

Water Resources Outreach Education Program
2021 Research & Education Vessel Use Report



**GRAND VALLEY
STATE UNIVERSITY®**

**ROBERT B. ANNIS
WATER RESOURCES INSTITUTE**

Water Resources Outreach Education Program
2021 Research & Education Vessel Use Report

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Executive Summary

Robert B. Annis Water Resources Institute's (AWRI) is a multidisciplinary research organization within GVSU's College of Liberal Arts and Sciences, with a mission to integrate research, education, and outreach to enhance and preserve freshwater resources. The Water Resources Outreach Education Program delivers hands-on, investigative education about water to the public, with special emphasis on youth. Our floating learning laboratories connect people in west Michigan with local water resources through experiential learning about water quality, aquatic food webs, and human impacts on water resources.

Participants aboard an educational cruise serve as freshwater scientists, collecting data and observations about the water bodies through which they sail. Since 1986, over 185,000 students (fourth grade through adults) have experienced hands-on science on Lake Michigan and adjoining waters through these programs. Offered onboard GVSU's research and education vessels *D.J. Angus* (docked in Grand Haven) and *W.G. Jackson* (docked in Muskegon), the program serves school groups as well as other organizations. Both vessels are used for AWRI research projects as well as the outreach program.

After a year and a half pandemic hiatus, AWRI's vessel education programs returned to the water in Fall 2021. Due to continued uncertainty around the pandemic, registration on both vessels was lower than usual and resulted in a lighter schedule of educational trips in Fall 2021. This combined with the cancellation of the Spring 2021 season resulted in overall participation numbers on both vessels being significantly lower in 2021 than in prior years. It was certainly the most unusual season in the program's 35-year history.

Nevertheless, nearly 1000 students from twenty schools experienced aquatic science onboard the *W.G. Jackson* and *D.J. Angus*. Public, private, charter, home schools, and parochial schools are all regular users of the vessels. Participants in outreach and education activities on the vessels in 2021 included: 190 high school students (21.7%); 463 middle school students (49.8%); 34 elementary school students (9%); 114 GVSU students (14.3%); and 164 adults including teachers, chaperones, other college students, groups, and the general public (5.1%). Program participants visited AWRI from Kent (20 trips), Muskegon (9), Ottawa (9), Allegan (3), Kalamazoo (2), Van Buren (2), Clinton (1), and Ingham counties (1).

In restarting vessel operations, the health and safety of visitors, staff, and students were our highest priorities. The AWRI vessel staff developed protocols based on current state, local, GVSU, Coast Guard, and CDC requirements and guidelines. We are pleased that as a result, there were no known COVID-19 cases in staff or participants connected with vessel experiences during the Fall 2021 season.

Going into the 2022 season, the AWRI vessel program is well-positioned to build on past successes and grow the program into the future. Many opportunities exist for the program to evolve to meet the needs of today's learners and incorporate the most pressing science into the vessel curriculum. Challenges (internal and external) also exist that pose threats to realizing this potential.

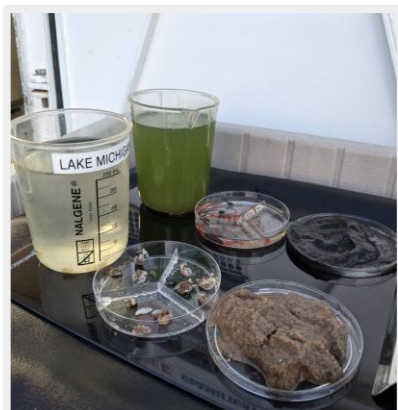
Program Overview

Robert B. Annis Water Resources Institute's (AWRI) is a multidisciplinary research organization within GVSU's College of Liberal Arts and Sciences, with a mission to integrate research, education, and outreach to enhance and preserve freshwater resources. The Water Resources Outreach Education Program delivers hands-on, investigative education about water to the public, with special emphasis on youth. Our floating learning laboratories connect people in west Michigan with local water resources through experiential learning about water quality, aquatic food webs, and human impacts on water resources. Participants aboard an educational cruise serve as freshwater scientists, collecting data and observations about the water bodies through which they sail. Since 1986, thousands of students (fourth grade through adults) have experienced hands-on science on Lake Michigan and adjoining waters through these programs. Offered onboard GVSU's research and education vessels *D.J. Angus* (docked in Grand Haven) and *W.G. Jackson* (docked in Muskegon), the program serves school groups as well as other organizations.



AWRI vessel instructor Tom Jackson explains Muskegon Lake water quality to students onboard the *W.G. Jackson*

In 1965, entrepreneur Donald J. Angus generously donated the *Angus* vessel to Grand Valley State College. For nearly 20 years, the *Angus* served as a floating classroom and laboratory. In 1986, a new research vessel, the *D. J. Angus*, replaced the *Angus*, and the Robert B. Annis Water Resources Institute's (AWRI) Water Resources Outreach Education Program was established the same year. The success of the onboard programs led to the *Making Waves in Muskegon* campaign, with a goal to raise funds to build and endow a second vessel, the *W. G. Jackson*, named after Dr. William Jackson, which began operating in July 1996. With the addition of the *W. G. Jackson*, the AWRI has been able to serve an even greater number of individuals through our onboard programs, as well as enhance AWRI research.



Samples of plankton, benthic organisms, and bottom sediments collected from Lake Michigan (front) and Spring Lake.

To date, there have been over 185,000 participants in the years of the program. They include: high school students (10%); middle school students (27%); elementary school students (21%); GVSU students (10%); adults including teachers, chaperones, other college students, groups, and the general public (23%); and dockside events (10%). Both vessels are used for AWRI research projects as well as the outreach program.

The curriculum of the trips is structured around conducting water quality tests and collecting other observations to compare the physical, biological, and chemical characteristics of Lake Michigan to smaller inland lakes. Both vessels offer the same overall trip structure and curriculum with place-based variations appropriate to their settings. For example, the *W. G. Jackson* trips discuss the industrial history and recent restoration of Muskegon Lake and its watershed, and how these inform today's water quality, whereas *D.J. Angus* cruises focus on the influence of the Grand River watershed and the status of smaller, shallower Spring Lake. Notably, the number of people who can be accommodated on a *D. J. Angus* cruise is less than on the *W. G. Jackson* due to the smaller size of the *D. J. Angus* and limitations set by U.S. Coast Guard regulations.

2021 Season Highlights

Research



AWRI students take Secchi disk measurements during the July 2021 Muskegon Lake monitoring trip

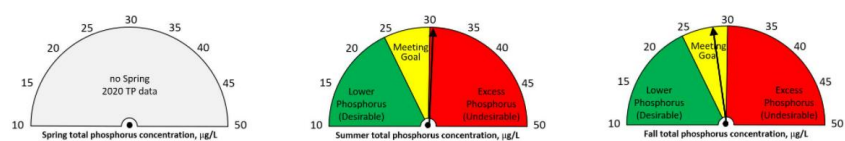
The W.G. Jackson Vessel Support Fund (held at the Community Foundation for Muskegon County) supports ship time on the *W. G. Jackson* for long-term monitoring of Muskegon Lake (Steinman and Ogdahl 2004). AWRI's monitoring of Muskegon Lake began in summer 2003. AWRI technicians collect samples at six stations to establish baseline water quality conditions. Stations were chosen to represent varying conditions across the lake. These stations are sampled 3 times per year (late spring, summer, early fall) from the *W. G. Jackson*. Fish monitoring is done at 4 other shallow-water sites using smaller vessels. Scientific papers based on data collected from the long-term monitoring study have been published in a variety of journals (see Appendix). These data sets have been incorporated in Master of Science theses as well. The [Muskegon Lake Water Quality Dashboard](#) provides an easy to understand visual representation of lake health. Due to the COVID-19 pandemic, the Spring 2020 sampling event was cancelled, but subsequent sampling events were held in July and September 2020, and May, July, and September 2021.

TOTAL PHOSPHORUS

Target Concentration: 30 µg/L

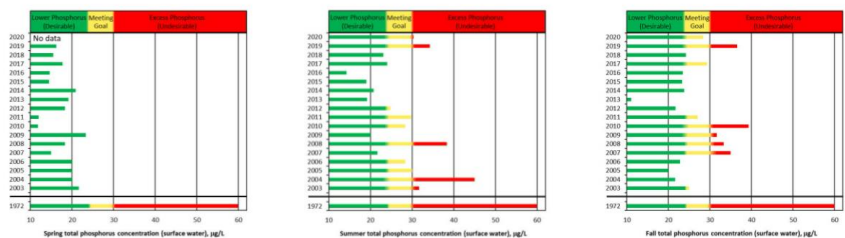
CURRENT STATUS

(2020)



HISTORICAL STATUS

(1972, 2003-2020)



Snapshot of Total Phosphorus conditions from the Muskegon Lake Water Quality Dashboard

The *W.G. Jackson* frequently also supports research in conjunction with the [Muskegon Lake Observatory](#) buoy, which is run by Dr. Bopi Biddanda's laboratory. A stop at the buoy is a highlight of K-12 and public cruises in Muskegon Lake. A lesson using the Muskegon Lake Observatory data has been developed for teachers (Vail et al. 2015).

Outreach & Education

Due to the COVID-19 pandemic, all education and outreach programs were cancelled for Spring and Fall 2020 and Spring 2021. After a year and a half hiatus, AWRI's vessel education programs returned to the water in Fall 2021.

Trips for the 2021 season ran from September 1st through October 15th. In 2021, there were no trip cancellations due to inclement weather, though several trips made weather-related adaptations (for example, not sailing on Lake Michigan in high wave and wind conditions).

A captain, deckhand, and generally two science instructors are onboard for outreach and education cruises (see Appendix for the staff listing). Interest earnings from our vessel endowment funds make it possible to offer highly subsidized trips onboard both vessels for schools and other groups. Thanks to the support from the community, various grants, and the R.B Annis Foundation, our endowment-generated subsidies enable vessel users to be responsible only for a small registration fee and transportation costs. Without doubt, fewer classes or groups would be able to participate in this unique program without this subsidy. Some groups have paid the full price for a trip when there are no more endowment-supported trips available.



