

## **GLASS – Great Lakes Association of Science Ships**

**29th Annual Science Vessel Coordination Workshop Thursday, January 9, 2025**

### Updates from the 2024 Science Vessel Workshop and Science Support and Fleet Assessment Workshop (Tom Crane, Mark Burrows, Dennis Donahue)

- Actions from January 2024 workshop and April 2024 virtual fleet assessment/science support workshop
  - Training
    - Establish an ad hoc committee on training
    - Research current training offerings and develop a catalog of training classes and programs (better understand trainings currently being offered, partnerships that exist, where the gaps are in training)
      - GLC has developed an abstract for a research project on training needs that has been shared with the GLASS steering committee and GLC Board of Directors
      - Shared abstract with University of Michigan’s School of Information and SEAS; has potential to be taken up as a student group project
    - Conduct a needs assessment for training
  - Interagency agreements
    - It is important to explore ways that agreements can support efforts related to training, funding, personnel recruitment and retention, and crew sharing
    - Review and evaluate existing models such as interagency agreements between EPA and USGS and various agreements under the Great Lakes Fishery Commission (GLFC) umbrella
  - Building/expanding partnerships
    - Smart Ships Coalition, esp. Regarding its work on AUVs
    - Continue dialogue w/Coast Guard about their development of AUV rules and regulations (expect an update from them at next year’s workshop)
    - Re-engage with UNOLS to explore cooperation opportunities
      - It has been ~20 years since the last update from UNOLS, IJC SAB interested in developing a closer relationship
    - Pursue opportunities for greater Canadian involvement in GLASS
  - Communications
    - Complete one-pager on the importance of the GL science vessel fleet

- “Door-knocker” for discussing fleet needs with lawmakers
    - Hope to have ready for distribution in early March in time for Great Lakes Day in DC
    - Draft already shared via email, please review and share specific feedback with Tom or Mark
  - Continue to improve GLASS website as a comms/info sharing tool
    - Please share input/feedback on how we can continue to improve
  - Formalizing GLASS role in the implementation of the decadal science strategy
    - If there are things you want relayed to the planning team, let us know
  - Begin updating the 1999 vessel action plan and align it with science planning priorities under the science strategy
- Updating the 1999 vessel coordination action plan
  - Documenting changes in the region and fleet
  - Review of fleet assessments and recapitalization efforts
  - Report on progress and success stories over 25 years
  - Highlight the importance of the fleet in science planning efforts
    - USGS Open File Report to Congress on science and data needs
    - IJC decadal science strategy flowed out of Open File Report
    - Desirable to coordinate work with these efforts
  - Realigning action plan categories with science strategy priorities
    - Basic research needs – cold weather research/winter limnology
    - Data collection, monitoring and forecasting
      - Role of fleet in accomplishing this mission
    - Human capital
      - Workforce development and training – Science Strategy discusses more broadly; workforce development for science vessel crews should be addressed more specifically
      - Crew recruitment and retention
  - Infrastructure needs and centers of expertise
    - Fleet modernization and recapitalization strategies and needs
    - Shoreside infrastructure – dockage, piers, navigation aids, etc.
  - Societal and cultural values and needs
    - Use/regulation of AUVs

- Better understand the challenges of incorporating these new technologies on vessels
  - Educating the public and decisionmakers on the importance of the Great Lakes fleet
    - Adding a companion document to the one pager
  - Binational coordination challenges and opportunities
- Goals for 2025 workshop
  - Discuss a strategic and sustainable training model that addresses the needs of the 21<sup>st</sup> century fleet
  - Review and finalize the one-pager about the importance of the GL fleet
  - Learn about UNOLS and how UNOLS uses its committee structure to advance its work
  - Continue dialogue with Smart Ships Coalition regarding ASVs/AUVs and challenges and opportunities regarding their deployment, use and regulation
  - Continue discussion on the use of interagency agreements to support vessel operations and maintenance
  - Hearing from each other about successes and challenges over the past year
- GLASS Steering Committee 2025
  - IJC - Mark Burrows, John Wilson
  - GLC - Tom Crane, Amanda Grimm, Mary Sabuda
  - NOAA - Dennis Donahue, Lacey Mason
  - USGS - Kurt Newman, Tyler Chapman, Joe Walters
  - GLFC (vacant)
  - WI DNR - Brandon Bastar
  - Ontario MNR - Michael Tasche
- Mark Burrows comments
  - Added page to website on ASVs/AUVs, asking for more participation to fill it out; add equipment listings and fix it as part of their annual updates
  - One pager is based in part on data available on website
    - Database on website has historic ship information, so users will see well over 100 vessels. In order to see a count of active vessels, use the “spreadsheet query” tool, and sort by “active vessels” in Great Lakes. The tool allows users to sort by other parameters as well.
    - Purpose of one-pager: conversation starter for anyone talking about these issues. Talking points last year were more detailed than this – this one pager is more of an overview.

- IJC SAB Research Coordinating Committee co-chaired by Chris Winslow has provided funding for the workshop for many years and is looking to enhance GLASS's role.

Progress toward developing a Great Lakes binational science plan (Heather Stirratt and Mark Burrows, IJC)

- 2022 delivered science strategy for the region, identified a lot of needs and gaps
  - Questions about how to implement it,
  - Common area of interest between the Tri-Commissions, signed agreement in March 2024
  - Great Lakes Science Plan includes:
    - Specific science needs and gaps
    - Needed level of investment
    - Recommended arrangements for governance and sustainable management
  - [Great Lakes Science Plan for the Next Generation](#)
  - Great Lakes Science strategy recommends expanding the GL science enterprise and identifies:
    - High level scientific questions and knowledge gaps
    - Research infrastructure needs
    - Workforce development issues
    - Needed level of funding and resources
  - Six big buckets have guided a series of workshops, including:
    - Basic process research
    - Monitoring and long time series measures
    - Enhanced models and forecasting systems
    - Workforce development
    - Science infrastructure & Centers of Excellence
    - Inclusion of broad socioeconomic and cultural perspectives
      - Especially Indigenous communities that run their own programs
  - Science Plan Development Pillars
    - Development convenings with collaborative members and other subject matter experts on specific themes
    - Review and analysis of other science plans; social network analysis on Great Lakes science stakeholders
    - Engagements with Indigenous and equity-deserving communities to understand science needs

