

## **Final Report**

### **A Remote Sensing Survey to locate the remains of *USS Dorado* off of Bahia de la Ascension, Quintana Roo, Mexico**



**Submitted To:**

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**[NOTE: This version edited by Coral Reef Foundation and Syneca Research Group prior to public release]**

**Cover Photo:** *Launching of USS Dorado on May 23, 1943, from New London, CT.*

**Abstract:**

In October 2006, Douglas Campbell, Ph.D., President & CEO of Syneca Research Group, Inc. contacted Geomar Research, LLC to discuss the possibility of conducting a remote sensing survey to locate the wreckage of a World War II U.S. submarine, *USS Dorado* (SS-248). Dr. Campbell had conducted extensive historical research concerning the fate of this submarine as reflected in his website [www.ussdorado.com](http://www.ussdorado.com). His research indicated that there was a possibility that the submarine had come to rest along the east coast of the Yucatan Peninsula, south of Cozumel off Bahia de la Ascension. One of the primary sources of information that Dr. Campbell had access to were first-hand stories from airplane pilots that indicated that they had seen a large “submarine”-like object in the Caribbean waters off of Bahia de la Ascension at a depth of, in their words, “approximately [REDACTED] feet.”

In May 2007, Geomar Research, LLC in close coordination with its host, the Mexican Instituto Nacional de Antropología e Historia, Subdirección de Arqueología Subacuática (INAH), conducted a remote sensing survey of an area off the mouth of Bahia de la Ascension. The project was sponsored by Syneca Research Group, Inc. Pilar Luna Erreguerena, Chief Underwater Archaeologist of INAH, served as the organization’s host and the project’s Principal Investigator. The Bahia de la Ascension survey utilized standard underwater archaeological survey remote sensing techniques to locate and identify acoustic targets consistent with potential submerged cultural resources.

The remote sensing survey conducted by Geomar Research, LLC determined that it is unlikely that the *USS Dorado* is located in shallow water off Bahia de la Ascension. No acoustic targets consistent with the remains of a WWII submarine were located during the survey. The survey did however identify an extensive coral reef structure that extends to the edge of the continental shelf in this area. The survey determined that the reef extended out to a depth of approximately [REDACTED] meters whereas the bottom then sloped away rapidly to a depth in excess of [REDACTED] meters.

## **Introduction:**

The Bahia de la Ascension survey had its beginnings when airplane pilots who had been transporting cargo to a construction site in British Honduras during the early 1970's spotted what they believed was a sunken submarine off the mouth of Bahia de la Ascension. The feature was prominent and easily recognizable and the pilots began using it as an aerial waypoint which they referred to as the "gray ghost." Those reports indicated that the submarine shaped object was in about [REDACTED] feet of water and that the conning tower or sail cast a large shadow across the seafloor in the morning and afternoon hours when the sun was low on the horizon (Campbell, Pers. Comm., 2006). Dr. Douglas Campbell a researcher and amateur underwater archaeologist, heard the story of the "gray ghost" directly from one of the airplane pilots, and began researching it. His research indicated that no submarines of any nationality had been reported lost in that area throughout modern history. As a result, Dr. Campbell began looking at submarine activities throughout the general area during the 20<sup>th</sup> century. Dr. Campbell's research determined that if there was indeed any wreckage of a submarine in that area, then it could very well be the remains of *USS Dorado* (SS-248) (Campbell, Pers. Comm., 2006). *USS Dorado* had been lost in 1943 while transiting between Groton Connecticut and the Panama Canal on its way to Pearl Harbor Hawaii where it was to join the Pacific Fleet. In October 2006, Dr. Campbell contacted Geomar Research, LLC about the possibility of performing a marine remote sensing survey off of Bahia de la Ascension along the east coast of the Yucatan Peninsula south of Cozumel, Mexico to locate the feature that the pilots had reported and to determine if it was indeed a lost submarine.

Geomar Research, in coordination with the Mexican Instituto Nacional de Antropología e Historia, Subdirección de Arqueología Subacuática (INAH), conducted the remote sensing survey in May 2007. That survey was unable to locate any acoustic targets that exhibited characteristics consistent with the remains of a World War II era submarine. However, the survey confirmed the existence of the world's second longest coral reef structure on the planet (second only to Australia's Great Barrier Reef). The extensive coral reef structure extended to the edge of the continental shelf in that area. That reef structure consisted of spur and groove formations that exceeded [REDACTED] meters in height in some areas. As a result, it is likely that the feature reported by the airplane

pilots was simply a section of the coral reef formation that under certain lighting conditions displayed characteristics consistent with the shape of a submarine. It is recommended, however, that diver exploration of the reef be conducted on specific coral reef features in the area to verify this hypothesis. This recommendation is due, in part, because of the early loss of Geomar's magnetometer and the possibility that some of the more interesting coral structures that exceeded [REDACTED] meters in height may exist because they are attached to historical artifacts. At the present time no other coral formations exceeding [REDACTED] meters in height have been found to exist on the planet, including the Great Barrier Reef, making this an historical finding by itself.