Students conduct dissolved oxygen tests in the D.J. Angus lab

Due to continued uncertainty around the COVID-19 pandemic, registration on both vessels was lower than usual and resulted in a lighter schedule of educational trips in Fall 2021. This combined with the cancellation of the Spring 2021 season resulted in overall participation numbers on both vessels being significantly lower than in prior years. A total of 994 people on 50 trips participated in vessel programming in 2021, compared to 5,231 people on 251 trips in 2019 (Table 3).

In 2021, middle school trips (6-8 grade) continued to account for the largest proportion of vessel program participants: 49.8% on both vessels; 37.9% on the *D.J. Angus* and 55.9% on the *W.G. Jackson* (Figure 2). This is consistent with use trends on the vessels since the early 2000s (Figure 1). Of the under 12th grade set, high school students and elementary school students used the vessels in comparatively smaller numbers. Public, private, charter, home schools, and parochial schools are all regular users of the vessel. Most students participate in the vessel program through a class field trip; however, some students participate through out-of-school time programs. For example, True North Community Services brought a group of Muskegon students on the *W.G. Jackson* through its [Project FOCUS program](#), which provides individualized academic support. In the future, partnerships with informal learning programs such as this one, have great potential to reach additional students when school resources are stretched.

The *D. J. Angus* continues to be the main vessel that serves GVSU students and staff. GVSU courses accounted for a higher proportion of trips on the *D.J. Angus* (32.1%) versus the *W.G. Jackson* (5.4%), which is consistent with past years. **Nearly 18,000 GVSU students and staff have been on both vessels since 1986.** Most of the GVSU class use is in September and October, and the vessel experience has long been a

part of the curriculum for some GVSU courses. The GVSU courses using the vessel in 2021 were Biology 107 (Great Lakes and Other Water Resources), Biology 362 (Biology and Diversity of Fishes), Education 631 (Teaching Science K-8), and Public Health 628 (Public Health Program Evaluation).

In 2021, two courses from Muskegon Community College (Environmental Science and Oceanography) also participated in cruises on the *W.G. Jackson*. Additionally, one non-college adult group participated in the vessel program: the Muskegon Lakeshore Chamber of Commerce again brought its Muskegon In Focus program on the *W.G. Jackson*, a leadership development program for local professionals.



Deckhand Dave Fisher assists students with a sample of the sediments from the bottom of Muskegon Lake

The service areas differ somewhat between the two vessels, likely due to ease of geographic access (Figure 4). In 2021, the majority of trips on the *W.G. Jackson* were trips based in Kent County (56.7%), whereas the *D.J. Angus* saw the largest number of trips originate from Ottawa County (47.1%), where it is berthed. All trips from Muskegon-based groups made their trips on the *W.G. Jackson* (30% of total). A small number of long-time users from farther away counties again made trips on both boats this year (Figure 3).

Throughout the years, there have been groups from 27 counties in Michigan on the *W. G. Jackson* at its home port in Muskegon. Seven more Michigan counties and three states (Illinois, Wisconsin, and Indiana) have been visited by the *W. G. Jackson* for the *Making Lake Michigan Great* (MLMG) summer tours. The *D. J. Angus* has visited eight ports of call in Michigan and one port in Indiana. Throughout the years, there have been groups on the *D. J. Angus* from 28 counties in Michigan. See Figure 5 for a map of the historic reach of the vessel program.



View of Muskegon Harbor from the W.G. Jackson during an educational cruise

COVID-19 Response

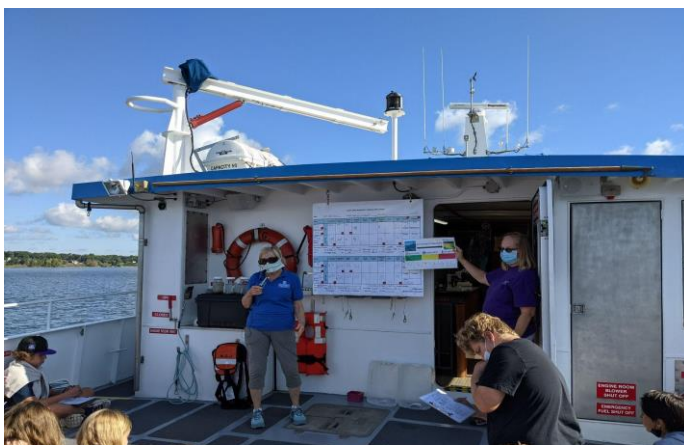
The Fall 2021 vessel season was unlike any other in the over 30 years of our vessel programming. The health and safety of visitors, staff, and students were our highest priority. The AWRI vessel staff developed protocols based on current state, local, GVSU, Coast Guard, and Centers for Disease Control (CDC) requirements and guidelines. We are pleased that as a result, there were no known COVID-19 cases in staff or participants connected with vessel experiences during the Fall 2021 season.

All visitors coming on a cruise on the vessels were required to fill out a version of [GVSU's Visitor Self-Assessment](#), which certified that they were neither experiencing symptoms of COVID-19 nor had a recent exposure. On the vessels, masks were required at all times in the indoor lab spaces for all staff, teachers, chaperones, and students, regardless of vaccination status. Masks were encouraged but not required in outdoor spaces. Masks were required at all times in the Lake Michigan Center (including the classroom, restrooms, and other common areas) for all staff and visiting teachers, chaperones, and students, regardless of vaccination status. All reduced capacity limits on AWRI vessels and in indoor classrooms that were COVID-19 related were lifted shortly prior to the start of the season, and normal capacity limits were put into effect. On vessels, the AC was kept off and the windows and doors kept open at all times, to maximize ventilation and air flow indoors.

Vessels were sanitized per the CDC guidelines for commercial vessels prior to passengers boarding. To allow time for this task, trips were scheduled with 1.5 hours between cruises (previously 30 minutes). This presented challenges for some schools who wished to bring two groups on the vessels, since it extended the total length of their time at AWRI, often exceeding their regular school day. For the 2022 season, 1 hour will be scheduled between trips.



Students and instructors work in the D.J. Angus lab with facemasks



Science Instructors lead the trip wrap-up on the W.G. Jackson aft deck

Efforts were made to maintain social distancing between guests and AWRI staff to the extent possible to minimize the amount of time staff spent within 6 feet of passengers, including making adaptations to the cruise activities. For example, staff determined that the entire group would not be in the vessel lab at the same time to reduce crowding, unless an imminent threat to health and safety was present. Any activities done indoors were conducted with no more than half the maximum capacity of the vessel, and any full group activities were done on the aft deck.

Making Lake Michigan Great Tour

Besides school-year cruises, the *W. G. Jackson* has traveled throughout the Lake Michigan basin in the summer to 34 ports of call since 1998 (Figure 5). The *Making Lake Michigan Great* tour involved using the AWRI research and education vessels to spread the word about stewardship and restoration activities in the Lake Michigan basin. Formerly a large component of the vessel program's activity, funding streams have changed for this effort. Since 2018, funding from the Great Lakes Restoration Initiative (GLRI) and other U.S. EPA Funds are no longer available. Funding from other partners allowed the tour to continue in 2019 to ports of call in Hammond, IN and Michigan City, IN, but due to the COVID-19 pandemic, no tours occurred in 2020 or 2021. The program will continue to consider away trip opportunities as budgets and staff capacity permit.

Outreach Program in the R.B. Annis Educational Foundation Classroom

AWRI continues to reach additional students through activities in the R. B. Annis Educational Foundation classroom at the Lake Michigan Center. The R. B. Annis Educational Foundation provided funds to start an endowment fund for support of classroom activities. AWRI hosts numerous K-12 classes and other groups in the classroom each year. In some cases, groups are divided in two, with half the group going on the *W. G. Jackson* and the other half staying in the classroom for hands-on activities that extend their learning about water science. Then the groups alternate, making it a complete day of comprehensive activities.

Due to having only the Fall season and the uncertainty around indoor capacity, only one school (West Oakview, 4th grade) chose to utilize the classroom in 2021 as part of their vessel program experience. We anticipate that over time we will return to more typical usage levels of the classroom (in 2019, the classroom program served 1964 people through 83 events). Spring 2022 cruises are being offered the classroom as an option with their registration and several schools have taken this opportunity.

The classroom also hosted a GVSU Frederick Meijer Honors College course, "Design Thinking for Social Product Innovation," which made a visit to AWRI on September 15. The students toured the AWRI labs and *W.G. Jackson* vessel and learned about AWRI's mission and history. They also heard presentations from AWRI researchers Rick Rediske ("Water Treatment Considerations for Developing Countries"), Bopi Biddanda ("Our water planet: Top-down and bottom-up perspectives"), and Christina Catanese ("Art & Science Collaborations").

Support Materials

The education program has developed an instructional video ([Exploring the Lakes](#)) and instructor's guide. The [AWRI outreach and education website](#) contains the Instructor/Student's Manual, program information, and directions of how to schedule the vessels. Students can explore real-time data at the [Muskegon Lake Observatory website](#). This GLRI/NOAA-funded project provided for deployment of a buoy with sensors in Muskegon Lake. Water sensors measure over 13 parameters including temperature, oxygen, nutrients, light, pH, conductivity, algal pigments, bacterial pigments, and current speed and direction. Air sensors measure 8 parameters including temperature, wind, humidity, and precipitation. Information is shared through live data display at the Lake Michigan Center as well as web-based observing networks.