- Participating orgs



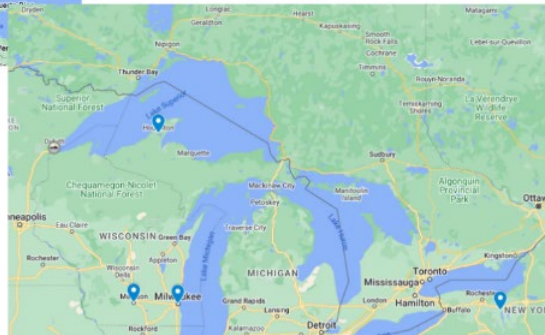
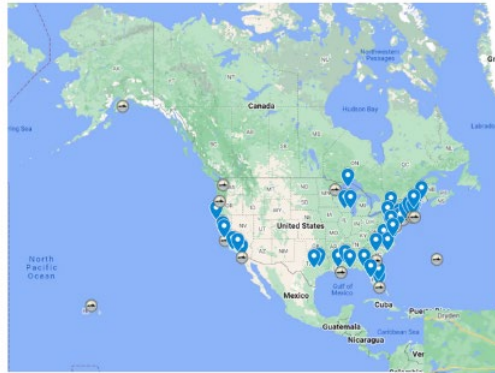
- Heather and Mark have been in conversation with about 10 agencies to discuss Great Lakes science
  - The Team previously met with USACE, NOAA, and NSF
  - Will soon be meeting with NR Canada today and will begin to move through the Canadian agencies
  - Timeline
    - Spring 2025 – workforce development and centers of excellence
    - IAGLR 2025 – review and feedback
- Discussion questions
  - How could the Science Plan advance vessel owner/operator goals/objectives/science gaps?
  - Are there any aspects of the science plan or related issues that are problematic from your perspective? If so please elaborate – what, how and why?
  - What role could vessel owners, operators and crew play in aiding in the development of the Science Plan and/or advancing implementation of a final plan?
  - Who else should we engage with to ensure the Science Plan will be aligned with ongoing activities and programs?
  - Anything else missed?
- Discussion
  - Education and outreach should be integrated into the plan as groups like Inland Seas play an important role in science education
  - It is important to frame the science plan in ways that are actionable and has some impact on the ground; that will be more accessible to the public

- Need to explore opportunities to include vessel operators and scientists in discussions. How do we get better engagement from the workforce?
  - Tendency to take broad strokes when we talk about the Great Lakes, need to make planning relevant to local issues and operations.
- Inland Lake Partnership might be another group to talk to.
- Importance of metadata when you're collecting data so that it's valid and shareable – incorporate into science strategy?
  - Heather: Have had considerable dialogues with indigenous communities about data sovereignty and how that could work. This plan is not going to be a silver bullet to every question but should give us the structure we need to address those questions.
- Engagement with the Great Lakes Fishery Commission Lake Committees will be important. Technical meetings are coming up, all the agencies and tribes are there, that could be a good opportunity.
- There is a tri-commission MOU in place, Andrew Muir (from the GLFC) has been regularly involved, Matthew Child at IJC has been meeting with the (GLFC) and giving presentations there.
- Broad agency buy-in to the planning process will be important.
- All of the agencies that have been met with so far have been holistically supportive, they have had specific pointers. This effort would be new, an additional investment beyond what is already in place. Some concern about how this relates to the funding streams like GLRI that are already in motion. This effort is really focused on an area that the GLRI, that is focused more on applied work like AOC cleanup, hasn't had as a comprehensive focal point.
- There have been no show-stopping concerns expressed and additional discussions can always be scheduled if any new concerns arise. Great Lakes Day in Washington is always an opportunity to carry your concerns to those with power over programs and investments, my door is always open.

Lessons from the University-National Oceanographic Laboratory System (UNOLS) (Doug Ricketts, UM-Duluth, Blue Heron)

- Blue Heron
  - Built 1985, obtained in 1998. Former fishing trawler that was refitted
  - Cruise length is ~4 days but can be up to 3 weeks away from shore
  - Close to 1900 days on the water since acquisition
  - Can travel on all Great Lakes; equipment for biology, geology, chemistry, and physics
- UNOLS

- Consortium of 58 academic oceanographic institutions collaborating with US government agencies; umbrella for Academic Research Fleet
- Does not fund cruises or science.
- Work done by the group's Executive Secretary, UNOLS staff, and numerous committees composed of academics, university staff, and mariners.
- Formed in 1971 for 3 primary reasons:
  - Explosion of marine science in 1960s – researchers from labs without ships needed access to time on ships. More labs acquiring ships.
  - Fed agencies were concerned about increasing costs and various modes of operation.
  - University ship operations saw a collision course between more ships, higher costs, and level funding.
- Stratton Commission (Presidential Commission 1969) recommended NOLS as a partnership between federal agencies and academic institutions (also recommended).
- Academics were worried about excessive federal control; proposed adding the U to NOLS.
- Community-wide ship access, cooperative ship scheduling, standardized operations & uniform funding arrangements – within the university sphere and coordinated by an association of labs.
- Currently membership consists of 14 institutions that operate ships and 45 non-operator institutions.
- 17 ships from 274 to 72 feet in length, owned by the Navy, National Science Foundation (NSF), and institutions.
- Cruises funded primarily by Office of Naval Research (ONR) and NSF; other funders are NOAA, NASA, EPA, institutions, etc.
- Will add three larger ships and retire one larger ship over the next 5 years.
- Distribution of UNOLS members



**Great Lakes Members  
of UNOLS**

- Beyond ships, the UNOLS umbrella covers
  - National Deep Submergence Facility
  - ROV Jason, HOV Alvin, AUV Sentry
  - National Oceanographic Aircraft Facility
  - Marcus G. Langseth – marine multichannel seismological research vessel
- Additional facilities with UNOLS-facilitated access that are available to assist shipboard science projects
  - Multibeam Advisory Committee (MAC)
  - Ocean Data Facility (ODF)
  - Operation SWAB – Enhanced Isotope Testing
  - OSU Marine Sediment Sampling Group (MARSSAM)
  - Rolling Deck to Repository Program (R2R)/Underway Data Support
  - University of Hawaii Currents Group/ADCP Support
  - UNOLS Technician Pool
  - WHOI Mooring Facilities & Services
  - Satellite Network Advisory Group (SatNAG)
  - Ocean Bottom Seismic Instrument Center (OBSIC)
  - NSF/UNOLS Van Pools, Winch Pools, and Wire Pool
  - Multidisciplinary Instrumentation in Support of Oceanography (MISO)
  - UMiami – when groups do radioisotope work they help to assess contamination in samples
- UNOLS and R/V Blue Heron
  - Joined in 1999



