocomplete="off" title="Select to view metric tonnage of coal imported">Coal</input>
<input type="radio" class="radio" id="other" name="radio" autocomplete="off" title="Select to view metric tonnage of dry bulk, liquid bulk and general cargo imported and exported ">Other</input>
</div>
```

```
<div id="VCRcont">
<span class="vcr play"></span>
<span class="vcr pause"></span>
</div>
</div>
```

```
<div id = "chartWindow" class="ext-">
<div class="int-box">
<div id= "chart"></div>
<div id="pop"></div>
</div>
</div>
```

```
<div class="ext-">
<div id= "salty">
<div id = "chartTitle">Sault Ste. Marie Tonnage</div>
<div id ="temporalSlider"></div>
</div>
<div id="infowindow">
<div id="title">Trends in Tonnage:<br> A Century of Lake Superior Shipping</div>
<p id = "textWindow">
```

The Lake Superior commerce has played an essential role in the development and the continued economic viability of its port cities.

Use the interactive proportional symbol map and charts to manipulate the time series and commodities being displayed.

As you examine the data, explore the visual and spatial patterns in tonnage and demographic data, consider the relationships in the data and the broader implications of the changes.

```
</p>
<p id="picWindow">
<b class ="photo" id="desc">Description</b>
<img class = "photo" id="pic" src ="img/default.jpg">
<i class ="photo" id="credit">Credit</i>
</p>
```

```
</div>
```

```
</div>
```

```
<!--<div id = "legend"></div-->
```

```
<!-- link to main js file-->
<script src="js/leaflet.js"></script>
```

```
<script src="js/d3.v3.js"></script>
<script src="js/jquery-1.9.1.js"></script>
<script src="js/jquery-ui.js"></script>
```

```
<script src="js/EventTarget.js"></script>
```

```
<script src="js/main.js"></script>
</body>
```

CSS:

```
body {
```

```
width: 100%;
```

```
height: 100%;
```

```
margin: 0px;
```

```
font-family: "Calibri", sans-serif;
```

```
background-image: -moz-linear-gradient(top, #7C9499 0%, #054852 100%);
```

```
}
```

```
h5{
```

```
float:left
```

```
}
```

```
#container{
```

```
height: 690px;
```

```
width: 1000px;
```

```
border-left: 2px solid #3b3b3b;
```

```
border-right: 2px solid #3b3b3b;
```

```
border-bottom: 2px solid #3b3b3b;
```

```
overflow: hidden; /* add this to contain floated children */
```

```
margin: auto;
```

```
background-color: #ebe5e5;
```

```
position: relative;
```

```
}
```

```
#map
```

```
{
```

```
padding-top: 5px;
```

```
height: 440px;
```

```
width: 1000px;
```

```
float:left;
```

```
margin:auto;
```

```
}
```

```
form{
```

```
float:left;
width:33%;
}
}
h1{
text-align: center;
font-size:20px;
font-family: "Calibri", Helvetica, sans-serif;
color:#74C476;
}
h2{
text-align: center;
font-size: 26px;
font-family: "Calibri", Helvetica, sans-serif;
color:black;

}
#title{
text-align: center;
font-size: 26px;
font-family: "Calibri", Helvetica, sans-serif;
color:black;

}
p
{
font-family: "Calibri", Helvetica, sans-serif;
color:#FFFF66;
}

#controls{
position: absolute;
bottom:0px;
left:0px;
z-index: 100;
margin: 8x 0 0 5px;
padding: 3px;

}
#vcr-controls2{
position: absolute;
bottom:0px;
left:0px;
z-index: 50;
margin: 8x 0 0 5px;
padding: 3px;
border-top: 1px solid white;
background-color: #3d708b;
opacity: .7;
width:100%;
height:22px;
}
```

```
#legend{
  position: absolute;
  z-index:100;
  right:5px;
  top:5px;
}
#temporalSlider{
  width:450px;
  top: 80px;
  left:90px;
}

.bar{
  fill: silver;
  text-align:right;
  color: black;
  padding: 3px;
  margin: 1px;
  font: 10px sans-ser
}
}
table{
  padding-left: 10px;
}
}
#chart{

  top:500px;
  right:300px,
  stroke: white;
  padding: 3px;
  margin: 1px;

}
}
#salty{
  margin-top:20px;
  margin-left:5px;
  float:left
}
}
.salty{
  position: absolute;
  bottom:40px;
  fill: silver;
  text-align:right;
  color: black;
  padding: 3px;
  margin: 1px;
  font: 10px "Calibri";
  color: white;
  height: 300px;
```

```
}
.pop{
fill: silver;
text-align:right;
color: black;
padding: 3px;
margin: 1px;
font: 10px "Calibri";

}

.yaxis text {
font: 10px "Calibri";
}

.yaxis path,
.yaxis line {
fill: none;
stroke: #000;
shape-rendering: crispEdges;
}
.xaxis text {
font: 10px "Calibri";
}

.xaxis line {
fill: none;
stroke: #000;
shape-rendering: crispEdges;
}

.xaxis path {
fill: none;
stroke: #000;
shape-rendering: crispEdges;
}
}

.axis text {
font: 10px "Calibri";
}

#background{
background-color: gray;
opacity:.7;
```

```
}
#chartWindow{
height 550px;

}
div.ext-box { display: table; }

#buttonPanel{
background-color:gray;
opacity:.7;
}

#clock{
font-family: "Calibri" , , Helvetica, sans-serif;
font-size:90px;
color: #054852;
position:absolute;
top:-25px;
left:5px;

z-index:100;
text-shadow: 1px 1px #6da0bb, -1px -1px #000;

}
#textWindow{
font-family: "Calibri" , Helvetica, sans-serif;
color: black;
text-align:center;
overflow-y: auto;
height:180px;
font-size:12px;

}
#VCRcont{
width:100px;
display:inline-block;
position:absolute;
top:85px;
left:15px;
z-index:100;

}
#picWindow{
color: black;
overflow-y: auto;
height:180px;

}
}
```

```
#desc{
  text-align: center;
  margin-bottom: 3px;
}
img{
  margin-bottom:30px;
}

i{
  text-align:left;
  font-size:10px;
}

.ui-tooltip, .arrow:after {
background: white;
border: 2px solid white;
}
.ui-tooltip {
padding: 10px 20px;
color: black;
border-radius: 20px;
font: 10px "Calibri", Sans-Serif;
box-shadow: 0 0 7px black;
}
.arrow {
width: 70px;
height: 16px;
overflow: hidden;
position: absolute;
left: 50%;
margin-left: -35px;
bottom: -16px;
}
.arrow.top {
top: -16px;
bottom: auto;
}
.arrow.left {
left: 20%;
}
.arrow:after {
content: "";
position: absolute;
left: 20px;
top: -20px;
width: 25px;
height: 25px;
box-shadow: 6px 5px 9px -9px black;
-webkit-transform: rotate(45deg);
-moz-transform: rotate(45deg);
-ms-transform: rotate(45deg);
-o-transform: rotate(45deg);
transform: rotate(45deg);
}
```

```
}  
.arrow.top:after {  
bottom: -20px;  
top: auto;  
}  
.radio{  
background:url(image.jpg)no-repeat;  
height:12px;  
width:12px;  
color:#fff;  
border:none  
}  
.vcrplay{  
padding-left: 5px;  
padding-right: 5px;  
}  
#chartTitle{  
text-align: center;  
font-family: "Calibri" , Helvetica, sans-serif;  
font-size: 20px;  
  
}  
#author{  
position: absolute;  
bottom: 5px;  
left:5px;  
font-size: 10px;  
  
}
```