Table 1. History of Participants Aboard the *W.G. Jackson*

| Year | Number of Events | Total Number Carried* | High School Students | Middle School Students† | Elementary School Students | GVSU Students | Adults & Visitors (trips) | Visitors (dockside) |
|--------------|------------------|-----------------------|----------------------|-------------------------|----------------------------|---------------|---------------------------|---------------------|
| 1996 | 111 | 3,188 | 94 | 305 | 105 | 203 | 1,098 | 1,383 |
| 1997 | 148 | 3,290 | 457 | 794 | 1,252 | 76 | 649 | 62 |
| 1998 | 199 | 4,734 | 216 | 627 | 1,447 | 128 | 1,318 | 998 |
| 1999 | 220 | 5,617 | 240 | 898 | 1,403 | 101 | 2,146 | 829 |
| 2000 | 204 | 5,198 | 381 | 1,500 | 1,083 | 77 | 1,091 | 1,066 |
| 2001 | 211 | 5,034 | 275 | 814 | 1,385 | 216 | 1,628 | 716 |
| 2002 | 205 | 4,548 | 235 | 1,595 | 1,106 | 72 | 1,244 | 296 |
| 2003 | 159 | 4,021 | 262 | 1,076 | 1,117 | 168 | 778 | 620 |
| 2004 | 129 | 2,937 | 92 | 1,049 | 664 | 95 | 722 | 315 |
| 2005 | 144 | 3,386 | 291 | 968 | 904 | 79 | 839 | 305 |
| 2006 | 148 | 3,694 | 342 | 1,029 | 851 | 64 | 906 | 502 |
| 2007 | 166 | 3,550 | 574 | 1,187 | 695 | 206 | 781 | 107 |
| 2008 | 144 | 3,546 | 366 | 1,226 | 687 | 108 | 854 | 305 |
| 2009 | 120 | 2,901 | 199 | 1,043 | 355 | 132 | 878 | 294 |
| 2010 | 122 | 3,216 | 226 | 1,090 | 599 | 27 | 863 | 411 |
| 2011 | 138 | 3,337 | 225 | 884 | 651 | 91 | 1,235 | 251 |
| 2012 | 142 | 3,229 | 303 | 1,132 | 613 | 58 | 926 | 197 |
| 2013 | 151 | 3,494 | 239 | 995 | 738 | 63 | 1,257 | 202 |
| 2014 | 135 | 3,148 | 228 | 1,095 | 622 | 71 | 931 | 201 |
| 2015 | 148 | 3,296 | 311 | 925 | 922 | 25 | 1,104 | 9 |
| 2016 | 130 | 3,308 | 206 | 1,302 | 903 | 31 | 753 | 113 |
| 2017 | 132 | 3,144 | 148 | 1,000 | 904 | 47 | 1,023 | 22 |
| 2018 | 152 | 3,443 | 297 | 1,049 | 1,002 | 59 | 1,018 | 18 |
| 2019 | 141 | 2,996 | 286 | 1,277 | 680 | 56 | 685 | 12 |
| 2020‡ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 33 | 635 | 137 | 331 | 34 | 16 | 117 | 29 |
| Total | 3,732 | 88,890 | 6,630 | 25,191 | 20,722 | 2,269 | 24,844 | 9,263 |

* Not including ship's crew

† Middle School includes Grades 6-8, Elementary includes Grades 4-5

‡ Due to the COVID-19 pandemic, the vessel did not operate in 2020 and operated in the Fall 2021 season only

Table 2. History of Participants Aboard the *D.J. Angus*

| Year | Number of Events | Total Number Carried*§ | High School Students | Middle School Students** | Elementary School Students | GVSU Students | Adults & Visitors (trips) | Visitors (dockside) |
|--------------------|------------------|------------------------|----------------------|--------------------------|----------------------------|---------------|---------------------------|---------------------|
| 1986 | 35 | 846 | 262 | 0 | 0 | 199 | 175 | 210 |
| 1987 | 67 | 1,604 | 415 | 98 | 187 | 353 | 251 | 300 |
| 1988 | 120 | 2,278 | 252 | 334 | 222 | 614 | 550 | 306 |
| 1989 | 132 | 2,903 | 308 | 481 | 344 | 609 | 256 | 905 |
| 1990 | 129 | 3,532 | 490 | 311 | 508 | 561 | 436 | 1,226 |
| 1991 | 137 | 4,393 | 518 | 390 | 571 | 604 | 503 | 1,807 |
| 1992 | 134 | 3,455 | 543 | 327 | 565 | 550 | 598 | 872 |
| 1993 | 147 | 3,632 | 417 | 544 | 695 | 616 | 676 | 684 |
| 1994 | 169 | 3,589 | 516 | 334 | 1,084 | 576 | 763 | 316 |
| 1995 | 231 | 5,057 | 462 | 510 | 1,609 | 593 | 1,491 | 392 |
| 1996 | 137 | 3,080 | 373 | 386 | 813 | 571 | 792 | 145 |
| 1997 | 150 | 3,030 | 493 | 659 | 790 | 580 | 508 | 0 |
| 1998 | 144 | 2,942 | 562 | 587 | 666 | 406 | 413 | 308 |
| 1999 | 146 | 2,919 | 288 | 575 | 969 | 512 | 552 | 23 |
| 2000 | 163 | 3,661 | 672 | 938 | 600 | 500 | 544 | 407 |
| 2001 | 158 | 3,124 | 349 | 1,054 | 540 | 665 | 486 | 30 |
| 2002 | 149 | 3,111 | 487 | 1,005 | 707 | 496 | 416 | 0 |
| 2003 | 123 | 2,520 | 314 | 724 | 653 | 448 | 381 | 0 |
| 2004 | 123 | 2,440 | 186 | 627 | 746 | 552 | 317 | 12 |
| 2005 | 135 | 2,689 | 322 | 932 | 469 | 497 | 469 | 0 |
| 2006 | 144 | 2,928 | 178 | 1,063 | 615 | 529 | 468 | 75 |
| 2007 | 131 | 2,764 | 281 | 1,028 | 547 | 333 | 465 | 110 |
| 2008 | 122 | 2,560 | 201 | 995 | 611 | 341 | 412 | 0 |
| 2009 | 105 | 2,282 | 219 | 880 | 499 | 384 | 300 | 0 |
| 2010 | 114 | 2,617 | 131 | 937 | 479 | 341 | 561 | 168 |
| 2011 | 102 | 2,126 | 213 | 837 | 370 | 378 | 328 | 0 |
| 2012 | 139 | 2,812 | 226 | 1,021 | 465 | 371 | 679 | 50 |
| 2013 | 120 | 2,481 | 258 | 938 | 460 | 343 | 482 | 0 |
| 2014 | 130 | 2,558 | 290 | 1,033 | 377 | 332 | 526 | 0 |
| 2015 | 123 | 2,555 | 311 | 919 | 462 | 352 | 511 | 0 |
| 2016 | 134 | 2,647 | 450 | 880 | 383 | 371 | 563 | 0 |
| 2017 | 109 | 2,211 | 237 | 891 | 359 | 332 | 392 | 0 |
| 2108 | 107 | 2,249 | 248 | 980 | 322 | 317 | 382 | 0 |
| 2019 | 110 | 2,235 | 137 | 1,121 | 282 | 368 | 327 | 0 |
| 2020 ^{††} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 17 | 330 | 53 | 132 | 0 | 98 | 47 | 0 |
| Total | 4,436 | 96,160 | 11,662 | 24,471 | 18,969 | 15,692 | 17,020 | 8,346 |

§ Not including ship's crew

** Middle School includes Grades 6-8, Elementary includes Grades 4-5

†† Due to the COVID-19 pandemic, the vessel did not operate in 2020 and operated in the Fall 2021 season only

Table 3. History of Participants Aboard both vessels

| Year | Number of Events | Total Number Carried** | High School Students | Middle School Students ^{§§} | Elementary School Students | GVSU Students | Adults & Visitors (trips) | Visitors (dockside) |
|---------|------------------|------------------------|----------------------|--------------------------------------|----------------------------|---------------|---------------------------|---------------------|
| 1986*** | 35 | 846 | 262 | 0 | 0 | 199 | 175 | 210 |
| 1987 | 67 | 1,604 | 415 | 98 | 187 | 353 | 251 | 300 |
| 1988 | 120 | 2,278 | 252 | 334 | 222 | 614 | 550 | 306 |
| 1989 | 132 | 2,903 | 308 | 481 | 344 | 609 | 256 | 905 |
| 1990 | 129 | 3,532 | 490 | 311 | 508 | 561 | 436 | 1,226 |
| 1991 | 137 | 4,393 | 518 | 390 | 571 | 604 | 503 | 1,807 |
| 1992 | 134 | 3,455 | 543 | 327 | 565 | 550 | 598 | 872 |
| 1993 | 147 | 3,632 | 417 | 544 | 695 | 616 | 676 | 684 |
| 1994 | 169 | 3,589 | 516 | 334 | 1,084 | 576 | 763 | 316 |
| 1995 | 231 | 5,057 | 462 | 510 | 1,609 | 593 | 1,491 | 392 |
| 1996*** | 248 | 6,268 | 467 | 691 | 918 | 774 | 1,890 | 1,528 |
| 1997 | 298 | 6,320 | 950 | 1,453 | 2,042 | 656 | 1,157 | 62 |
| 1998 | 343 | 7,676 | 778 | 1,214 | 2,113 | 534 | 1,731 | 1,306 |
| 1999 | 366 | 8,536 | 528 | 1,473 | 2,372 | 613 | 2,698 | 852 |
| 2000 | 367 | 8,859 | 1,053 | 2,438 | 1,683 | 577 | 1,635 | 1,473 |
| 2001 | 369 | 8,158 | 624 | 1,868 | 1,925 | 881 | 2,114 | 746 |
| 2002 | 354 | 7,659 | 722 | 2,600 | 1,813 | 568 | 1,660 | 296 |
| 2003 | 282 | 6,541 | 576 | 1,800 | 1,770 | 616 | 1,159 | 620 |
| 2004 | 252 | 5,377 | 278 | 1,676 | 1,410 | 647 | 1,039 | 327 |
| 2005 | 279 | 6,075 | 613 | 1,900 | 1,373 | 576 | 1,308 | 305 |
| 2006 | 292 | 6,622 | 520 | 2,092 | 1,466 | 593 | 1,374 | 577 |
| 2007 | 297 | 6,314 | 855 | 2,215 | 1,242 | 539 | 1,246 | 217 |
| 2008 | 266 | 6,106 | 567 | 2,221 | 1,298 | 449 | 1,266 | 305 |
| 2009 | 225 | 5,183 | 418 | 1,923 | 854 | 516 | 1,178 | 294 |
| 2010 | 236 | 5,833 | 357 | 2,027 | 1,078 | 368 | 1,424 | 579 |
| 2011 | 240 | 5,463 | 438 | 1,721 | 1,021 | 469 | 1,563 | 251 |