- UNOLS does not fund cruises
- UNOLS members are part of the Marine Facilities Planning system which allows potential users to request time on board UNOLS vessels
- NSF is our primary funder (has funded ~50% of our cruises. Members negotiate with them every year to determine the day rate. This rate is applied to all users of the vessel. All users of vessel have access to ADCP data even if not NSF funded.
- For NSF Funded research, UMD receives awards to fund the operation of RV Blue Heron, simplifying lives of researchers who use the vessel.
- All researchers that use the vessel have access to the facilities that UNOLS coordinates (ADCP support, satellite communication support etc.) - paid by NSF, not out of individual research grants each time.
- Joining UNOLS
  - Membership in UNOLS is open to those institutions that use or operate and use sea-going facilities AND maintain an academic program in marine science
  - Application form on UNOLS website. The applications are reviewed at a UNOLS council meeting and if approved, forwarded to the full UNOLS membership for a vote at the annual meeting.
- Becoming an operating institution:
  - UMD was the last operating institution added to UNOLS after UM withdrew RV Laurentian from the fleet
  - Some level of negotiation... (KITES – NSF funded program studying Keweenaw Copper)
  - They had to pass a UNOLS inspection (biannual inspection that occurs for every UNOLS vessel). This inspection was completed by a contracted Naval Architecture firm that NSF hires. All UNOLS vessels must pass this inspection every 2 years to gain and/or retain their support from NSF and ONR. Inspections involve extensive preparation.
- UNOLS structure
  - The Executive Secretary and staff are facilitators. UNOLS council members (appointed by the UNOLS members) run the organization.
  - UNOLS is community-run. Non-operating and operating members can participate in various committees (Arctic Icebreaker Coordinating, Deep Submergence Science, Marine Science Research Operations, Scientific Committee for Oceanographic Aircraft Research, etc.)
  - These committees advise the UNOLS council which advises NSF and the other funders as to the direction the greater scientific community thinks

marine research should go. The Fleet Improvement Committee is currently gathering information on the largest vessels (Navy Built) that are aging. It takes a long time to go from concept to having a ship. Trying to replace the three older ships in the fleet.

- Research Vessel Operators Committee (RVOC)
  - Promotes cooperation, fleet standards, marine safety, efficiency and quality of service among marine science research and educational institutions.
  - Annual in-person meeting and monthly virtual meetings
  - This level of communication:
    - Makes sure that operators know what is happening at NSF/ONR
    - Allows NSF/ONR to have a connection to respond quickly to any request for info from Congress or the WH
    - Allows operators to quickly communicate problems to funders -
      - e.g., Build and Buy America (BABA) Act rules applied inconsistently by NSF vs other federal agencies. RVOC was able to articulate the operators' concerns to NSF.
    - Instead of piece-meal response to new federal regulations such as Safer Seas Act, RVOC facilitated a consistent response to this Act's requirement for the Academic Research Fleet.
- Research Vessel Technical Enhancement Committee (RVTEC)
  - Promotes scientific productivity on research vessels and fosters activities that enhance technical support for sea-going scientific programs
  - Annual in-person meetings and monthly virtual meetings
  - Technical staff on Academic Research Fleet (ARF) vessels are spectacular
  - Primary advantage of RVTEC is that they maintain an email list where the ARF technicians regularly (daily?) ask questions and get almost immediate, valuable responses.
  - RVTEC facilitates
    - Technician exchanges between ships
    - Exchange of instrumentation
    - Assistance with cyber security and satellite comms
    - Testing of wire rope (making sure wire rope is safe)
- Non-ARF Small Vessel Inventory
  - List of smaller research vessels (35-135 ft) that are not a part of the US Academic Research Fleet but are operated by UNOLS institutions

- If you are funded by NSF and choose to use these vessels you must use the Guidance for Chartering Vessels outside US ARF (non-UNOLS vessels)
- The list was just updated in March 2024.
- Small Research Vessel Compendium
  - Document from 2004; more information about science vessels & science research requirements.
- Early Career Program
  - NSF-UNOLS chief Scientist Training Cruises
  - UNOLS Cruise Opportunity Programs
  - MATE Program
  - STEMSEAS Program
- Discussion
  - Some modifications to the Blue Heron needed to be made to meet UNOLS requirements. They were very flexible and acknowledged that we're in a different system, inspection is mostly focused on safety. There are some applications that don't make any sense in the Great Lakes and they were flexible on those kinds of things.
  - It is desirable for ships to be in use as much as possible, but some university professors are concerned that becoming a UNOLS vessel could interfere with their own access to the vessel. How much usage are you getting per season?
  - There is an opportunity for more usage of the Blue Heron. If the Blue Heron has 60 days on the water and the rest of the fleet gets more like 250, it's a question of resources. More research support is needed to up the days on the water. Under current conditions, they're going to be able to schedule their cruises when they need to because the demand so far is limited. Also consider that UNOLS is defining our costs, the university essentially buys some ship time.
  - With UNOLS you get consistency with time on the ship. It's hard to pass inspections, the standard is high but it's a good standard. A researcher on a UNOLS vessel has access to a lot of things that you don't need to think about. If you need in situ pumps, for example, they will have them. Also, marine technicians can work on other NSF-funded ships.
  - The Blue Heron falls within the size range for the Small Vessel Inventory of UNOLS but it's part of the fleet. The largest ships are Navy-owned, NSF owns some vessels, but they're operated by academic institutions.
  - One potential downside to UNOLS is that it is aimed at the larger vessels, but the current crop of NSF program managers acknowledge that there are smaller vessels in the system and help us out.

- Researchers also come from other regions/countries to do research. Initially, it was all UMD and they're still heavy users, but within the last 5-6 years we've had more folks from other institutions including some from outside the GL region. At the NSF level they have a barter system to put European academics on UNOLS research vessels and American academics on European vessels. Researchers can also just charter a vessel directly.
- With regards to the day rate, the university matches MN DNR's paid time on the boat, this lowers costs for DNR and meets our requirement for the university to spend money on the boat under the UNOLS cooperative agreement.
- UNOLS is not flexible on safety standards for wire vs. winch loads, otherwise they are flexible. We operate at a safety factor of 5 because our packages are relatively light and we don't put a lot of wire over the side, this can be quite different from ocean vessels.


