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**NOAA Office of Ocean Exploration  
FY09 Expeditions**

**Cruise Plan**

**Thunder Bay 2010: Pushing the Boundaries**

**August 16 to August 27 2010**

**Principal Investigators:**

**Russ Green, Thunder Bay National Marine Sanctuary**

**Charles Loeffler, Applied Research Lab- University of Texas at Austin**

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**1. Cruise Overview:**

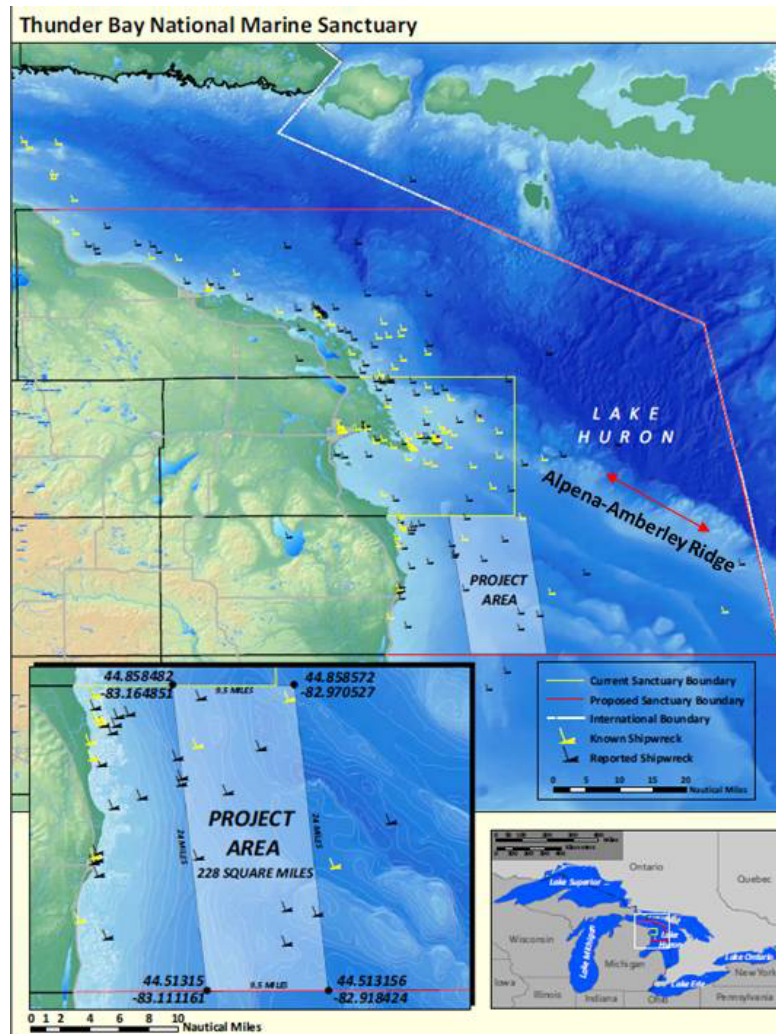
- a. Chief scientist contact information

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- b. Vessel identification and cruise number  
Main platform will be 50-foot NOAA R/V Storm

- c. Study area  
228 square mile survey area south of the current Thunder Bay NMS boundaries. See below:
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Goals and objectives

1. The proposed project has three goals for TBNMS:
  - a. To discover new shipwreck sites within the potential expanded boundaries of the Thunder Bay National Marine Sanctuary (TBNMS).
  - b. To develop an efficient, cost effective remote sensing method for surveying broad, relatively deep (+100 feet) areas that will best serve TBNMS and the archaeological community.
  - c. To foster among the public an increased appreciation for America’s maritime heritage, NOAA and its relevant programs, and advanced marine technology.
  