** Not including ship's crew

^{§§} Middle School includes Grades 6-8, Elementary includes Grades 4-5

*** The D.J. Angus was dedicated in June 1986 and began operations in July 1986

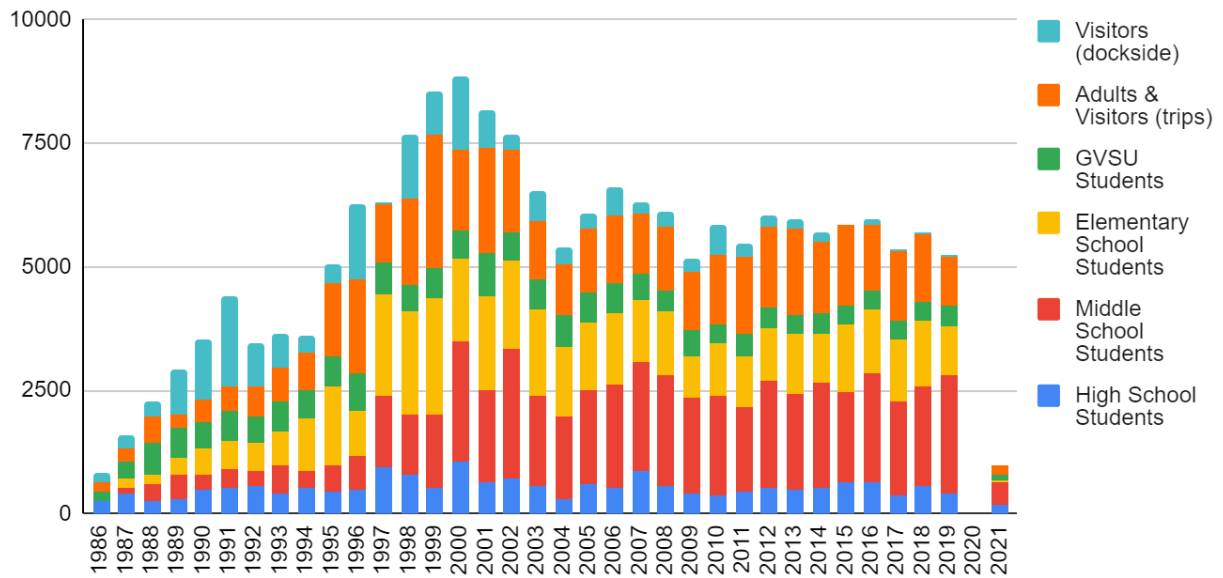
*** The W.G. Jackson was dedicated in June 1996 and began operations in July 1996.

| Year | Number of Events | Total Number Carried | High School Students | Middle School Students | Elementary School Students | GVSU Students | Adults & Visitors (trips) | Visitors (dockside) |
|---------------------|-------------------------|-----------------------------|-----------------------------|-------------------------------|-----------------------------------|----------------------|--------------------------------------|----------------------------|
| 2012 | 281 | 6,041 | 529 | 2,153 | 1,078 | 429 | 1,605 | 247 |
| 2013 | 271 | 5,975 | 497 | 1,933 | 1,198 | 406 | 1,739 | 202 |
| 2014 | 265 | 5,706 | 518 | 2,128 | 999 | 403 | 1,457 | 201 |
| 2015 | 271 | 5,851 | 622 | 1,844 | 1,384 | 377 | 1,615 | 9 |
| 2016 | 264 | 5,955 | 656 | 2,182 | 1,286 | 402 | 1,316 | 113 |
| 2017 | 241 | 5,355 | 385 | 1,891 | 1,263 | 379 | 1,415 | 22 |
| 2018 | 259 | 5,681 | 545 | 2,029 | 1,324 | 376 | 1,400 | 18 |
| 2019 | 251 | 5,231 | 423 | 2,398 | 962 | 424 | 1,012 | 12 |
| 2020 ^{***} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 50 | 965 | 190 | 463 | 34 | 114 | 164 | 29 |
| Total | 8,168 | 185,039 | 18,292 | 49,662 | 39,691 | 17,961 | 41,864 | 17,609 |

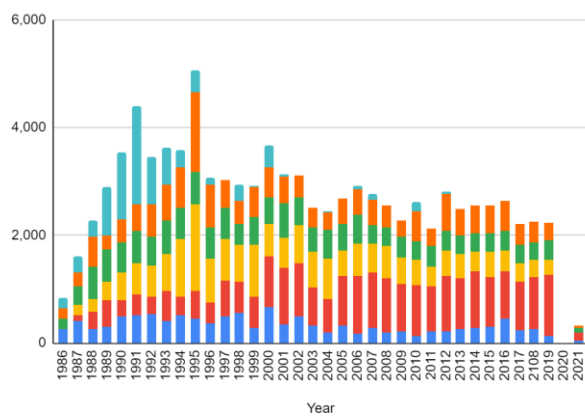
^{***} Due to the COVID-19 pandemic, the vessels did not operate in 2020 and operated in the Fall 2021 season only