#### Autonomous Vehicle and Smart Ships Coalition Update

- Update: Smart Ships Coalition activities/leadership
  - Focus during 2024 was planning and conducting demonstration projects with crewed and autonomous tech for specific applications and use cases
  - Completed numerous testing missions and large area mapping project with Armada 8 ASV (on long term loan from Ocean Infinity to MTU)
    - Useful for initiatives like Lakebed2030
  - Smart ships coalition founding member, GSGP, is transitioning to admin lead for SSC in 2025 – watch for updates, announcements, and membership survey.
  - MTU/GLRC continues to lead the Marine Autonomy Research Site, providing experienced technical staff, facilities, equipment, and testbed location to those seeking support with uncrewed/autonomous marine technology testing, development, applications, etc.
- Update: inventory of autonomous systems, a joint IJC/MTU pilot project
  - Enhancement to canamglass.org
  - Thankyou to Mark Burrows/IJC for implementing a new database on canamglass.org listing the organization, home port/location, description, contact info and related links for AUVs and ASVs
  - MTU helped to test and provide feedback on this page in 2024 and populated information on some of the uncrewed assets under its management, we will be adding more


- Snapshot: NOAA GLBM (BITWISE) use of autonomous systems for bottom mapping validation on the GL
  - At MTU call it BITWISE. Massive coordination effort on the GL. Using all sorts of techniques from AUVs, camera grabs of sediment, and overall high-resolution characterization of lake bottom. Iteration 2023-2025.
  - Incremental transition of AUVs/ROVs to autonomy
  - High-bandwidth communications like Starlink allowing greater remote piloting even far offshore, reducing the need for onboard crew
- Overview: Smart ships coalition led large area search for a plane missing in Lake Superior since 1968
  - GLRC-led search for missing plane using uncrewed technology, specifically ASV & high performance multibeam systems.
  - Project lead Travis White ([tmwhite@mtu.edu](mailto:tmwhite@mtu.edu), currently on parental leave), contact w/questions (notes from his December 2024 presentation are available on request)
  - Outline
    - Mission background
      - 1968 NCAR missing airplane search & large area lakebed mapping on Lake Superior near Keweenaw Peninsula
    - Technology mobilization
      - Ocean Infinity Armada 8 ASV, Norbit winghead i77h High resolution multibeam sonar, Kongsberg EM 2040P MKII Multibeam satellite, and radio communication
    - Survey execution
      - Mapping the infamous “Great Lakes Triangle”
    - Data management
      - How data was collected and stored, future dissemination
    - Future plans
      - Lakebed 2030, SSC, future mapping efforts
  - Objectives
    - Demonstrate an advanced approach using a combination of modern tech for lakebed mapping
    - Align above efforts with historically significant events to help solve a long-standing mystery
    - Collect lakebed data
    - Increase public awareness and contribute to Lakebed 2030 initiative

- GL lakebed - less than 50% mapped at high resolution
- Utilizing new technology to find the NCAR airplane missing in Lake Superior since 1968
  - 50' wingspan
  - Technology
    - Armada 8m ASV
      - Gyro stabilizer, remotely operated over radio and satellite comms, serves as force multiplier alongside crewed vessels
    - Norbit Winghead i77h high-res multibeam sonar
    - Kongsberg EM 2040P MKII multibeam
    - ASView portable helm, Starlink, AIS (other ships can see the AUV and that it is unmanned), ASView Bridge, Kongsberg MBR radio (backup communication), and IVER3 AUV
  - Ocean Infinity Armada 8m ASV is provided to MTU by an MOU
    - 3kW payload power
    - Custom payloads
    - Offshore/coastal tasks – monitoring, surveying

## Ocean Infinity Armada 8



**Navigation/Safety**  
Class B AIS TX/RX  
FLIR thermal cameras  
Kongsberg maritime broadband radios  
Redundant propulsion, comms, power  
5x HD video cameras  
Simrad 4G radar  
Airmar DT800



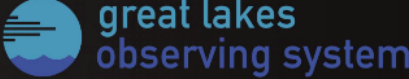

General	
Year Built	2018
Hull Type	Mono / Aluminium / Self Righting
Max Sea State (design)	Sea State 5
Weight	3.7te/4.8te ~8200 lbs dry
Length	7.61m 25' OAL
Beam	2.14m 7' beam
Draft * (*minimum)	0.99m 3.3' draft
Engines	Twin Yanmar 4JH 45HP Diesel
Propulsion	2 x Yanmar SD80 Sail Drives
Fuel Capacity	1,200 Ltr 317 gallons
Max Speed	10kts
Endurance	7 Days @ 4tkts

- Built 2018 & self-righting hull
- A week of preparation before plane search
- Risk Mitigation
  - Vessel Traffic – crewed chase boat within sight of the ASV at all times to maintain lookout & safe perimeter

- Coast Guard notified in advance of the search & provided input on planned ASV operations in addition to local notice to mariners
- Rogue ASV – many emergency stops put in place to stop the ASV at any point, both operator-controlled & automatic.
- Environmental – ASV serviced and tested before the mission similar to any crewed vessel. Fully sealed hull, self-righting, gyro-stabilizer to help prevent capsizing
- Survey Execution
  - Planned search area 21 sq miles, they actually surveyed 29 sq miles + 16 sq miles of transit lines surveyed for a total of 0.142% Lk Superior mapped.
  - Bathymetry mapping + “backscatter” - reflectivity
    - Sonar found a possible target but also many artifacts
    - Looking for features with high reflectivity in backscatter map, indicating likely manmade
  - Chase boat investigated possible targets (object ID missions), over 30 possible targets ID’ed
    - Drove ~3m from the lakebed
- Lessons learned & benefits
  - Great coverage, advanced data, fairly affordable in multibeam survey world, and demanded a collaborative approach from industry/agencies/universities, strong public involvement through live streaming and media coverage, potential discoveries in survey-continuing data review and future publication.
- Data management & sharing
  - Will get data out to partners