2. The proposed project has four goals for ARL:UT
  - a. To collect and process ATLAS (Autonomous Topographic Large Area Survey) sonar data in a variety of environments with new types of objects.
  - b. To expand ATLAS’s operating envelope (speeds and lane spacing) to maximize the area coverage survey rates.
  - c. To collect data that will be used to improve the sonar and vehicle’s autonomous capabilities in the areas of obstacle avoidance, object recognition, and on-the-fly mission survey optimization.
  - d. To collect data to develop archeological survey specific autonomous sensing and maneuvering capabilities. (i.e the capability for the sonar system to recognize large ship-like structures then direct the vehicle on a fly-by path to collect high-resolution imagery with a camera or an ultra-high frequency imaging sonar).
  
3. Four objectives serve the project’s goals:

- a. Conduct field-testing with experimental, forward-looking sonar mounted on an AUV.
- b. Produce bottom imagery, bottom bathymetry, and contact maps of the surveyed areas with the new sonar technology.
- c. Collaborate with recognized leaders in the fields of archaeology, AUV research and development, and data processing.
- d. Provide a meaningful learning experience for a broad range of students and the general public by conducting a newly created, real-time distance learning component centered on exciting marine technology and exploration theme.

**2 Description of operations:**

- d. Submersible (HOV, ROV, AUV)  
Project will utilize a REMUS 600 AUV with the ATLAS forward looking sonar
- e. Video recording – wiring diagram if necessary  
Representative topside video and still imagery will be taken.
- f. Standard oceanographic:
  - i. CTD information. We can also provide the vehicle’s track with attitudes and velocities, which can be used to derive some information about the water currents.
- g. Scientific sample processing - NONE
  - i. geologic
  - ii. biologic
  - iii. chemical
- h. Small boat operations  
Main platform will be 50-foot NOAA RV Storm
- i. Archaeological
  - i. Remote sensing  
Project will use a forward looking sonar (ATLAS) developed by ARL:UT.  
The ATLAS sonar is expected to support 800 to 1000 yd lane spacings in these conditions, and the vehicle should operate between 3 and 4 kts. Thus the coverage rate should be 1 to 2 nm<sup>2</sup>/or 10 to 20 nm<sup>2</sup> per day (assuming 8 to 10 hr sorties)
  - ii. Site characterization  
The purpose of the project is to locate new maritime heritage sites, primarily shipwrecks. Sonar images in combination with historical research will allow archeologists to begin the process of characterizing specific targets. Ultimately, the aggregation of targets found during the 10-day survey will be used to better characterize the sanctuary and region. The team will also spend up to two days surveying a portion the Alpena-Amberley Ridge, a submerged land bridge that was exposed 8,000 years ago. The team will collect bathymetry data in an attempt to pinpoint likely locations for prehistoric archeological sites.
- j. Visits - education and outreach events  
The expedition will be a live signature expedition for OE. There will also be media visit opportunities.
- k. Other  
Media requests to be onboard the research vessel can be accommodated depending on daily run times to the survey area.

**2. Itinerary:**

a. Summary - staging, underway, demob

August 16: ARL UT-Austin team arrives in Alpena, MI. Mobilization.

August 17: Install vehicle on host craft; in-harbor testing; short shakedown cruise

August 18-24: Survey begins in earnest. Operations will be "day ops" running variously out of Alpena Harbor and Harrisville Harbor depending on where within the larger survey area we are going on a given day.

August 25-26: Survey of Alpena-Amberley Ridge; Running out of Alpena.

August 27: De-mobilization

b. Details - dates, times, way points, activities

See above and survey area map in section 2C. Activities are remote sensing using a forward looking sonar capable of 1000 meter swaths. Water depths will range from 150 to 200 feet.