### **Background:**

In the mid 1970's, Mayor Richard Daley of Chicago began building a complex in British Honduras (renamed Belize in 1981 when they became an independent nation). The area where the complex was to be constructed was remote. As a result, during construction of this complex a runway was built to facilitate the movement of construction supplies to the site. A group of pilots who owned cargo aircraft capable of operating in remote locations were contracted to transport construction materials from the United States to the location in British Honduras. The last leg of their flight were from Cozumel to their final location. Early on in these flights the pilots identified a submerged feature off the mouth of Bahia de la Ascension which they believed was the conning tower or sail of a submarine. The pilots named the feature the "gray ghost" and began using the feature as an aerial waypoint on their approach to the construction site in British Honduras. On their flights to the construction site, the pilots would radio the site as they passed over the "gray ghost" waypoint, thus signaling the construction crews to prepare the runway so that they could safely land. The pilots described the feature as a submarine conning tower or sail that cast a significant shadow across the seafloor. They also reported that they believed that the feature was in approximately [REDACTED] feet of water (Campbell, Pers. Comm., 2006).

Dr. Douglas Campbell is an acquaintance of one of the pilots. When he heard the story of the "gray ghost," Dr. Campbell began researching its identity. His research was unable to identify any submarines that had been reported lost in the immediate area. He expanded his historical research to include all submarine activities in the

general area. That search identified the *USS Dorado*, a World War II US submarine, as a vessel of interest.

*USS Dorado* was a Gato class submarine built at Groton Connecticut by Electric Boat and launched May 23, 1943. After commissioning and completing sea trials, *USS Dorado* was given orders to proceed to Pearl Harbor to join the Pacific Fleet. *Dorado* sailed from Groton on October 6<sup>th</sup>, 1943, heading through the Mona Passage and into the Caribbean Ocean, based on Operational Orders to report to the Panama Canal for passage, but *Dorado* never reported in. Research conducted by Dr. Campbell indicates that at about the same time *USS Dorado* would have been passing a point south of the Dominican Republic, a US patrol bomber (PBM) attached to VP-210 (Guantanamo Bay, Cuba) attacked what it thought was a German U-boat. That action occurred on October 12, 1943 and consisted of two separate attack runs that were executed approximately two hours apart. When *USS Dorado* failed to arrive at the entrance to the Panama Canal, the US Navy launched a search for the submarine and at the same time held an informal Board of Investigation at the squadron's base in Guantanamo Bay; and later a more formal Court of Inquiry at the Washington Navy Yard in Washington, D.C., to determine its fate. The investigations concluded that the crew of the PBM had more than likely attacked a German U-boat and not the *USS Dorado*. After the war, the German U-boat U-214 logbook was turned over to the Americans and translated; the log was later declassified and made available to Dr. Campbell under a Freedom of Information Act (FOIA) request. The log showed that at the same time as the attack, there was indeed a U-boat in the area, U-214, a 600-ton Type VII mine-laying submarine. Additionally, the logbook reflected the events occurring in the area and that the U-boat had witnessed the initial attack occurring a few miles away. The U-boat spotted a flare on the horizon that coincides with the PBM's logbook that it had attacked and depth-charged a submarine and dropped a flare to witness the aftermath. The second attack by the PBM crew was on the U-boat itself, but consisted of search light flashes. When the U-boat began returning fire the PBM banked into cloud cover and the U-boat made an emergency dive. Neither saw each other again. (Campbell, Pers. Comm., 2006).

Dr. Campbell asked several oceanographers, What would happen if *Dorado* was dead in the water, but did not sink? The answer that he was consistently given was that

the sub would have drifted with the prevailing currents and washed up on the east coast of the Yucatan Peninsula. Dr. Campbell has further hypothesized, based on evidence from its sea trials that *USS Dorado* had a great deal of difficulty submerging; that *USS Dorado* was probably damaged during the attack and the damage prevented her from surfacing and radioing for help (Campbell, Pers. Comm., 2006). *USS Dorado* never broke radio silence after sailing from Groton Naval Base, even when repeatedly requested by SubForceCaribbean to do so.