## Data Management & Sharing

Armada 8 ASV	Norbit MBES	Kongsberg MBES
<ul style="list-style-type: none"> <li>• Mission plans from NCAR search</li> <li>• ASV mission logs and operator notes</li> <li>• Will be used by MTU and OI to inform future missions</li> </ul>	<ul style="list-style-type: none"> <li>• Water column, bathymetry, and backscatter data were collected</li> <li>• Physical copies of data saved to external drives</li> <li>• MTU post processing with support from GLOS</li> <li>• Lakebed data will be contributed to Lakebed 2030</li> </ul>	<ul style="list-style-type: none"> <li>• Water column, bathymetry, and backscatter data were collected</li> <li>• Physical copies of data saved to external drives</li> <li>• MTU post processing with support from GLOS</li> <li>• Lakebed data will be contributed to Lakebed 2030</li> </ul>

- Ongoing efforts & future plans
  - NCAR Plane search
  - Lakebed 2030
    - Continue to use the ASV for mapping & other lakebed exploration tasks through collaboration with additional partners and sponsors
    - Work with Ocean Infinity to advance hardware & software capabilities of Armada fleet
    - Plan additional great lakes missions and contribute to Lakebed 2030
  - Smart Ships Coalition
    - Continue to demonstrate technology applications for uncrewed and autonomous events
    - Participate in future events such as Oceans 2025 and Lakebed 2030 conferences

Briefing on the Argonaut and Davis Aerospace Program (Aidan Hall, Fleet Captain)

- Partner with Cleveland municipal school district
  - Davis High School
- Students have the opportunity to learn about safety planning & emergency management
- Stewardship of Cuyahoga River also pulled >1M lbs of marine debris out of river.
- Place two students on ships to get real world commercial sailing experience



- Assist LimnoTech with Lake Erie Water Buoy, students have opportunities to get experience this way also
- Work with students to get their private pilot license, students can attend ground school & Partnerships with Cleveland Clinic's flight program
- Fabrication lab at Cleveland high school to experience 3D modeling and other tech.
- Drone club where students can earn their pilots' license, robot club where students can build robots
- Helped 2 students earn their 100-ton USCG Master's license
- 2 former students in college to become pilots, others hoping to become pilots
- Aidan comes from commercial maritime background, want to make connections to get students at Davis exposure in the marine science world – peer mentoring, field trips, capstone projects, internships etc. Thinking really anything that could help students get out on the water.
- The current class of students is 187 enrolled; freshman class is 85. They are #2 selected high school in the Cleveland school district.
- Choice school system – anyone in Ohio can apply to the Cleveland School District – mainly kids from Cleveland, but others from an hour away plus too.

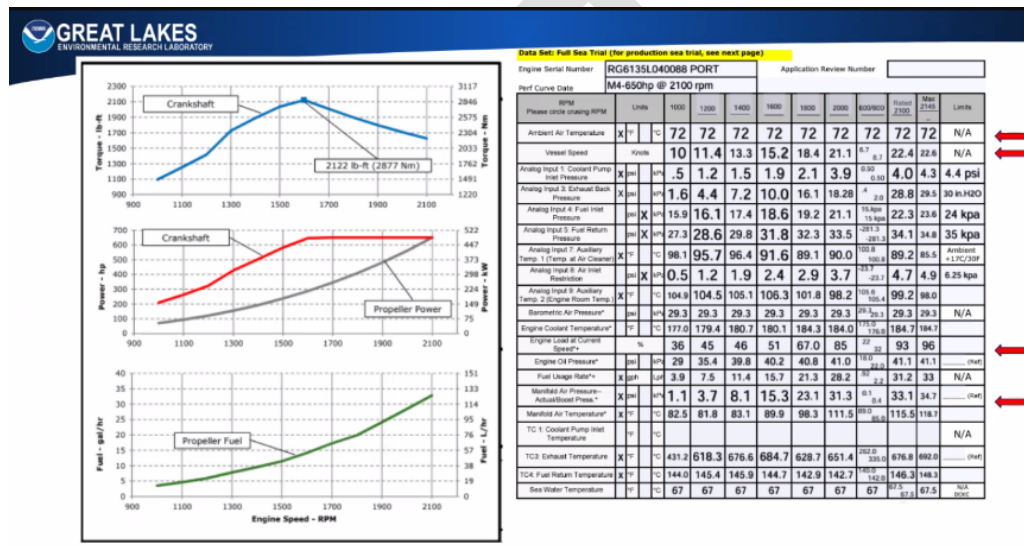
University of Michigan Research Vessel Carbon Footprint Project (Dennis Donahue, NOAA)

Marine Emissions Decision Support Tools

- US Strategy 2021 – Goals for GHG emissions reduction
  - Decarbonizing transportation is critical to addressing the climate crisis by meeting the national goal of net zero GHG emissions by 2050 & the interim target of 50-52% below 2005 levels by 2030.
    - Dennis asked around at NOAA about this, wondered what emissions currently are
  - Fleet for the Future – A net-zero emissions NOAA fleet by 2050
    - Response to the NOAA Science Advisory Board
    - The report says this is a very hard thing to do, it will be expensive.
    - [https://sab.noaa.gov/wp-content/uploads/SAB\\_Report\\_July2024\\_NOAA-Response\\_SAB\\_Net-Zero-Emissions-Fleet.pdf](https://sab.noaa.gov/wp-content/uploads/SAB_Report_July2024_NOAA-Response_SAB_Net-Zero-Emissions-Fleet.pdf)
- Relevance -
  - Contribute to National or Institutional GHG reduction goals
  - Reduce local environmental impact – NEPA
    - Trawls – what is environmental impact? Everyone maybe takes categorical exclusion