Figure 1. Number of Participants by Age Group and Year

Grand Total



Angus



Jackson

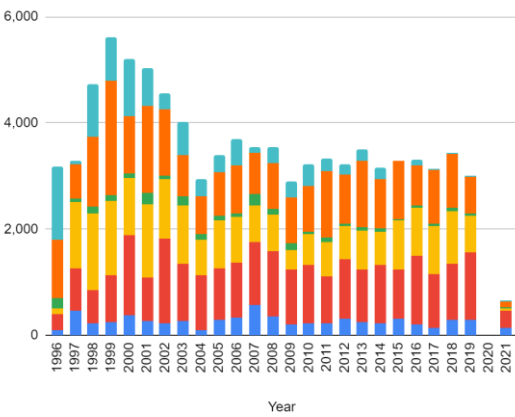


Figure 2. Type of Groups Participating in Field Trips, Fall 2021

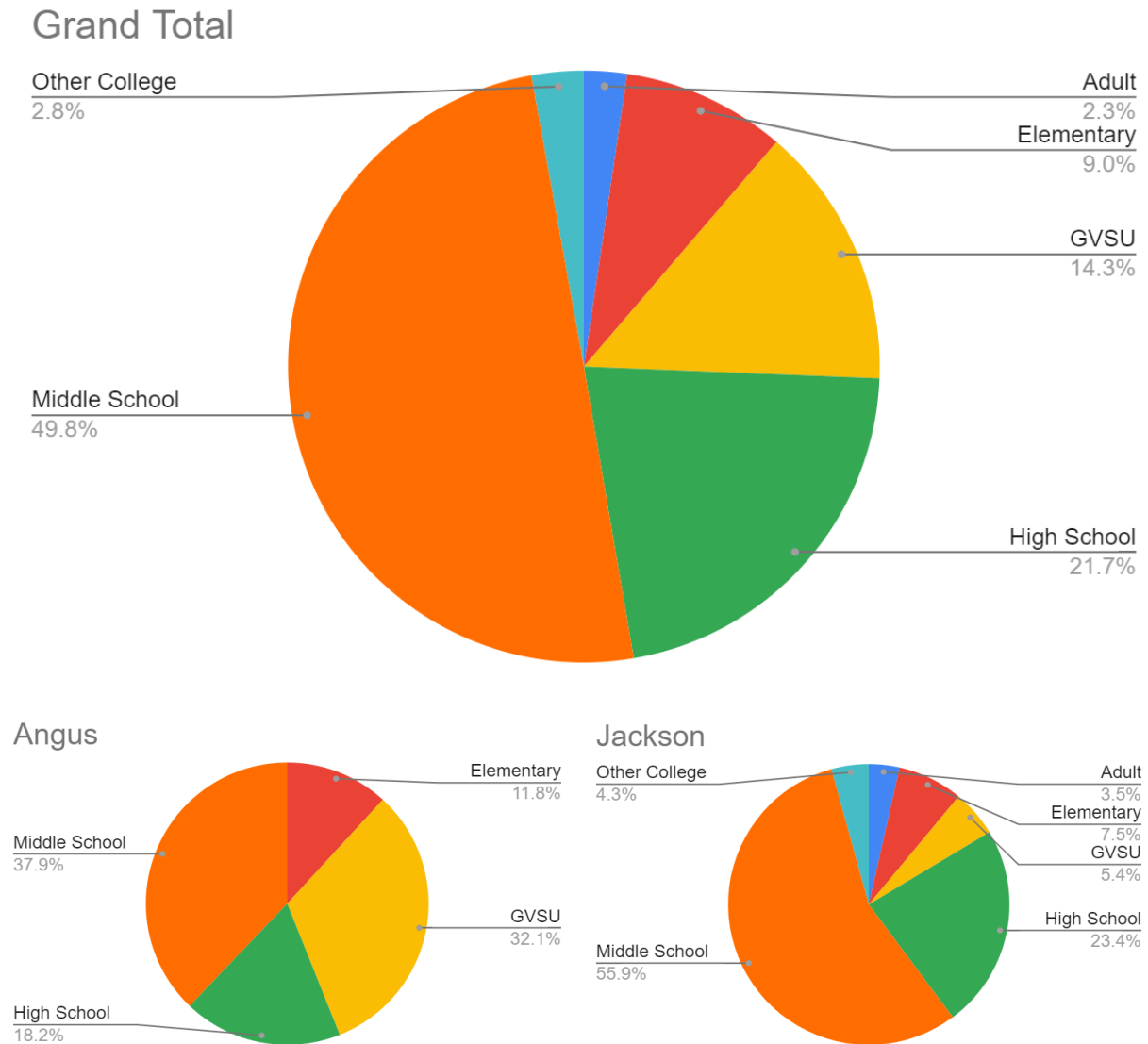
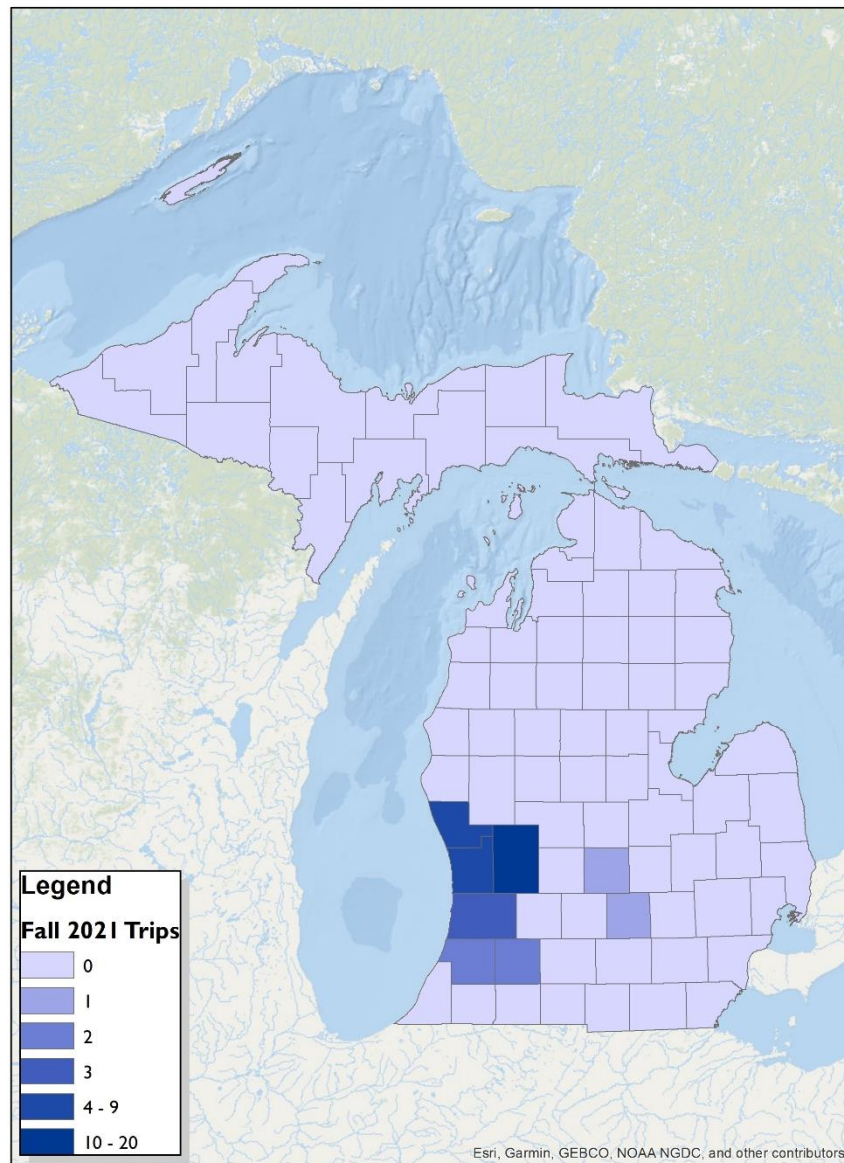


Figure 3. Map of the Vessel Program Service Area, Fall 2021



These figures show the county of origin of groups using the *D.J. Angus* and *W. G. Jackson* in Fall 2021.

| County | Angus | Jackson | Grand Total |
|--------------------|-----------|-----------|-------------|
| Allegan | 3 | | 3 |
| Clinton | 1 | | 1 |
| Ingham | | 1 | 1 |
| Kalamazoo | | 2 | 2 |
| Kent | 3 | 17 | 20 |
| Muskegon | | 9 | 9 |
| Ottawa | 8 | 1 | 9 |
| Van Buren | 2 | | 2 |
| Grand Total | 17 | 30 | 47 |

Figure 4. Number of Trips by County of Group Origin, Fall 2021

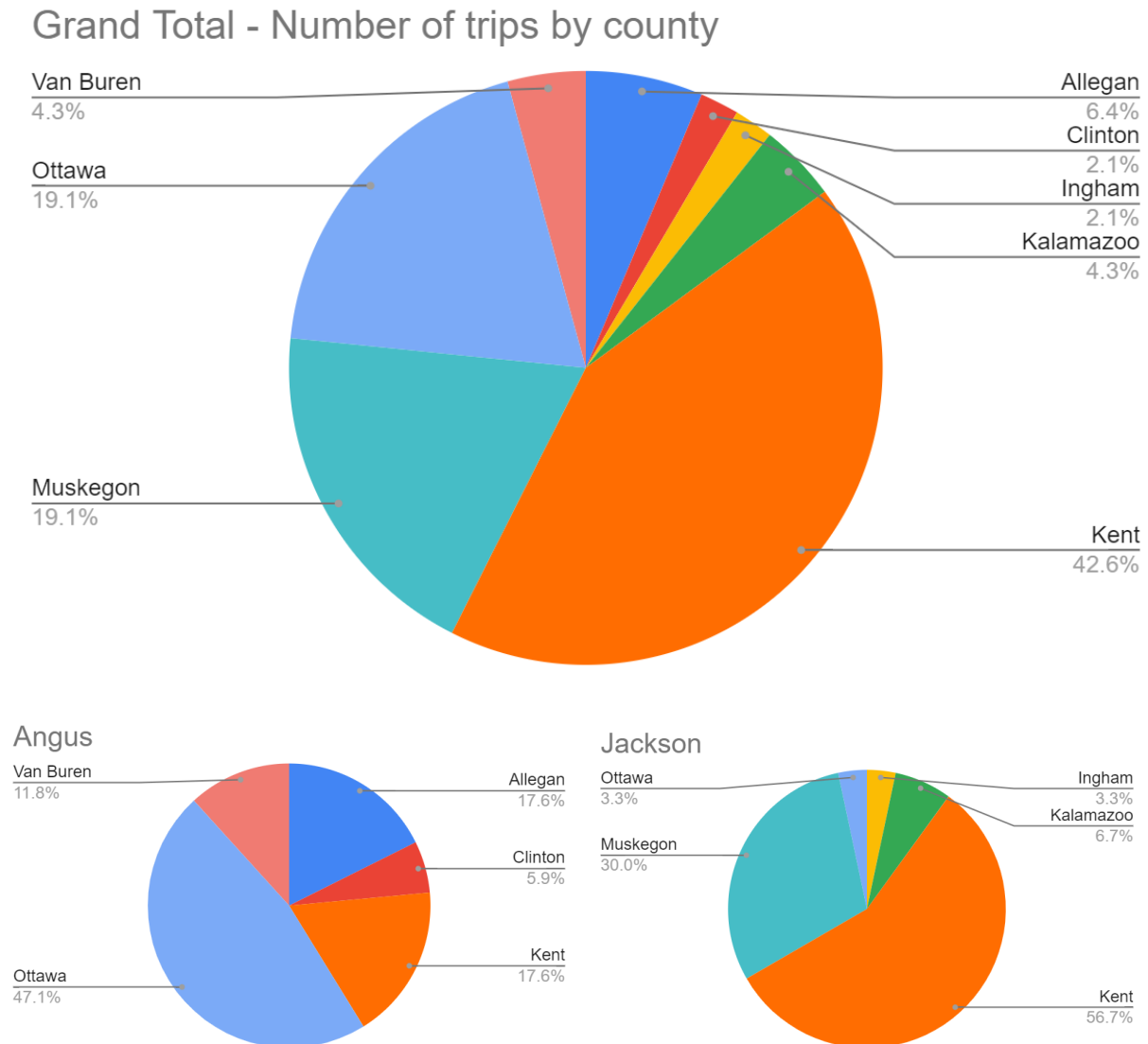
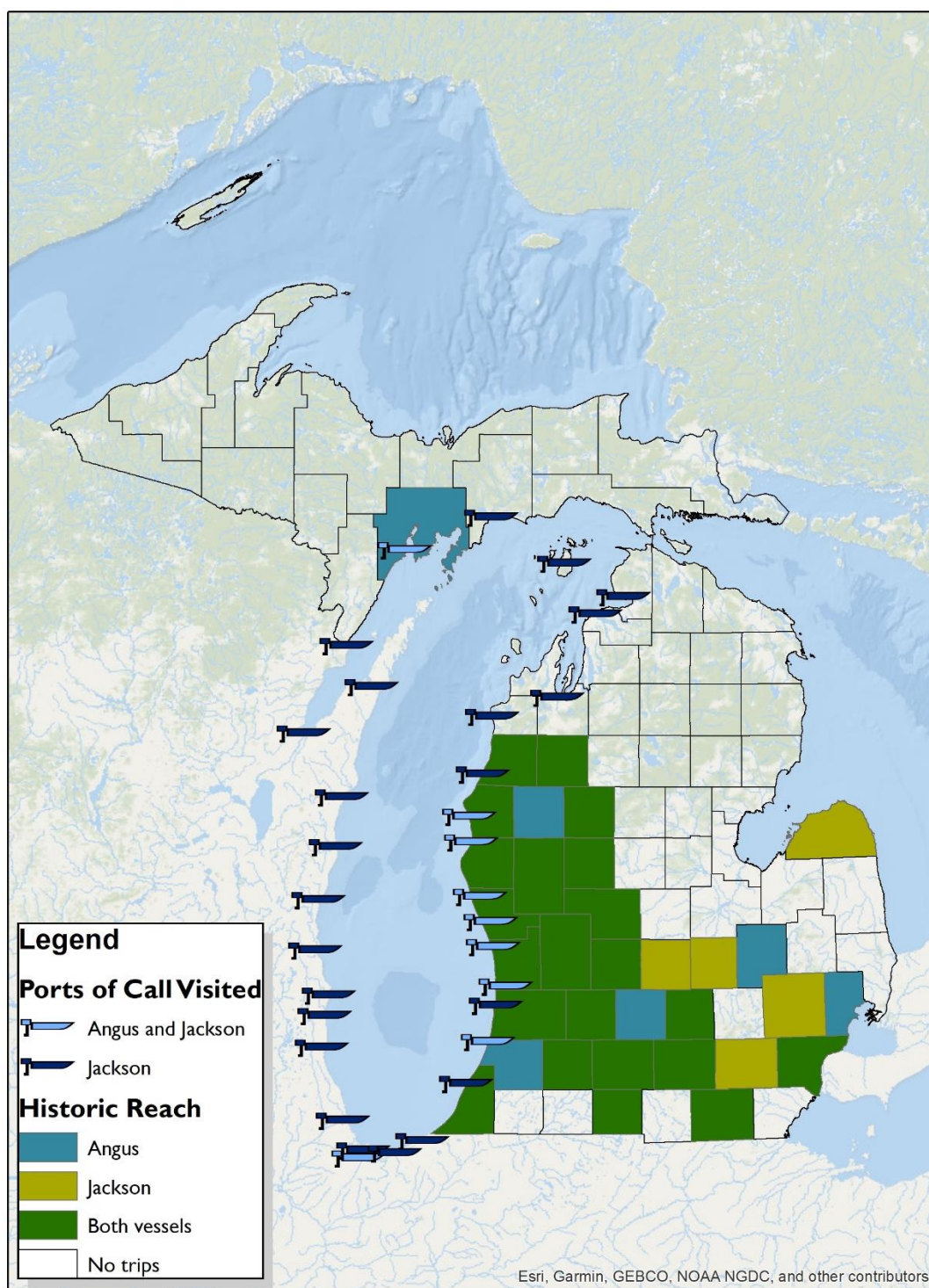