In preparation for the survey, Geomar Research personnel met with Dr. Campbell to discuss his research, the environmental details of the area, and the logistics and permits that would be required to complete a survey off the coast of Mexico. Based upon those discussions, Geomar Research determined that a remote sensing survey using both acoustic and magnetic detection systems was warranted to determine if there was a submarine present off the Bahia de la Ascension. That survey would provide a scientific mapping of the area and serve as baseline from which additional investigations could be conducted in the future if targets were detected.

The historic background research in support of this project was conducted over many years by Dr. Douglas Campbell. Geomar Research, LLC did not conduct any independent historical research related to these events. Geomar Research focused its attention on research related to the characteristics of World War II Gato class submarines in an effort to characterize the acoustic and magnetic signatures that such a target would exhibit in marine remote sensing data.

### **Survey Area Description:**

The Bahia de la Ascension (Ascension Bay) is located in the state of Quintana Roo on the Yucatan Peninsula, Mexico (Chart 1). The closest town is Punta Allen, within the Sian Ka'an Biosphere. The survey area spanned the mouth of Bahia de la Ascension and extended from shallow water (█ meters) out to the █ meter depth curve. The goal of the survey was to collect remote sensing data from the edge of the reef which spans the mouth of the bay out to the drop off of the continental shelf. From hydrographic charts of the area, it was apparent that the area of interest was a narrow ribbon of seafloor. From those hydrographic charts, the survey area was estimated to be approximately █ kilometers (█ nautical miles) by approximately █ kilometers

(■■■ nautical miles). The survey determined that the reef extended out to sea almost to the drop off of the continental shelf. The distance between the reef and the drop off was approximately ■■■ meters on average and as short as ■■■ meters in some areas. The bottom throughout the area was covered with coral reefs that gave way to areas of sand, just before the drop off. Water depths throughout the survey range from exposed reef to more than ■■■ meters.

The survey conducted by Geomar Research, LLC was conducted using the Universal Transverse Mercator Projection (UTM), based upon the World Geodetic System 1984 datum (WGS84). All coordinates and measurements listed in this document are in meters based upon UTM Zone 16N using the WGS84 datum.

**Chart 1: Chart showing the Bahia de la Ascension and the survey area.**

*[deleted]*

**Survey Area**

**Pre-Survey Testing:**

In the months leading up to the survey, Geomar Research personnel collected both magnetic and acoustic remote sensing data at two submarine shipwreck sites in the Chesapeake Bay, Maryland. Testing was first conducted at the site of the pre-World War II US submarine S-49. The S-49 lies intact on the bottom of the Patuxent River, Maryland and is similar in size and tonnage to the *USS Dorado*. Magnetometer readings in the vicinity of the site indicated that the submarine could be detected from approximately ■■■ meters away. It generated a magnetic signature in excess of 1,000 gamma's. Acoustic imagery collected at the S-49 at ■■■ meters range scale clearly show the effectiveness of that range scale for locating targets similar to *USS Dorado* (Figure 1).

Additional testing was also carried out at the wreck site of the U-1105. The U-1105 was a captured German type XX U-boat that was intentionally sunk after the war. It is also of similar size and tonnage to *USS Dorado*. The U-1105 lies intact, but buried in the Potomac River, Maryland. Magnetometer readings in the vicinity of the U-1105 were very similar to the magnetic readings recorded at the site of the S-49. That testing

indicated that the U-1105 could be easily detected at a range of [REDACTED] m and produced a magnetic signature in excess of [REDACTED] gammas.