- Older ships = higher impacts
  - Science vessels should be examples of stewardship
  - Reduce operation cost, extend engine life
    - Helpful to everyone regardless of Green House Gas (GHG) aspect
- Challenges for Research Vessels
  - Workboat fleet – very small fraction of the GHG problem. A study found all maritime is only 4% of emissions.
  - Government vessels have not been eligible for incentives
  - Combustion engines with single gear reduction
    - Biggest issue they have – inherently inefficient in transferring fuel to propulsion.
  - Variable vessel loading & operating modes
    - Need to be much more flexible than ferry or commercial boat
    - Challenge because they aren't charging per trip like shippers do per load, sometimes sit, and lack return trip.
  - Instrumentation & training
- NOAA SBP/University of Michigan emissions project
  - Margaret Wooldridge – fuel emissions efficiency research
    - Helped small boat community look at emissions
    - Put together team including Carissa Yim, Rahul Ramesh, Christopher Woodley
    - A team of social scientists on engineering review contributed a lot to the discussion
  - Project Objectives
    - Develop easy tools to help boat operators look at their carbon footprint (web based decision support tools)
    - Simplify complex engineering issues to start discussions with experts
    - Provide potential alternatives – fuel, engines, operations
    - Include gas and diesel plants – 100 Hp to 800 Hp
  - Project approach - Baseline
    - Develop tools & link resources to:
      - Calculate current emissions: annual, project, operating mode.
      - Identify powertrain performance across operating modes
      - Benchmark to OEM and industry standards
  - Operator inputs
    - Engine make/model
    - Boat length, draft, beam, displacement, type – planning/semi/displacement

- Fuel usage – annual & project level
- Operating modes (Percent or time)
  - Transit/survey/station keeping speeds
- Power curves – heavy and light loaded conditions (heaviest lift for project)
  - Idle to WOT at 100 RPM increments
  - Fuel rate/engine load/vessel speed
  - Compare to industry standard
- Sea trial data – evaluate your vessel



- Giving a reality check for the vessel to see if they're ok or need more work
- Project approach – behavior changes
  - Develop tools/link resources to:
    - Simplify complex engineering data
    - Understand load/RPM/speed relationship
    - Understand the impact of weather, fuel & passenger loads
    - Manage transit operations
  - Focus on what can be done from a driver's aspect to reduce fuel & GHGs
- Project approach – engineering changes
  - Developing tools to
    - Select best duty cycle
      - Continuous, heavy, medium, light
    - Match gear ratio/prop to primary mode

- Estimate impact of fuel alternatives
  - Bio, renewable, synthetic diesel
  - E10, octane, synthetic
- Estimate impact with engine upgrades
  - Tier 0,1,2,3,4
  - Cal 2002, 2012, 2022
  - Can scroll through to see “what if I have a Tier 3, what savings do I have” - helps make a pitch for new engines & initiatives.
- Case Studies – Early lessons learned
  - 100 boats uploaded into it, asked people to test it.
  - Behavior change – fuel more frequently
    - Catamarans
      - Model for when low on fuel:
      - One boat - Emissions go up 4%, loses 2 knots
      - Chesapeake boat loses almost 3 knots, +17% GHG
  - Engineering Changes – match engines to operating mode
    - Survey boats built to go very fast but often go at ~6 knots.
      - Twin 200Hp = 32knots
      - Twin 225 Hp = 38 knots
  - Behavior change – adjust for passenger loading & engine model
    - Never recalibrated the engine speeds. Going much faster than should be. 30’ boats can have 2-6 people on board.
    - Two person/six person – adjust RPM to maintain target engine load depending on how many people on board.
      - Speed is an output, RPM is input, engine load is critical measure.
      - With a higher number of people on board, it won’t hit the higher speeds and waste energy
    - Twin 130 Honda and twin 150 Yamaha have different power curves
      - Cruise RPM must be adjusted
      - Engine load is critical measure
    - Takeaway: Run the boat by engine load, not RPMs
  - Engine upgrades – GLERL 2017-2024
    - Repowered 8 Tier 0 engines with Tier 3 engines
      - 26% reduction in GHG emissions

- 18% reduction in fuel usage
- 9% increase in speed
- 12 year ROI
- Moving forward
- Phase 1 – complete early FY25
  - Publicly accessible decision support tools; will be app on computer to scroll through
- Phase 2 - Pending
  - Enhance tools based on field use and feedback
  - Develop DSTs for alternative power
    - Given your operation/requirements, do various alternative power sources make sense, target the right experts for those options
- Questions
  - Downside for these technologies is cost – there's always a tradeoff on size/speed/etc.
  - Heather Stiratt: How has NOAA reacted to this app?
    - This was done on behalf of NOAA's small boat program but it does apply to all of NOAA, there's no reason you couldn't apply it more broadly.
  - H: How is it resonating across NOAA?
    - We presented it to Admiral Han and she loved it. No one has been opposed to it; everyone gets the need to understand carbon footprint. When we get to engineering changes, where the funding is going to come from, that's a harder sell.
  - H: Does U of M get receive anything for this?
    - To my knowledge no
  - Mark: Are variable pitch propellers an option?
    - I would like to include that in future versions
  - Hopefully, next year we'll have Margaret here to present more information and an update on this.

Collaborative Benthic Habitat Mapping Project (Dennis Donahue, NOAA)

- “Projects of Excellence” - new category with Heather's Centers of Excellence point earlier
- Started with one boat, no operator, \$20k in funding
- Heather Stirrat got involved, now more than \$4 million/year

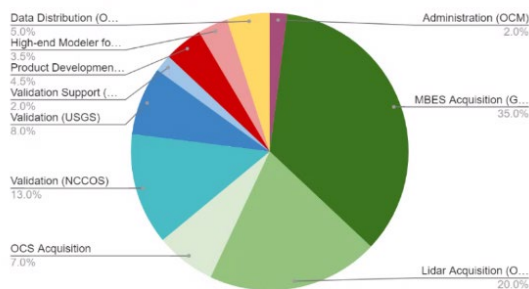
- Brandon Krumwiede, NOAA GSP Physical Scientist & regional geospatial coordinator; Charlie Menza; Dennis Donahue; Jamey Anderson and Hayden Henderson, Michigan Tech GLRC.
- Only 13% of US GL has been mapped to modern standards; people have been mapping for a long time for individual purposes but no forum to collaborate & make sure the data management is seamless across efforts – has been basin-wise initiative.
  - Mapping is far behind US ocean waters
- Why do benthic mapping?
  - Nearshore Great Lakes is very dynamic
  - Areas of high productivity and great biodiversity
- Overview
  - Partners
    - NOAA GLERL, NCCOS, OCM, OCS, and ONMS
    - NPS
    - USGS
    - Michigan DNR
    - Wisconsin DNR
    - Minnesota DNR
    - Michigan Technological University
  - Still adding partners
- Our focus
  - 0 to 80 meter water depths
  - Collect high res bathymetry
  - Normalized backscatter or lidar reflectance
  - Underwater drop camera video
- Funding