Figure 5. Map of the Historic Reach of the Vessel Program



This figure depicts the overall usage of the *D.J. Angus* and *W. G. Jackson* from 1986 to 2021. Ports of call visited in Lake Michigan are represented by boat icons. The Michigan counties that have had schools and organizations using the vessels are colored accordingly on the map.

Fleet Maintenance

Alongside the vessels' rigorous regular maintenance program, there were a few major maintenance undertakings on both vessels.

The *D.J. Angus* set sail with a fully renovated lab this season. Almost single handedly, Fleet Captain Tony Fiore completely gutted and refurbished the inside of the vessel in 2020. He replaced all windows; upgraded plumbing and lighting; installed new flooring, cabinets, and countertops; and more.

The *W.G. Jackson* had all lab and engine room lights replaced with LEDs. The crew also rehabilitated all interior floors, removed and replaced all trim in the lab, and reinforced ceiling panels.

On both vessels, the crew sanded, prepped, and painted the entire hull with 3 coats of paint.



The D.J. Angus lab, during and after renovation

2022 Outlook and Goals

Going into the 2022 season, the AWRI vessel program is well-positioned to build on past successes and grow the program into the future. Many opportunities exist for the program to evolve to meet the needs of today's learners and incorporate the most pressing science into the vessel curriculum. Challenges (internal and external) also exist that pose threats to realizing this potential.

Opportunities

Significant leadership changes in the program present opportunities for reassessment and re-envisioning the program in a new way. Both long-time vessel program leader Janet Vail and long-time Fleet Captain Tony Fiore retired in 2021. New leadership in both these positions is allowing a fresh perspective on the program.

The vessel program is very fortunate to have access to many prestigious researchers in aquatic science at AWRI. Further integration and connection with the research of these scientists would boost the impact and relevance of the vessel curriculum. Incorporating more real-world data and high profile contemporary environmental issues into the vessel experience will further distinguish our already-unique vessel program.

The vessel program has not historically tracked demographic data for participants, leaving a dearth of information about what proportion of participants are from historically underrepresented or underserved groups in science education (e.g. BIPOC students, Title 1 or low resource school districts, etc.). As diversity, equity, and inclusion are AWRI and GVSU priorities, the vessel program intends to do further analysis, build relationships, and identify and remove barriers to more diverse populations participating in our programming, especially among Muskegon schools.

Though some groups are well-prepared for their cruises and continue their learning in the classroom after a cruise, this is highly varied across visiting groups. Some teachers draw from our available support materials and their own research to construct larger learning arcs across the school year for their students, while others' experiences are limited to the 2.5 hours onboard. Understanding that this variability will always be the case, AWRI Education staff are in the process of developing additional support materials, including optional pre- and post-cruise resources for teachers to utilize in their classrooms to build on their group's experience on the vessels and extend their learning. Our intention is that this will be particularly supportive for teachers at less resourced schools who may not have capacity for additional curriculum development, or for whom environmental science and place-based learning is outside of their training and expertise.

Challenges

Staffing the positions of science instructors, deckhands, and captains for the 2022 season has proved challenging so far. Because of the short but intensive seasons for vessel operations, as well as constrained salaries, finding prospective employees in the area has been difficult for several years. In addition, several long-time instructors retired at the end of the Fall 2021 season, leaving significant gaps. Many staff are retired educators, and having more intergenerational diversity on the team would be of benefit.

The uncertainty of the COVID-19 pandemic continues to present challenges to the planning of the vessel program and for prospective groups registering for trips. This may or may not be related to the fact that some long-time vessel program attendees have not been back on the roster since operations resumed in Fall 2021. It is a long-term goal of the vessel program to both reestablish fruitful past relationships as well as build new ones with local schools who have not been users of the vessels historically.

Other external challenges include maintaining numbers served in spite of K-12 budget cuts and increasing class sizes in some school districts. For some schools, even the cost of transportation can be prohibitive.

The *D. J. Angus* is a retrofitted vessel that was acquired by GVSU-AWRI in 1986. As such, maintenance and upgrades are a priority to keep the vessel operating in a safe and efficient manner. Also, there were unusually high water levels in 2019 resulting in flooding on the access road to the *D. J. Angus* on Harbor Island in Grand Haven, and modifications needed to the docking of the *W.G. Jackson*. Operations staff will continue to be responsive to water level variations.

Program Goals

- Near term
 - Deliver high quality programs in a cost-effective manner.
 - Continue development and enhancement of curriculum for the vessel and classroom programs, with emphasis on the Michigan Science Standards.
 - Assess staffing needs and rebuild the vessel team after several retirements.
 - Update instructional equipment and graphics as needed and appropriate.
 - Continue to prioritize health and safety of staff and participants as we adapt practices and protocols to the COVID-19 pandemic.
 - Continue to achieve a high level of maintenance and evaluate future infrastructure changes that may be needed for both vessels.
- Mid term
 - Enhance curriculum connections between vessel/classroom programs and the current research of AWRI scientists.
 - Review vessel program evaluation and demographic data and assess through a DEI lens.
 - Develop pre- and post-cruise resources to enhance student learning and extend their experience beyond their time on the vessels.
 - Conduct/coordinate professional development sessions for K-12 educators in response to needs.
- Long term
 - Explore opportunities for integrating the arts into AWRI outreach and education programs.
 - Explore opportunities for expanded funding of the outreach program.

Appendices

AWRI Publications Related to Use of AWRI research vessels

AWRI Publications Related to Use of *W. G. Jackson* and Muskegon Lake Long-Term Monitoring Study

Altenritter, M.E.L., A.C. Wieten, C.R. Ruetz III, and K.M. Smith. 2013. Seasonal spatial distribution of juvenile lake sturgeon in Muskegon Lake, Michigan. *Ecology of Freshwater Fish* 22: 467-478.

Bhagat, Y., and C.R. Ruetz III. 2011. Temporal and fine-scale spatial variation in fish assemblage structure in a drowned river mouth system of Lake Michigan. *Transactions of the American Fisheries Society* 140:1429-1440.

Biddanda, B., Dila, D., Weinke, A., Mancuso, J., Villar-Argaiz, M., Medina-Sánchez, JM., González-Olalla, JM., and P. Carrillo. 2021. Housekeeping in the Hydrosphere: Microbial Cooking, Cleaning and Control Under Stress. *Life* doi:10.3390/life11020152

Biddanda, B., S. Kendall, A. Weinke, I. Stone, N. Dugener, S. Ruberg, J. Leidig, E. Smith, M. Berg, and G. Wolffe. 2021. Muskegon Lake Observatory Buoy Data: Muskegon Lake, Michigan: 2011-2019. Environmental Data Initiative <https://doi.org/10.6073/pasta/d1ef6101a1870a0b0bd54d3914dc13dc>

Biddanda, B.A., A.D. Weinke, S.T. Kendall, L.C. Gereaux, T.M. Holcomb, M.J. Snider, D.K. Dila, S.A. Long, C. VandenBerg, K. Knapp, D.J. Koopmans, K. Thompson, J.H. Vail, M.E. Ogdahl, Q. Liu, T.J. Johengen, E.J. Anderson and S.A. Ruberg. 2018. Chronicles of Hypoxia: Time-series buoy observations reveal annually recurring seasonal basin-wide hypoxia in Muskegon Lake – a Great Lakes estuary. *Journal of Great Lakes Research* 44:219-229.

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DOI:10.1016/j.jglr.2015.04.014

Gezon, N.R., D.W. Haywick, J.M. Sanders, I. Hewson, and K.B. Strychar. In Press. Surveying the Circular Rep Encoding Single Stranded (CRESS) DNA viral consortium in quagga mussels (*Dreissena rostriformis bugensis*) and sediment from the central Lake Michigan benthos. *Journal of Great Lakes Research*.