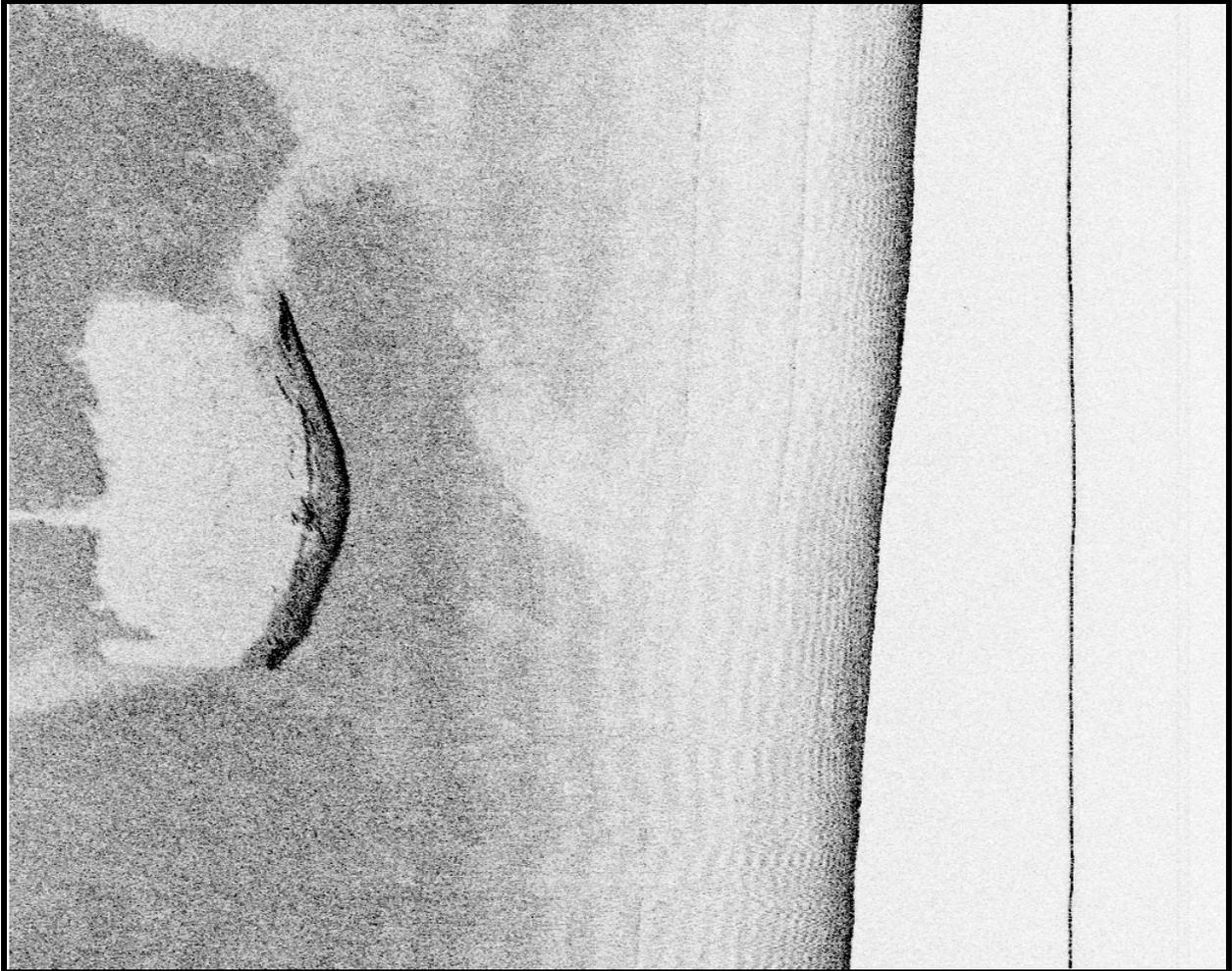


Figure 1: [REDACTED] meter Range Scale Sonar Image of S-49.

#### **Remote Sensing Survey Methodology:**

Geomar Research reviewed historical and location data provided by Dr. Campbell to determine an effective and efficient methodology to identify acoustic and magnetic targets with characteristics consistent with a World War II, Gato class submarine. Based upon pre-survey testing that Geomar Research personnel conducted over two known submarine wreck sites in the Chesapeake Bay, Maryland, an initial lane spacing of [REDACTED] meters was chosen. That survey lane spacing would allow acoustic data to be collected at a sonar range scale of [REDACTED] meters. Conducting the

survey with lanes ■■■ m apart would provide ■■■ meters of sonar coverage overlap between survey lanes thus allowing for navigational errors and sonar mosaic feature matching. In addition, the ■■■ meter lane spacing would insure that the submarine, if present, would never be more than ■■■ meters away from the magnetometer. ■■■ meters was well within what pre-survey testing in the Chesapeake Bay had determined was the “detection envelope” for a submarine of similar age and size.

