RPM
NAUTICAL
FOUNDATION
www.rpmnautical.org

OVERVIEW

RPM Nautical Foundation is a non-profit (US 501 c 3) research and educational organization that performs maritime archaeological research in the Mediterranean. Our supported institution is the Program for Maritime Studies at East Carolina University. Among the goals for RPMNF is the effort to assist Mediterranean countries with the location, identification, assessment, and research of their submerged cultural material so that these important cultural resources can be protected for future generations. Accordingly, our projects are carried out in conjunction with host governments in the Mediterranean and serve as a crucial component in the effort to protect submerged archaeological sites and maritime heritage in association with UNESCO's efforts to preserve world heritage sites.

Over the past decade RPMNF has moved into the forefront of maritime archaeology through intensive and systematic use of advanced technologies in the littoral investigation of the Mediterranean. RPMNF's research vessel, the R/V *Hercules*, is a purpose-built maritime archaeological platform that has seafloor mapping and three-dimensional modeling capabilities for identification of submerged cultural material sites. Potential sites are verified and documented with ROV investigation. The ROV is employed for video and image documentation, sampling, artifact retrieval, and limited excavation of sites. For further details on the systems and methods used by RPMNF during our program objectives please see our website (www.rpmnautical.org).

Our cooperative projects have proved successful in the identification, mapping, and recording of shipwreck sites and harbor works from the ancient through modern eras. To date, project areas include Spain, Albania, Montenegro, Croatia, Malta, Morocco, Cyprus, Sicily, Amalfi and Calabria in Italy, and Turkey. As all archaeological work is performed in conjunction with the host country's cultural authority, the one of the crucial outcomes is that the projects assist in both scholarly research and educational projects. All recovered artifacts remain under the jurisdiction of the host government for educational/research purposes and eventual museum display in each country. The location and assessment data of wreck sites has proved beneficial to the many governments with which we have worked as it provides their cultural authorities pertinent information for protecting their submerged archaeological resources. Bathymetric data is also made available to host country hydrographic departments in order to supplement their oceanographic mapping programs. RPMNF research vessel *Hercules* is flagged in Malta, where it based in Valetta during the off-season, and is deployed throughout the Mediterranean on a project basis.

EQUIPMENT: R/V *HERCULES*

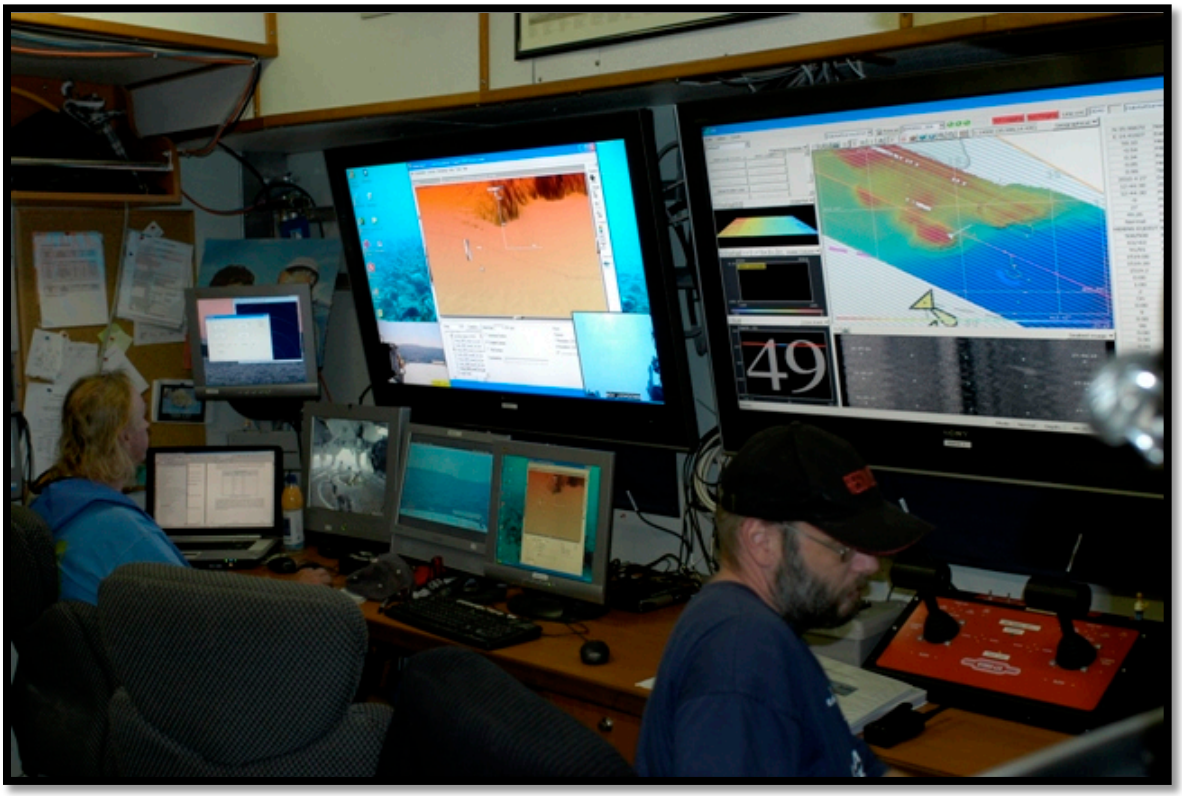
The R/V *Hercules* has been designed and built to perform littoral maritime archaeological survey and limited excavation. The vessel is designed as a self-sufficient base for a wide range of project functions in moderately deep littoral waters, typically limited to 500 m. These operations include remote sensing equipment (primarily multibeam systems), the deployment of ROVs, the ability to deploy other submersibles, the capability for side-scan sonar, and diving operations. *Hercules* is equipped with a dynamic positioning system and advanced data processing capabilities that include a state-of-the-art data control center. Additionally, the R/V *Hercules* is also equipped with adequate deck space and lifting systems to transport and deploy submersibles and auxiliary vessels, as well as an integrated Nitrox system for multi-diver operations.