Gillett, N. and A.D. Steinman. 2011. An analysis of long-term phytoplankton dynamics in Muskegon Lake, a Great Lakes Area of Concern. *Journal of Great Lakes Research* 37: 335-342.

Harris, B.S., C.R. Ruetz III, T.J. Ellens, B.A. Biddanda, and A.D. Weinke. 2020. Adult lake sturgeon (*Acipenser fulvescens* Rafinesque, 1817) occurrence in the Muskegon River system, a Lake Michigan drowned river mouth, USA. *Journal of Applied Ichthyology* 36(5):547-558.
<https://doi.org/10.1111/jai.14076>.

Janetski, D.J., C.R. Ruetz III, Y. Bhagat, and D.F. Clapp. 2013. Recruitment dynamics of age-0 yellow perch in a drowned river mouth lake: assessing synchrony with nearshore Lake Michigan. *Transactions of the American Fisheries Society* 142(2): 505-514.

Kleindl, P.M. and A.D. Steinman. 2021. Contrasting trajectories in macrophyte community development after shoreline restoration: water level obscures trends. *Aquatic Botany* 169: 103327.

Liu, B., C.E. McClean, D.T. Long, A.D. Steinman, and R.J. Stevenson. 2018. Eutrophication and recovery of a lake inferred from sedimentary diatoms originating from different habitats. *Science of the Total Environment*, 628-629: 1352-1361. doi:10.1016/j.scitotenv.2018.02.174

Liu, Q., E.J. Anderson, Y. Zhang, A.D. Weinke, K.L. Knapp and B.A. Biddanda. 2018. Modeling reveals the role of coastal upwelling and hydrologic inputs on biologically distinct water exchanges in a Great Lakes estuary. *Estuarine, Coastal and Shelf Science*, 209: 41-55. doi:10.1016/j.ecss.2018.05.014

Mancuso, L.J., A. D. Weinke, I.P. Stone, S.E. Hamsher, M. Villar-Argaiz and B. A. Biddanda. 2021. Cold and Wet: Diatoms dominate the phytoplankton community in a year of anomalous weather in a Great Lakes estuary. *Journal of Great Lakes Research*. 47: 1305-1315. <https://doi.org/10.1016/j.jglr.2021.07.003>

Mancuso, L.J., A. D. Weinke, I.P. Stone, S.E. Hamsher, M.M. Woller-Skar, E.B. Snyder, and B. A. Biddanda 2021. Bloom and burst: Historical trends of harmful algal blooms in Muskegon lake, Michigan, a Great lakes estuary. *Freshwater Science*. 40: 463-477.
<https://www.journals.uchicago.edu/doi/full/10.1086/716236>

Nelson, W. and A.D. Steinman. 2013. Changing trends in benthic communities in a coastal drowned river mouth lake, a Great Lakes Area of Concern. *Journal of Great Lakes Research* 39: 7-18.

Ogdahl, M.E. and A.D. Steinman. 2014. Factors influencing macrophyte growth and recovery following shoreline restoration activity. *Aquatic Botany* 120: 363-370.

Salk, K.R., P.H. Ostrom, B.A. Biddanda, A.D. Weinke, S.T. Kendall and N.E. Ostrom. 2016. Ecosystem metabolism and greenhouse gas production in a mesotrophic northern temperate lake experiencing seasonal hypoxia. *Biogeochemistry* 131: 303-319. <https://doi.org/10.1007/s10533-016-0280-y>

Schmidt, M. L., B. A. Biddanda, A. D. Weinke, E. Chiang, F. Januska, R. Props and V. J. Denef. 2020. Microhabitats are associated with diversity-productivity relationships in freshwater bacterial communities. *FEMS Microbiology Ecology* 96. doi: 10.1093/femsec/fiaa029

Steinman, A.D. and M. Ogdahl. 2004. An innovative funding mechanism for the Muskegon Lake AOC. *Journal of Great Lakes Research* 30: 341-343.

Steinman, A.D., M. Ogdahl, R. Rediske, C.R. Ruetz III, B.A. Biddanda, and L. Nemeth. 2008. Current status and trends in Muskegon Lake, Michigan. *Journal of Great Lakes Research* 34: 169-188.

Vail, J., A. Meyer, A. Weinke, and B. Biddanda. 2015. Water quality monitoring: Lesson plan for exploring time-series data. *Michigan Science Teachers Association Journal* 60(1): 37-48.

Weinke, A.D., S.T. Kendall, D.J. Kroll, E.A. Strickler, M.E. Weinert, T.M. Holcomb, D.K. Dila, A.A. Defore, M.J. Snider, L.C. Gereaux, and B.A. Biddanda. 2014. Systematically variable planktonic carbon metabolism along a land-to-lake gradient in a Great Lakes coastal zone. *Journal of Plankton Research* 36: 1528-1542.

Weinke, A.D. and B.A. Biddanda. 2018. From bacteria to fish: Ecological consequences of seasonal hypoxia in a Great Lakes estuary. *Ecosystems*, 21: 426-442. doi: 10.1007/s10021-017-0160-x

Weinke, A.D., and B.A. Biddanda. 2019. Influence of episodic wind events on thermal stratification and bottom water hypoxia in a Great Lakes estuary. *Journal of Great Lakes Research*. 45: 1103-1112.
<https://doi.org/10.1016/j.jglr.2019.09.025>

Xie, L., R.R. Rediske, N.D. Gillett, J.P. O'Keefe, B. Scull, and Q. Xue. 2016. The impact of environmental parameters on microcystin production in dialysis bag experiments. *Scientific Reports* 6: 38722.

Vessel Program Staff

Administrative

Christina Catanese, Education Specialist^{§§§}

Dr. Alan Steinman, Allen I. and Helen J. Hunting Director

Tonya Brown, AWRI Assistant

Roxana Taylor, AWRI Secretary

Dr. Janet Vail, Research Scientist Emerita

Science Instructors (vessels)

Paula Capizzi, Lead Science Instructor, *D. J. Angus*

Jamie Cross, Science Instructor

Tom Jackson, Science Instructor

Shirley McIntire, Science Instructor

Michele Smith, Science Instructor

Diane Veneklasen, Science Instructor

Outreach Education Instructors (classroom)

Amanda Syers, Science Education Specialist

Captains

Anthony W. Fiore, Jr., Fleet Captain

Eric Hecox, Lead Captain, *W. G. Jackson*; Relief Captain, *D. J. Angus*^{****}

Deckhands

Dave Fisher, Marine Engineer

Mitch Gingras, Deckhand

Tim Halloran, Deckhand

Pete Hewett, Deckhand

Support

Brad Nieboer, Marine Electrician

^{§§§} Catanese has succeeded Vail as lead for the vessel education program as of June 2021, after Vail's retirement.

^{****} Hecox has succeeded Fiore as Fleet Captain as of January 2022, after Fiore's retirement.

Groups using the *W.G. Jackson* in 2021

Ingham County

Okemos High School

Kalamazoo County

Vicksburg High School

Kent County

Crestwood Middle School

East Grand Rapids Middle School

Grandville IMAGE

West Oakview Elementary School*

Muskegon County

Holton High School*

Mona Shores High School

Muskegon Community College - Environmental Science

Muskegon Community College - Oceanography

Muskegon Lakeshore Chamber of Commerce - Muskegon in Focus

Project FOCUS - True North Community Services

GVSU Classes and Events

GVSU Honors College Design Thinking Course*

GVSU Public Health masters students

Other

Muskegon Lake Long Term Monitoring

**Indicates first time vessel program participant*

Groups using the *D.J. Angus* in 2021

Allegan County

Saugatuck High School

St. Stanislaus School

Clinton County

Dewitt High School

Kent County

City High Middle School*

Holy Trinity School*

Ottawa County

Jenison ACT

Van Buren County

St. Basil School*

GVSU Classes and Events

GVSU EDI631 - Teaching Science K-8

GVSU BIO107 - Great Lakes and Other Water Resources

GVSU BIO362 - Biology and Diversity of Fishes, Fish Trawl

**Indicates first time vessel program participant*

Summary of Outreach and Education Events during the 2021 Season

D.J. Angus

| Date | Group Name | Instructor | County | Number Carried onboard | Purpose of Trip | High School | Middle School | Elem School | GVSU Students | Adults | Visitors (dockside) | Total (onboard and dockside) |
|-----------|---|---------------------|-----------|------------------------|-----------------|-------------|---------------|-------------|---------------|--------|---------------------|------------------------------|
| 9/9/2021 | GVSU EDI631 - Teaching Science K-8 | Ellen Schiller | Kent | 13 | Education | | | | 12 | 1 | | 13 |
| 9/15/2021 | Dewitt High School | Chris Thelen | Clinton | 20 | Education | 18 | | | | 2 | | 20 |
| 9/20/2021 | GVSU BIO107 - Great Lakes and Other Water Resources | Erin McNally-Goward | Ottawa | 19 | Education | | | | 18 | 1 | | 19 |
| 9/20/2021 | GVSU BIO107 - Great Lakes and Other Water Resources | Erin McNally-Goward | Ottawa | 21 | Education | | | | 19 | 2 | | 21 |
| 9/23/2021 | St. Basil School | Camille DeLano | Van Buren | 18 | Education | | | 13 | | 5 | | 18 |
| 9/24/2021 | City High Middle | Kurt Rizley | Kent | 25 | Education | 21 | | | | 4 | | 25 |
| 9/27/2021 | GVSU BIO107 - Great Lakes and Other Water Resources | Erin McNally-Goward | Ottawa | 21 | Education | | | | 20 | 1 | | 21 |
| 9/27/2021 | GVSU BIO107 - Great Lakes and Other Water Resources | Erin McNally-Goward | Ottawa | 17 | Education | | | | 15 | 2 | | 17 |
| 9/28/2021 | St. Stanislaus School | Randi Restau | Allegan | 23 | Education | | 15 | | | 8 | | 23 |
| 9/29/2021 | St. Stanislaus School | Randi Restau | Allegan | 21 | Education | | | 16 | | 5 | | 21 |
| 9/30/2021 | St. Basil School | Camille DeLano | Van Buren | 22 | Education | | 16 | | | 6 | | 22 |