## Project Funding

### Project Budget:

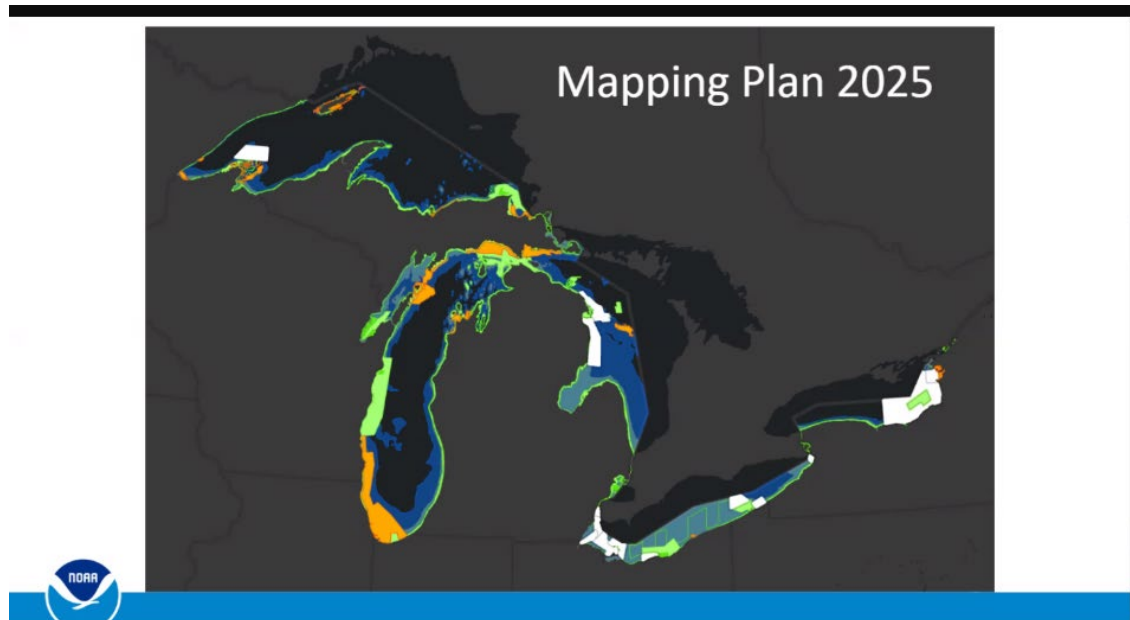
FY19 – \$500,000  
 FY20 – \$400,000  
 FY21 – \$300,000  
 FY22 - \$6,000,000  
 FY23 - \$5,000,000  
 FY24 - \$4,000,000  
 FY25 (P) - \$4,000,000  
 FY26 (P) - \$2,000,000

Benthic Habitat Collaboration FY23



- Takeaway: multi-agency effort, we know when we need to back off and go to the experts.
- Project phases
  1. Gap analysis, mission planning, data acquisition, dataset development, and data QA/QC
  2. Phase 2 spatial modeling/analysis
  3. Data distribution and discovery
- Project data pipeline: airborne lidar
  - Official soundings for areas like Whitefish Bay are very sparse, lidar can uncover previously unknown bottom features, improves hydro models
- Project data pipeline – multibeam sonar
  - Almost done with lidar, now need to go back w/sonar
  - GLERL has 3-4 boats dedicated to the cause: R/V echo, swath, and Laurentian
  - Looking for partners already mapping for other purposes to follow our standards and support the greater mapping effort
- Benthic habitat mapping 2021 –
  - Sleeping bear point multibeam sonar bathymetry & backscatter
  - Backscatter is the most important part because predictive modeling on the composition can be performed
- Project data pipeline: characterization
  - Make use of underwater video imagery to identify features
  - Now it is possible to zoom in and see rocks and features that wasn't possible before
  - CMECS – anyone can go in, pull up chart, get lat/long, data, and imagery.
    - Coastal & Marine Ecological Classification Standard
  - Completed 14,000 square miles of mapping last year
  - Not just on-the-water innovations, but also on the data processing side
    - TATOR – web-based application used for underwater imagery annotation. Many tools are built to help support the annotation process, including AI. Validation as well
    - NOAA Benthic Data Hub – built this new because didn't have one that served their purpose. Open for participants to contribute videos and any information – it's a place & contact for helping to get data into usable condition
- Mapping status 2024
  - Not Lakebed 2030, but parallel objectives
  - Objective is US waters 0-80 meters

- 2024: southern Lake Michigan Chicago to Milwaukee
- 2025 planned map areas in white – lots in Lake Ontario and Erie



- 2026: Saginaw Bay & Lake Huron + Straits of Mackinac
- Saldrone mapping in Lake Superior north of Apostle Islands next year funded through this project, will be a demo for mapping in Arctic waters
- NOAA Thomas Jefferson back on the lakes & bringing drones with them to help survey
- Advocating “crowdsourcing” from the science ship community to leverage the work already being done. Part of Lakebed 2030 is how crowdsourcing data can play a role but also considering the needs for high-quality navigational maps/imagery such as multibeam.
- It is important to consider how best to feed data to a project. Other team members would be better to speak on this. Dennis said he will consult team members on how to submit it.
- Next steps
  - Public distribution of underwater video and imagery
    - Use AI to characterize
    - Public outreach
    - Long-term monitoring

Around the Lakes: short updates and lessons learned regarding vessel operations, shipyard and drydock experiences and research coordination (Brandon Bastar moderator: various presenters TBD)



Brandon Bastar introduced the session. Last year Michigan DNR presented on the boat they were looking to build, they're now starting the construction process, the boat will be built in MI. Also, heard from Amy Eliot – update on Sadie Ann out of Duluth. Currently in Louisiana in final construction phase. Bastar then introduced several people to give brief updates:

- Greg Genheimer – Ohio State University Stone Lab & Ohio Sea Grant, Gibraltar III
  - Research education & outreach
  - Looking into getting a new boat, a wide range of applications makes it difficult to design a vessel. Currently in planning mode for it
  - 38 foot M/V BioLab is our largest boat, trawler vessel
  - NSF's bio program has a marine section, can submit a proposal for a planning process then get a larger award for procurement
- Max Morgan, EW Milwaukee and Neeskay
  - Challenges & positive takeaways from the Neeskay 2024 shipyard
  - Departed from Manitowoc Oct 16<sup>th</sup> – do some work with GLOS buoys, the ones they're responsible for had to come out early
  - Hull in relatively good shape, needed diver for keel blocks
  - Got steps and power in place immediately
  - Propeller shaft & rudder service and inspection – took 4-8 weeks
  - Shaft was a little bit off, had to be straightened out – laser scanning helped to identify the shape
  - All thru hull valves inspected, repacked, repaired
  - Replaced wet lab door
  - Cut holes for new WASSP F3 Multi-beam sonar; wrote grant application & awarded \$8k for this, installed new cofferdam
  - Had hull ultrasounded to check thickness
  - Repainted the ship & markings
  - New sonar is promising – had to do some calibrations but preliminary data is good; data goes to our Noble system and updates our charts automatically. It can accurately map the lakebed while going full speed – 9.5 knots. Planning to map mid-lake reefs – choosing locations with USGS and searching for spawning grounds. Doing ground truthing as well.
- Ben Hale, Inland Seas
  - Sutton's Bay, MI since 1989
  - Tall ships
  - Education and stewardship focus, some data collection

- Schoolship.org
  - 1994 Schooner *Inland Seas* launched. Instead of them writing & developing their own programs and marketing that, their strategy is writing their programs but also finding people with parallel missions & interests and trying to form partnerships around the GL.
  - Used to stay in northern Lk MI, now we traverse all of the GL working w/partners
  - Needed another boat due to demand, wanted another, larger sailing schooner
  - Found 3-master w/same builders as our existing boat
  - Some corrosion to deal with, went to a shipyard in Chesapeake area
  - Trying to make ID resources available and get information on great shipyards and other crowdsourced information
  - 90 gallon blackwater capacity wasn't going to work for us, had to increase wastewater capacity to make trip back to Sutton's Bay
  - Removed existing staterooms, went from 6 to 18 bunks, one open cabin
  - Modified to improve their wastewater capacity
  - Had to put in new freshwater tanks, redo stability test and make sure things were ok
  - Welded handholds onto mast, anchor points to connect fall protection
  - Always struggling to find crew – turned deckhand position into paid position vs volunteer. May not have room for them to advance on the ship but want to have options for them to go someplace else. Open to conversations on this.
  - The new vessel will be fully operational for 2025
  - Working with Michigan Tech on their summer youth program for HS students, will be in Lake Superior out to Duluth this summer
- Kurtis Winter, OMNR
    - Glenora fisheries station
      - Aquatic research and monitoring section
        - Provides science-based info to inform fisheries policy, species recovery, invasive species mitigation, and land use and water quality planning
      - Lake Ontario management unit
    - Their large vessels are rather small compared to US vessels mentioned so far
      - Twin Volvo D270s; 11.5m long, 3.5m beam, 15GT, built by hike metals Wheatley, ON
      - Glider, acoustic telemetry

- Steelcraft – fish tug
      - Detroit Diesel single screw; 12.5m long, 3.6m beam; 13.4 GT;
      - Built by Russell Bros. Ltd. In Owen Sound
    - Ontario Explorer
      - CAT C12 single screw fish tug; 20m long, 6.5m Beam
      - Robust hydraulic system for trawl, gill nets, water pumps
      - Can stock up to 40,000 lake trout in single trip; 3-4 trips per year
    - Six small vessels 22-26'
      - Used for e-fishing, trap netting, gill netting, tagging
      - Twin outboard motors
      - Trailerable anywhere in Ontario
      - Have flexibility to meet program goals; service entire Lake Ontario watershed
  - Acoustic telemetry
    - Receivers across NE Lake Ontario
    - Used new ROV Jocelyn
      - Helped to find lost receivers – Sonar & GPS helped pinpoint receivers with accuracy and cut free with grinder blade
  - Built in PEI by Marine Nav, we added a lot, had to rework the power system to run everything, they were very helpful and 3D printed new floats when it didn't have the neutral buoyancy we were looking for
- Amy Eliot, U Wisconsin Superior – Lake Superior Research Institute
    - Getting ready to take delivery of the Sadie Ann catamaran
      - Max speed 18 kts, range 600 nm
      - Main mission is education & outreach, but also available for research if anyone wants to do that.
      - Coast Guard certified vessel, planning to operate on the Western shore of Lk. Superior
      - It is diesel – electric hybrid. Funded through private donations makes some things considerably easier
      - The hybrid system cost ~\$1 million more, we believe that it will pay for itself in 10-12 years, and needs to redo life cycle analysis
      - Hybrid is quiet, saves wear and tear on diesel engines
      - Builder - Midship Marine in Louisiana

- There were no incentives for them to do this, they were hopeful to build in their own backyard in GL. The Hybrid system added level of risk for builders, and they didn't want to assume the risk because they didn't have experience in the field.
- Lessons learned
  - Electric motor companies are all in Europe, issues getting Coast Guard certified, ex: marine wire used in Europe not allowed here
  - Coast Guard in DC concerned about fire potential from batteries; added a deluge system as a backup for fires,
  - battery compartment hatch & vents added to original design
  - Had to adjust gate to allow door to open all the way
  - Shore charger/additional wiring needed due to miscommunication w/Esco Power
  - These issues caused a delay but not additional costs for us
- Fold-up dive platforms
- Moon pool, upper deck has classroom that's wide open
- Important that the public understands why the research & the work is very valuable. The classrooms should be available to anyone to use
- Figuring out Route Home options – either Atlantic Intracoastal, Mississippi – Illinois River, or Hopper barge Mississippi – Chicago Canal
- Will do light programming in 2025 and hoping to be up and running more fully in 2026.
- Freshwater research & education center – newly opened looking for partners

#### Workshop Wrap Up and Action Items (Tom Crane, GLC, Mark Burrows, IJC)

- Meeting is recorded, will go up on canamglass website.
- Meeting record will be available to everyone, and can share link with those who weren't able to make it today
- Need input & feedback on the one pager ASAP – by COB next Tuesday.
  - May try to set up a steering committee meeting in the next week to debrief from the mtg and get feedback on the one pager.
- Finalizing workforce training abstract. The steering committee received it, request for committee to give input.
  - Hoping to get funding secured by next workshop.
- Aligning 1999 action plan with the science plan & have two companion docs that influence the science planning moving forward.
- With no further business, the meeting was adjourned at 3:00 p.m.