Length: 37.3 m / 122 ft **Beam**: 6.7 m / 22 ft **Configuration**: Monohull
Draft: 1.5 m / 5 ft (thrusters deployed: 2.1 m / 7 ft)
Engines: Two Caterpillar 900-horsepower 3412 diesel engines
Power Supply: Two 65-kw and one 30-kw Northern Lights generators

Fuel Capacity: 26,500 liters /7,000 gallons **Cruising Speed**: 12-16 knots
Range: 1,000 nautical miles

Navigation Systems:

- Two Simrad RA54 (12 kw) 72-mile range radars
- Furuno RC1815 GMDSS weather and distress communication system
- KVH Fleet 77 SATCOM
- Simrad CP44 GPS WAAS chart plotter
- Trimble DSM132 DGPS (Omnistar ready)
- Kongsberg/Simrad DPIO System Dynamic Positioning Computer – Fugro demodulator interfaced with Seatex 200 DGPS system
- Kongsberg/Simrad HIPAP System Acoustic Positioning
- Simrad EQ60 and EQ42 depth sounders
- Data room aboard R/V *Hercules* with full collection, processing, and analytical capabilities for multibeam data.
    - Two 52-inch display screens that allow multiple video feed manipulation.
    - Video/display controller for customizing feeds for job specific tasks.
    - 16-channel video/display router that allows ship-wide display of imagery.



Berthing: Accommodations for 7 crew members; space for 5 additional individuals that include technicians, archaeologists, and guests.

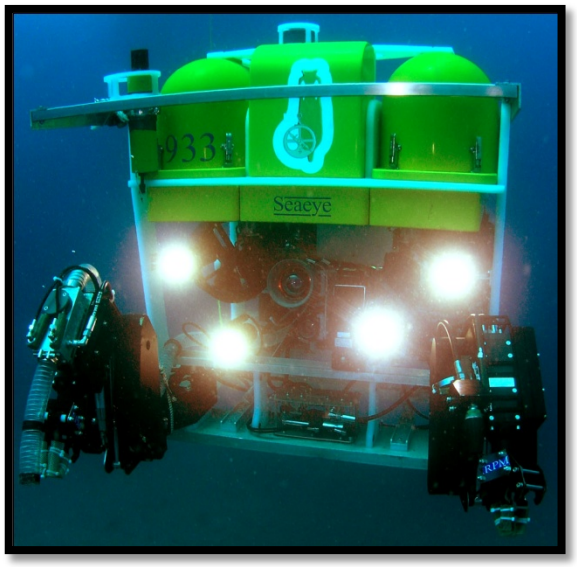
Deck and Fixed Equipment:

- Lifting Crane: 5-ton capacity with 6.7 m / 22 ft reach
- A-Frame: 5-ton capacity
- Nitrox Technologies scuba compressor system

Remote Sensing Equipment:

- Kongsberg – Simrad multiBeam echo sounder systems (R/V *Hercules*):
  - EM1002S: maximum depth to 600 m, 95 kHz frequency
  - EM30020D maximum depth to 120 m, 300 kHz frequency
- Primary processing software: CARIS HIPS/SIPS and IVS Fledermaus
- 3 Geometrics G-881 Cesium Magnetometers: 300 m operating depth

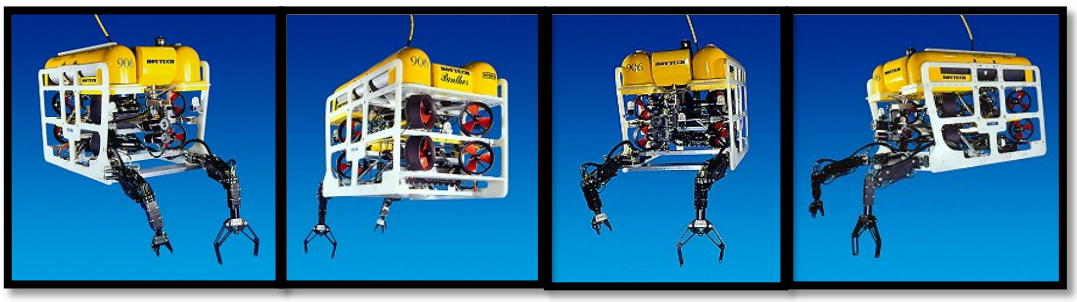
EQUIPMENT: REMOTELY OPERATED VEHICLE (ROV)

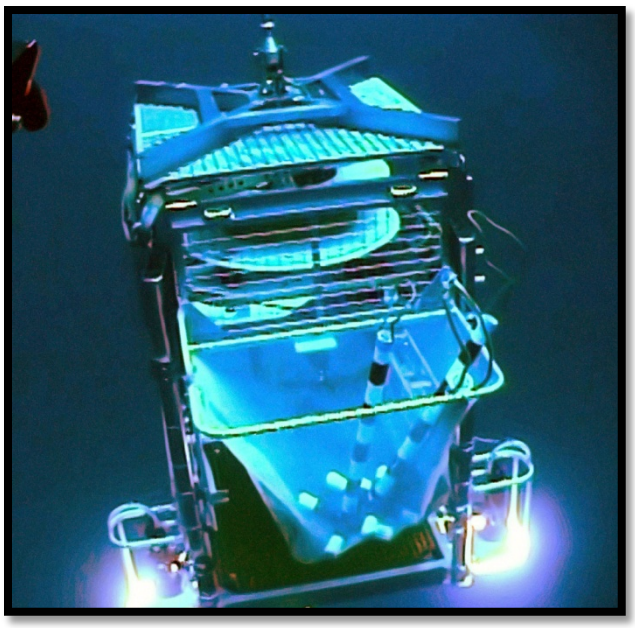


Model: Seaeye Panther XT
Length: 1.750 m
Height: 1.217 m
Width: 1.060 m
Weight: 500 kg
Forward thrust: 220 kg
Lateral thrust: 170 kg
Vertical thrust: 75 kg Payload: 105 kg
Maximum working depth: 1500 m

ROV Equipment:

- Four simultaneous video channel feeds via fiber-optic transmitters
- Kongsberg High-Definition color camera.
- Two additional color cameras mounted on the left manipulator arm and downward facing on top rack.
- 360^{o} sonar navigation system
- Depth sensor with +/- 0.1% accuracy of full scale deflection
- Kongsberg HiPAP 350 tracking and positioning system; beacon for determining ROV position from support ship
- Two multi-function manipulator arms: 6-function manipulator and 5-function grabber
- Suction/blower tool.
- Laser measuring device set at 10 cm for video and photographic scale