| Date | Group Name | Instructor | County | Number Carried onboard | Purpose of Trip | High School | Middle School | Elem School | GVSU Students | Adults | Visitors (dockside) | Total (onboard and dockside) |
|------------|---|--------------|--------------|------------------------------|--------------------|----------------|------------------|----------------|------------------|-----------|------------------------|------------------------------------|
| 10/4/2021 | Jenison ACT | Julie Clark | Ottawa | 19 | Education | | 18 | | | 1 | | 19 |
| 10/5/2021 | Jenison ACT | Julie Clark | Ottawa | 25 | Education | | 24 | | | 1 | | 25 |
| 10/7/2021 | Jenison ACT | Julie Clark | Ottawa | 24 | Education | | 22 | | | 2 | | 24 |
| 10/7/2021 | Holy Trinity School | Jeff Readwin | Kent | 12 | Education | | 8 | | | 4 | | 12 |
| 10/14/2021 | Saugatuck High School | Brad Smit | Allegan | 15 | Education | 14 | | | | 1 | | 15 |
| 10/14/2021 | GVSU BIO362 - Biology and Diversity of Fishes, Fish Trawl | Carl Ruetz | Ottawa | 15 | Education | | | | 14 | 1 | | 15 |
| | | | Total | 330 | | 53 | 103 | 29 | 98 | 47 | 0 | 330 |

| Date | Group Name | Instructor | County | Number Carried onboard | Purpose of Trip | High School | Middle School | Elem School | GVSU Students | Adults | Visitors (dockside) | Total (onboard and dockside) |
|-----------|---|----------------|----------|------------------------|------------------|-------------|---------------|-------------|---------------|--------|---------------------|------------------------------|
| 7/14/2021 | Muskegon Lake Long Term Monitoring | AWRI | Muskegon | 11 | Research | | | | 5 | 6 | | 11 |
| 9/8/2021 | Muskegon Community College - Oceanography | Amber Kumpf | Muskegon | 7 | Education | | | | | 7 | | 7 |
| 9/13/2021 | East Grand Rapids Middle School | Becky Martin | Kent | 24 | Education | | 23 | | | 1 | | 24 |
| 9/13/2021 | East Grand Rapids Middle School | Christina Zink | Kent | 22 | Education | | 21 | | | 1 | | 22 |
| 9/14/2021 | East Grand Rapids Middle School | Christina Zink | Kent | 22 | Education | | 20 | | | 2 | | 22 |
| 9/14/2021 | East Grand Rapids Middle School | Becky Martin | Kent | 23 | Education | | 21 | | | 2 | | 23 |
| 9/15/2021 | East Grand Rapids Middle School | Christina Zink | Kent | 29 | Education | | 28 | | | 1 | | 29 |
| 9/15/2021 | East Grand Rapids Middle School | Sarah Youngs | Kent | 30 | Education | | 28 | | | 2 | | 30 |
| 9/15/2021 | GVSU Honors College | Paul Lane | Ottawa | 0 | Visit (dockside) | | | | | | 29 | 29 |
| 9/16/2021 | East Grand Rapids Middle School | Becky Martin | Kent | 28 | Education | | 26 | | | 2 | | 28 |
| 9/16/2021 | East Grand Rapids Middle School | Sarah Youngs | Kent | 26 | Education | | 25 | | | 1 | | 26 |
| 9/17/2021 | East Grand Rapids Middle School | Becky Martin | Kent | 27 | Education | | 24 | | | 3 | | 27 |

| Date | Group Name | Instructor | County | Number Carried onboard | Purpose of Trip | High School | Middle School | Elem School | GVSU Students | Adults | Visitors (dockside) | Total (onboard and dockside) |
|-----------|--|-----------------|-----------|------------------------|-----------------|-------------|---------------|-------------|---------------|--------|---------------------|------------------------------|
| 9/20/2021 | Okemos High School | Laura Bell | Ingham | 22 | Education | 18 | | | | 4 | | 22 |
| 9/23/2021 | Holton High School | Susan Morris | Muskegon | 20 | Education | 18 | | | | 2 | | 20 |
| 9/23/2021 | Muskegon Lakeshore Chamber - Muskegon in Focus | Cindy Larsen | Muskegon | 23 | Education | | | | | 23 | | 23 |
| 9/28/2021 | Mona Shores High School | Mary Poort | Muskegon | 21 | Education | 19 | | | | 2 | | 21 |
| 9/29/2021 | Muskegon Lake Long Term Monitoring | AWRI | Muskegon | 7 | Research | | | | 5 | 2 | | 7 |
| 9/30/2021 | Mona Shores High School | Mary Poort | Muskegon | 21 | Education | 19 | | | | 2 | | 21 |
| 10/1/2021 | West Oakview Elementary School | Colleen Heyboer | Kent | 21 | Education | | | 19 | | 2 | | 21 |
| 10/1/2021 | West Oakview Elementary School | Colleen Heyboer | Kent | 17 | Education | | | 15 | | 2 | | 17 |
| 10/4/2021 | Holton High School | Susan Morris | Muskegon | 20 | Education | 18 | | | | 2 | | 20 |
| 10/5/2021 | Muskegon Community College - Environmental Science | Matt Cooper | Muskegon | 10 | Education | | | | | 10 | | 10 |
| 10/5/2021 | Muskegon Community College - Environmental Science | Matt Cooper | Muskegon | 11 | Education | | | | | 11 | | 11 |
| 10/6/2021 | Vicksburg High School | Noreen Heikes | Kalamazoo | 25 | Education | 23 | | | | 2 | | 25 |
| 10/6/2021 | Vicksburg High School | Noreen Heikes | Kalamazoo | 24 | Education | 22 | | | | 2 | | 24 |

| Date | Group Name | Instructor | County | Number Carried onboard | Purpose of Trip | High School | Middle School | Elem School | GVSU Students | Adults | Visitors (dockside) | Total (onboard and dockside) |
|------------|----------------------------|-----------------|--------------|------------------------|-----------------|-------------|---------------|-------------|---------------|------------|---------------------|------------------------------|
| 10/7/2021 | Crestwood Middle School | Bobbie Fletcher | Kent | 24 | Education | | 22 | | | 2 | | 24 |
| 10/7/2021 | Crestwood Middle School | Bobbie Fletcher | Kent | 22 | Education | | 20 | | | 2 | | 22 |
| 10/11/2021 | Grandville IMAGE | Kyle Anderson | Kent | 25 | Education | | 19 | | | 6 | | 25 |
| 10/12/2021 | Grandville IMAGE | Kyle Anderson | Kent | 25 | Education | | 18 | | | 7 | | 25 |
| 10/12/2021 | GVSU Public Health | Azizur Molla | Ottawa | 17 | Education | | | | 16 | 1 | | 17 |
| 10/13/2021 | Grandville IMAGE | Kyle Anderson | Kent | 21 | Education | | 16 | | | 5 | | 21 |
| 10/13/2021 | Project FOCUS - True North | Don Williams | Muskegon | 11 | Education | | | 10 | | 1 | | 11 |
| 10/14/2021 | Grandville IMAGE | Kyle Anderson | Kent | 17 | Education | | 10 | | | 7 | | 17 |
| | | | Total | 642 | | 137 | 321 | 44 | 21 | 119 | 29 | 671 |

Evaluation Data

The leader of the group is asked to fill out a short evaluation of the trip before disembarking the vessel. The current evaluation forms for the vessel program ask a series of Yes/No questions that vary by age group. All of the evaluation forms for 2021 answered “Yes” to every question; therefore, an analysis of the data is not provided here. Participants filling out the evaluation form also have an opportunity to provide qualitative feedback via comments, a selection of which are provided below.

Comments:

- Great job, instructors!
- Thank you for an amazing experience!
- We love this program! Thanks for another opportunity for hands-on real science!
- Fabulous! You did a great job of tying everything together for my students!
- It was a great experience. The students got a lot out of hands-on learning and it was very well run
- Great job tying together a lot of what we've been learning in class
- Thanks for your efforts to keep the group dry and engaged even with the early showers. This week has been so special. Thank you for providing these irreplaceable learning experiences again this year.
- Another outstanding trip! Thank you, GVSU.
- Very professional and knowledgeable; staff understood how to engage the students. Excellent staff.
- Two trips and I am even more excited for the 6th graders on Wed and Thurs to have their experiences. Thank you for today's learning.
- Thanks so much for accommodating these make-up trips for our 2019-2020 6th graders. It's great that many of them have been able to have the experience we'd talked up since they were 3rd graders. Always love these trips!
- Loved the actual sample of the sea lamprey
- Excellent trip! Amazing learning opportunity for all students!!
- Great and relevant activities, experiments for our students. Thank you!
- I like the students sharing learnings. Well done engaging students throughout. The crew did great with safety onboard. Seeing and using the teaching tools on the windy deck was challenging. I'd recommend figuring out the audio. It's helpful.
- Lots of information - good hands on experiences
- Great work! You were very patient and informative
- Maybe explain stations the students are actually going to do? When they are at the station. Also, maybe a big blow up of the second chart too?
- Wonderful, as ALWAYS! Thank you! :)
- Great staff and many hands-on learning activities! Loved it!
- Amazing trip - very informative and engaging for the students
- This was great! Students were totally involved in collecting data, and the instructors were knowledgeable and helpful throughout.
- Thank you for a great learning opportunity for our students. What you do is so important.
- The trip is ALWAYS run FLAWLESS! Love being back on the boat.