**3. Personnel** \* sounds like only two of the three ARL people will be coming besides Charlie; not all personnel will be onboard each day. Team members will rotate through.

a. List

1. Russ Green, PI – TBNMS
2. Charlie Loeffler, PI – ARL: UT
3. Jeff Gray, TBNMS Superintendent
4. Cathy Green, TBNMS Education Coordinator
5. Tane Casserley, NOAA Maritime Heritage Program
6. Wayne Lusardi, Underwater Archaeologist, State of Michigan
7. Mark Story, ARL:UT
8. Clinton Johnson, ARL:UT
9. Matt Peoples, ARL:UT
10. Dennis Donahue, Captain
11. Crew: TBD
12. OER Web Coordinator
13. OER Data Manager

b. Berthing plan

None as of now

**4. Organizational structure** - roles/responsibilities

Russ Green: Project planning, operations, logistics, archaeology, media

Charles Loeffler: Project planning, AUV operations, data processing

University of Texas staff (2)

Dennis Donahue: Vessel captain

Cathy Green: Education, media

Jeff Gray: Sanctuary superintendent

Tane Casserley /Wayne Lusardi: archaeology

**5. Equipment lists:**

- a. Required from ship
- b. Provided by science party - size, weight

Major equipment is REMUS 600 AUV and companion data acquisition and processing hardware/software

**6. Disposition of Data:**

- a. Data and samples  
Processed sonar data to Thunder Bay NMS
- b. Records and reports  
University of Texas; Thunder Bay NMS
- c. Real-time products (highlights video, high-res image CD, etc.)  
Possibly sonar images; Thunder Bay NMS  
Also video and still images of topside operations

**7. Emergency information**

On board

**8. Communications**

N/A

**9. Miscellaneous:**

- a. HAZMAT inventory
  - i. REMUS 600 AUV uses Lithium Ion Batteries
- b. Meals  
N/A

**Appendices:**

- A. Detailed project descriptions -see below
- B. Primary operating area maps – see below
- C. Permits and certifications – no permits required
- D. MSDS sheets
- E. Contact information – see below

## Appendix A:

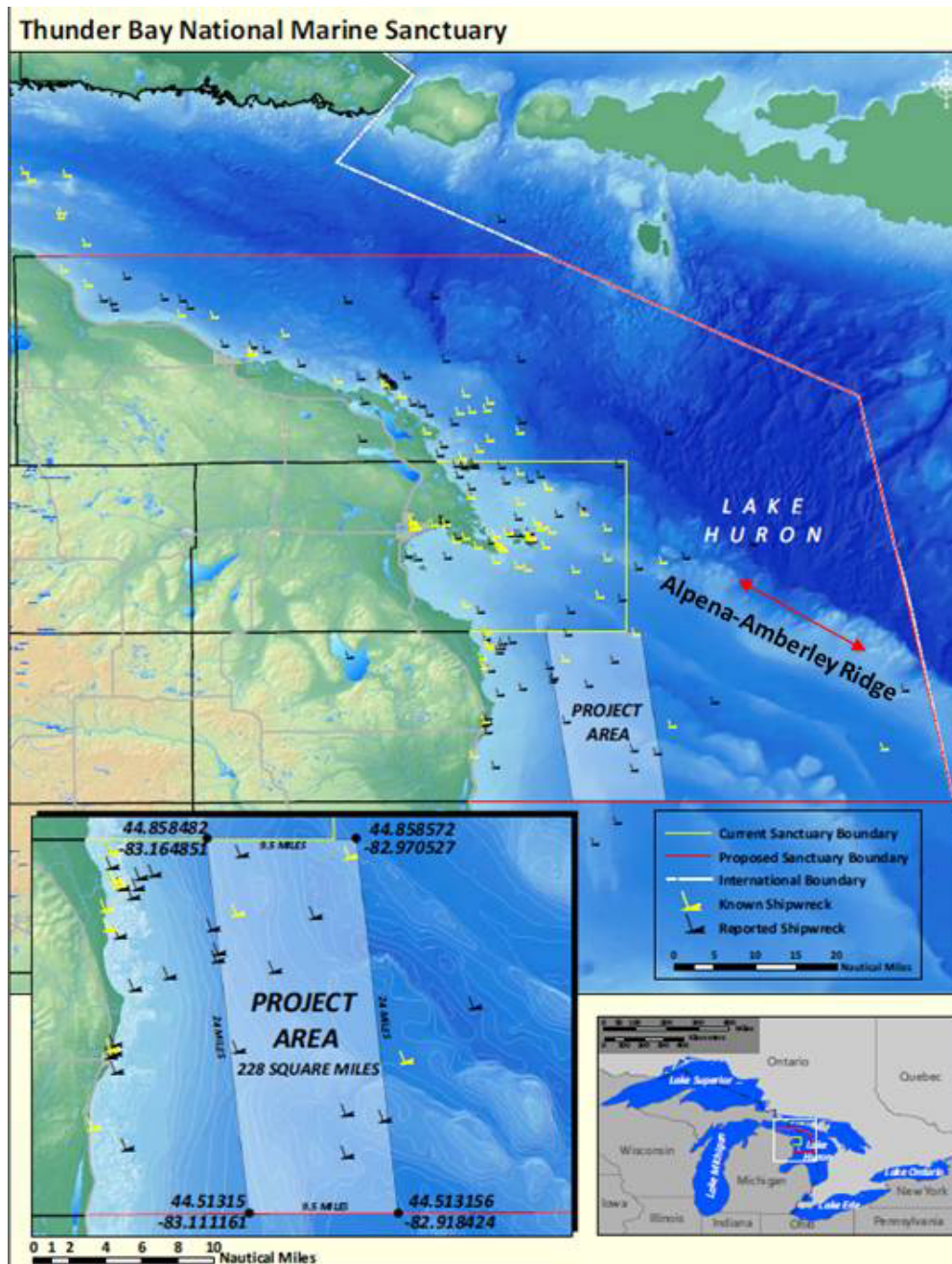
### Project Description:

Established in 2000, the Thunder Bay National Marine Sanctuary (TBNMS) protects one of the nation's most historically significant collections of shipwrecks. Located in the northeast corner of Michigan's lower-peninsula, the 448 square-mile sanctuary contains 40 known historic shipwrecks. Archival research indicates that over 100 sites await discovery beyond the sanctuary's current boundaries. This fact, coupled with strong public support and the occurrence of dozens of known shipwrecks, provide the rationale for the sanctuary's desire to expand from 448 square-miles to 3,662 square-miles (an eight fold increase). Boundary expansion is well underway with five public scoping sessions completed, seven local governments and NGOs supporting expansion, and a bill before the U.S. Congress. Yet, the sanctuary has only just begun systematic remote sensing in the potential expansion area. With NOAA OE funding, a successful remote sensing project was completed in 2008 using traditional towed side scan sonar, and a stock sonar system mounted on an Iver2 autonomous underwater vehicle (AUV). Both platforms produced excellent data and each ultimately defined its most practical role within the long-term research effort to survey the large expansion area: a towed Klein 3000 system for high quality sonar imaging of discrete areas at moderate area coverage rates, and the Iver AUV for sonar imaging of very shallow areas where survey vessels cannot navigate.

However, a third survey system must be found that has the ability to efficiently search broad, deep water areas with high area coverage rates and high resolution bottom imagery. This type of data is critical to evaluating, characterizing and eventually managing resources within the sanctuary's potential expanded boundaries. To that end, this proposal seeks to bring cutting edge marine technology to Thunder Bay: a REMUS 600 autonomous underwater vehicle (AUV) outfitted with a new generation Integrated Precision Underwater Mapping (ATLAS) sonar system developed by Applied Research Laboratories with the University of Texas at Austin (ARL:UT). The proposed 10-day project squares nicely with OER's emphasis on the early phases of marine archeology and brings together the disciplines of marine archeology and advanced marine engineering. ATLAS's capabilities nicely mesh with the sanctuary's survey goals. The ATLAS sonar system will provide high area coverage rates, bottom imagery, and much needed bathymetric data. The combination of the ATLAS sensor on an AUV (a new development) enables surveying large areas unencumbered from tethers to surface ships. This capability was demonstrated at the 2008 AUVfest, a joint Office of Naval Research (ONR) and OER undertaking that sought to introduce state-of the-art AUV technology to the maritime archeology community. Notably, the proposed project's genesis can be found in the early AUVfest planning sessions.

Appendix B.

Project Area:



Appendix C:

Contact Information:

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