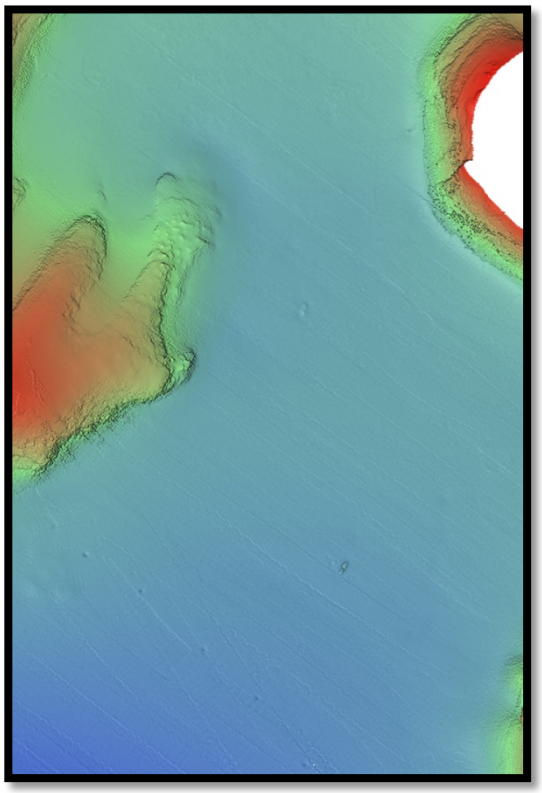


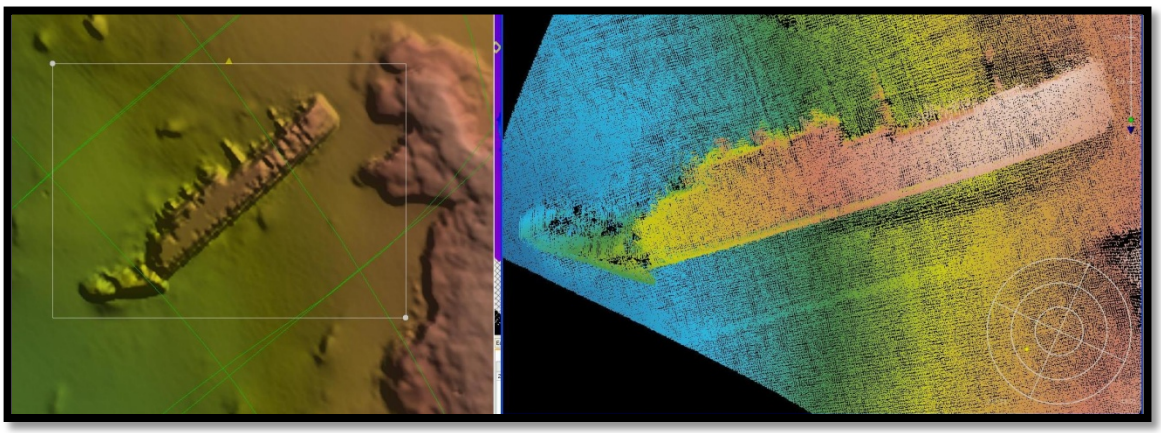
Tether Management System (TMS):

- Type 3 bale arm tether management system; 150-m excursion limit
- Two 400-watt lights affixed pointing downward
- Lookdown and reverse-look camera.
- Large collection nets for raising artifacts.

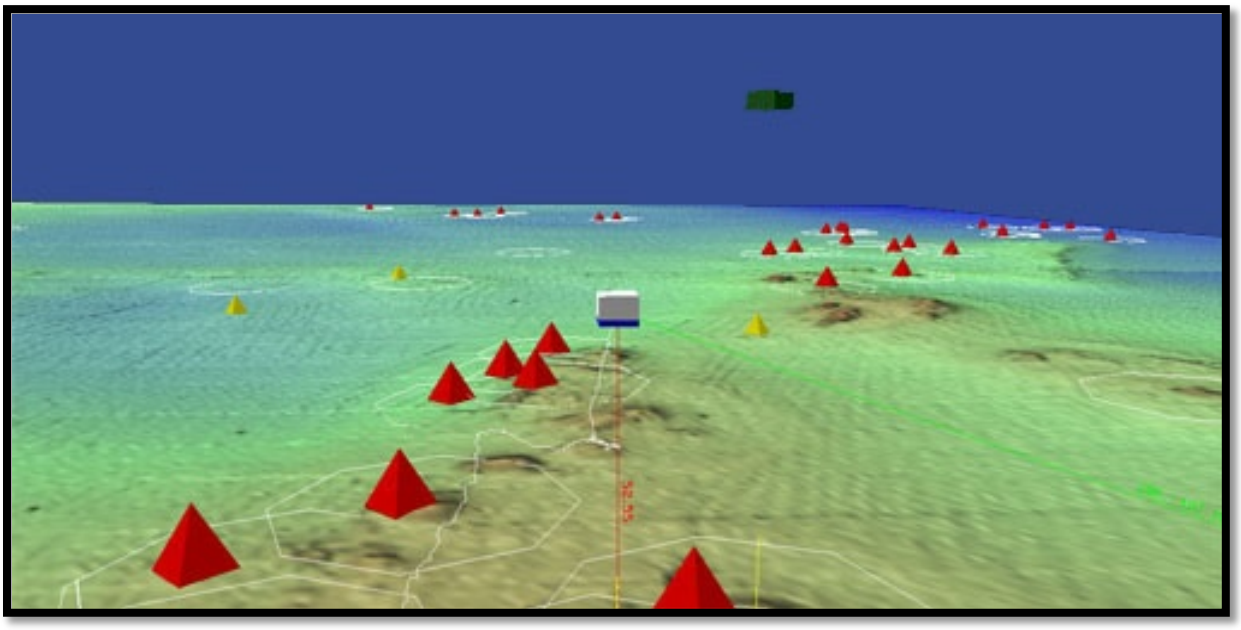
METHODOLOGY

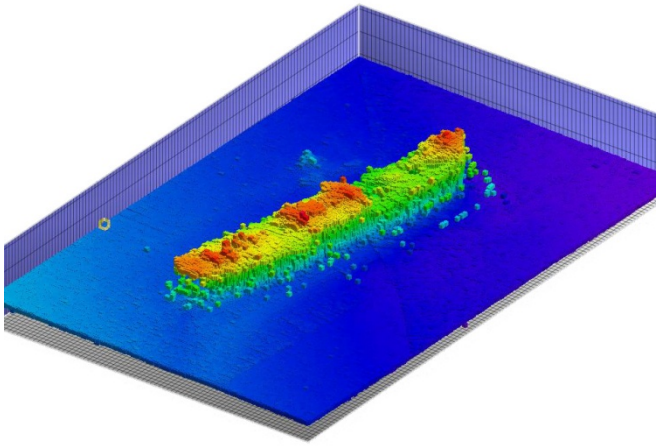
Detailed bathymetric data will be collected along the Croatian coast by RPMNF's research vessel *Hercules*. Its primary remote sensing system is a multibeam echosounder that employs two transducer heads affixed to the underside of the vessel. This multibeam system is model type EM3002D, from Kongsberg Maritime division. The two heads emit up to 508 individual beams at a maximum rate of 40 times per second. Three frequencies are employed by the system (293, 300, and 307 kHz); additionally the system has the ability to dynamically control angular coverage that results in a practical depth resolution of a few centimeters. This multibeam system is found to be effective for archaeological survey up to c. 100-110 m of depth. Survey lanes are run in accordance with the bottom contours and relative to coastline formations to minimized depth variation along a survey lane. Archaeological investigation requires detection of anomalies as small as one-half meter in size and c. 30 cm high off the seafloor. To achieve this resolution overlapping survey lanes are run at a relatively slow vessel speed with 200% coverage to ensure a high number of individual beams per unit of seafloor area. Multibeam data is processed during and directly after collection to produce three-dimensional models of the seafloor, which are then analyzed for anomalies. Multibeam data is acquired through Kongsberg's SIS software, processed in CARIS HIPS/SIPS, and modeled in IVS Fledermaus software for anomaly analysis. All acquisition and processing of data is

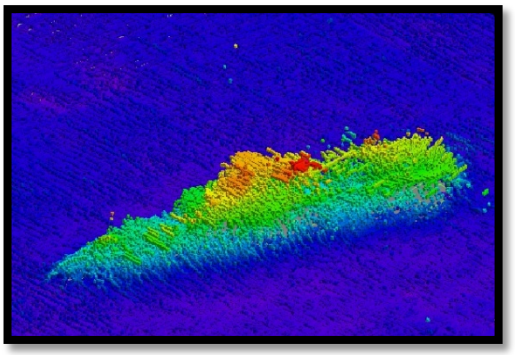




performed by surveyors contracted from Highland Geo Solutions Inc. of Fredericton, NB, Canada. Software applications allow the visualization and manipulation of each individual beam reading in order to attain the best possible seafloor image and the identification of anomalies. Anomalies meeting specified criterion are plotted with navigation and spatial software. This software allows controllers in the data room to track the Hercules, ROV, and TMS in real time within the three-dimensional models of the seafloor. This ability increases the efficiency of verifying anomalies and locating verified sites.



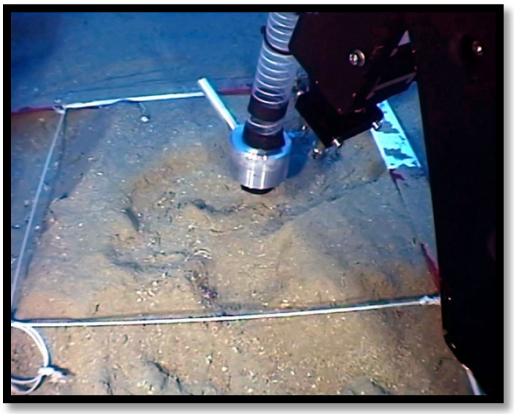




The ROV, deployed from the R/V *Hercules*, is the primary verification tool. Once plotted, the R/V *Hercules* navigated into position over anomalies and the ROV equipped with a transponder is deployed; real-time tracking of the R/V *Hercules* and ROV within a three-dimensional seafloor model allows precise location of sites and individual finds. IVS-Fledermaus provided this prototype software module that allows the tracking of all vessels within the 3-D models of the seafloor. The ROV is deployed via a tether management system (TMS) that includes a cage equipped with cameras and lights. A high-resolution sonar affixed to the ROV facilitates location of each anomaly and the examination of the surrounding area for scattered objects. Geologic formations are scanned for cultural material that often is trapped from drag net or current movement.

Both sites and individual finds are recorded by the ROV's multiple video cameras and their locations are ascertained by ROV tracking and from coordinates in the seafloor model. The principle camera for video recording is a high-definition (HD) camera; however several other cameras on the ROV and TMS are used for additional video recording. Downward-facing lights on the TMS supplement those on the ROV and provide excellent quality images. When recording specific sites, the HD camera is affixed to look downward and multiple flyovers are performed; the result is imagery that can be used to produce a photo mosaic site plan. The high HD resolution of the imagery also allows detailed still images to be taken from the video frames.

When conservation facilitates are available, representative objects are raised to assist in determining the date, provenience, and nature of a site or individual find. The ROV is equipped with two high-precision multi-function arms that allow great flexibility in the manipulation of objects. These arms have been used to successfully extract many types of ceramics from sites. Additionally, a suction/blower tool can be manipulated by the ROV arms for either controlled excavation or assistance in loosening objects. This system has successfully been employed in a test limited excavation of a 4th-cenrtury CE wreck site in Sicily. The excavations were carried out within 1-m2 metal frames to allow for provenience control of artifacts. A mesh back affixed to the



ejection end of the suction/blower hose captures small objects taken in by the water dredge. After any large artifact has been freed and is ready for retrieval, it is placed in the large nets affixed to the TMS for recovery to the *Hercules*. This system provides a secure method for transferring objects from the seafloor to the deck of the Hercules.

Artifacts recovered with the ROV during survey or excavation are brought aboard the R/V *Hercules* for documentation, recording, and analysis. All copies of recording data and photographic records are provided to the host government. Afterwards, all artifacts are stored on the work deck until they are delivered to the appropriate representative within each country for storage, conservation, further analysis, and eventual display.


RPMNF PROJECTS 2003-12
Croatia
2012
Montenegro
2009-12
Albania
2007-12
Almalfi,
Italy 2005
Sicily,
2005-12
Calabria,
Italy 2004-6, 11
Cadiz,
Spain 2004
Cartagena,
Spain 2003
Tunisia
2012
Malta
2005, 06, 10-11
Turkey,
2005-6
Tangiers,
Morocco 2003
Cyprus
2005
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