## **SURVEY EQUIPMENT:**

Due to the remote location of the project area, Syneca Research chartered a live-aboard expedition vessel, the ex-US Coast Guard cutter *Primrose* owned and operated by the Coral Reef Foundation, Inc. out of Gulf Shores, Alabama, USA presently working out of Mexico, to serve as a base of operations and living quarters (Figure 2). The majority of survey operations, however, were performed from a twenty-five foot fiberglass dive boat, *Bonglis II* a vessel belonging to Jorge Canul one of the crew members that works for the Coral Reef Foundation (Figure 3). Navigation and positioning data aboard *Bonglis II* were received on a temporarily mounted Garmin 276C Global Positioning System (GPS) with an integrated Wide Area Augmentation System Differential Global Positioning System Receiver (WAAS DGPS). Bathymetric Data was collected utilizing the survey boats integrated Garmin GPS and depth sounder. Hypack, Inc.’s hydrographic survey suite served as the primary survey navigation and data collection system. The Hypack software package provided the capability to lay out survey lines, collect navigation, acoustic, bathymetric, and magnetic data, and provided an accurate real-time visual representation of the survey vessel and survey lane tracking. Power for the systems was provided by an 1800-watt inverter connected to a large battery bank. The batteries were recharged nightly.



Figure 2: Expedition vessel  
*Primrose.*



Figure 3: Survey Vessel *Bonglis II.*

**Acoustic Data Collection:**

Acoustic data was collected using an Imagenex Yellowfin digital side scan sonar system interfaced to Hypack's survey collection software. This system was chosen for this survey due to its portability and flexibility to image the seafloor at a variety of different resolutions. The Imagenex Yellowfin is a triple frequency unit operating at 260, 330 or 770 kHz with selectable range control ranging from [REDACTED] to [REDACTED] meters. Geomar personnel selected a range scale setting of [REDACTED] meters for this survey. The Hypack survey suite provided sonar control, sonar and navigation data collection, real-time sonar data analysis and targeting, and sonar and navigation data post-processing capabilities. Geomar personnel configured Hypack parameters to collect the sonar data files in Triton exchange format (XTF) for post processing in Triton Imaging, Inc.'s Isis software and Echowision's 2020 software. Side scan sonar mosaics of the area were created using the Triton Isis software package, while the survey target database, coverage, and towfish track were generated using Echowision's 2020 software.

**Magnetic Data Collection:**

Magnetic data was collected using a Marine Magnetics Explorer overhauser magnetometer. The Marine Magnetics Explorer magnetometer can detect variations in the earth's magnetic field to .001 nano-tesla's (1/10<sup>th</sup> of a Gamma) and takes readings of that field once a second (1 Hertz). Hypack survey software recorded the magnetic readings along with navigation data for each survey lane. Geomar personnel configured Hypack parameters to record magnetic readings at 1 Hertz and account for the towfish layback behind the survey vessel.

Unfortunately, either due to shipping damage or damage from an improperly grounded electrical system, the magnetometer's RF tuner failed during the first day of survey. As a result only a small amount of usable magnetic data was collected during the survey. The data that was collected was analyzed and edited in Hypack's single beam survey editor.

### **Survey Data Integration:**

All survey data was integrated for visualization and the production of survey maps using ESRI's ArcGIS software. Side scan sonar mosaics in GeoTIFF format, the survey geo-database, as well as data from ESRI's ArcGIS map library were integrated into a single ArcGIS project. This GIS project allowed Geomar Research personnel to analyze the spatial relationships between acoustic anomalies and the surrounding geology.

### **Findings:**

The remote sensing survey conducted by Geomar Research, LLC surveyed an area approximately [REDACTED] nm<sup>2</sup> locating a variety of acoustic anomalies (Charts 2 & 4). No magnetic anomalies were detected, although approximately only one square nautical mile of the area was surveyed with the magnetometer. A total of 26 valid acoustic anomalies were detected during the survey (Table 1). Of those acoustic anomalies, none of them display characteristics consistent with a sunken submarine. All of the anomalies are consistent with possible man-made features of one type or another. Some of those anomalies are likely modern debris, others could simply be unusually shaped reef structure, others could possibly be other historic shipwreck sites.

In addition to the possible man-made features, the survey mapped an extensive coral reef structure that extends to the edge of the continental shelf in this area (Chart 3). The survey determined that the reef extended out to a depth of approximately [REDACTED] feet where the bottom sloped away rapidly to a depth in excess of [REDACTED] feet (Chart 5). The reef consists of a large spur and groove reef structure with some spurs greater than [REDACTED] meters in height (Figure 4).

**Table 1. Valid Acoustic Anomalies.**

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**Chart 2: Side Scan Sonar Mosaic with a Magnetic Gradient Overlay Showing the Overall Coverage Map.**

*[deleted]*

**Chart 3: Side Scan Sonar Mosaic with Reef Area Delineated.**

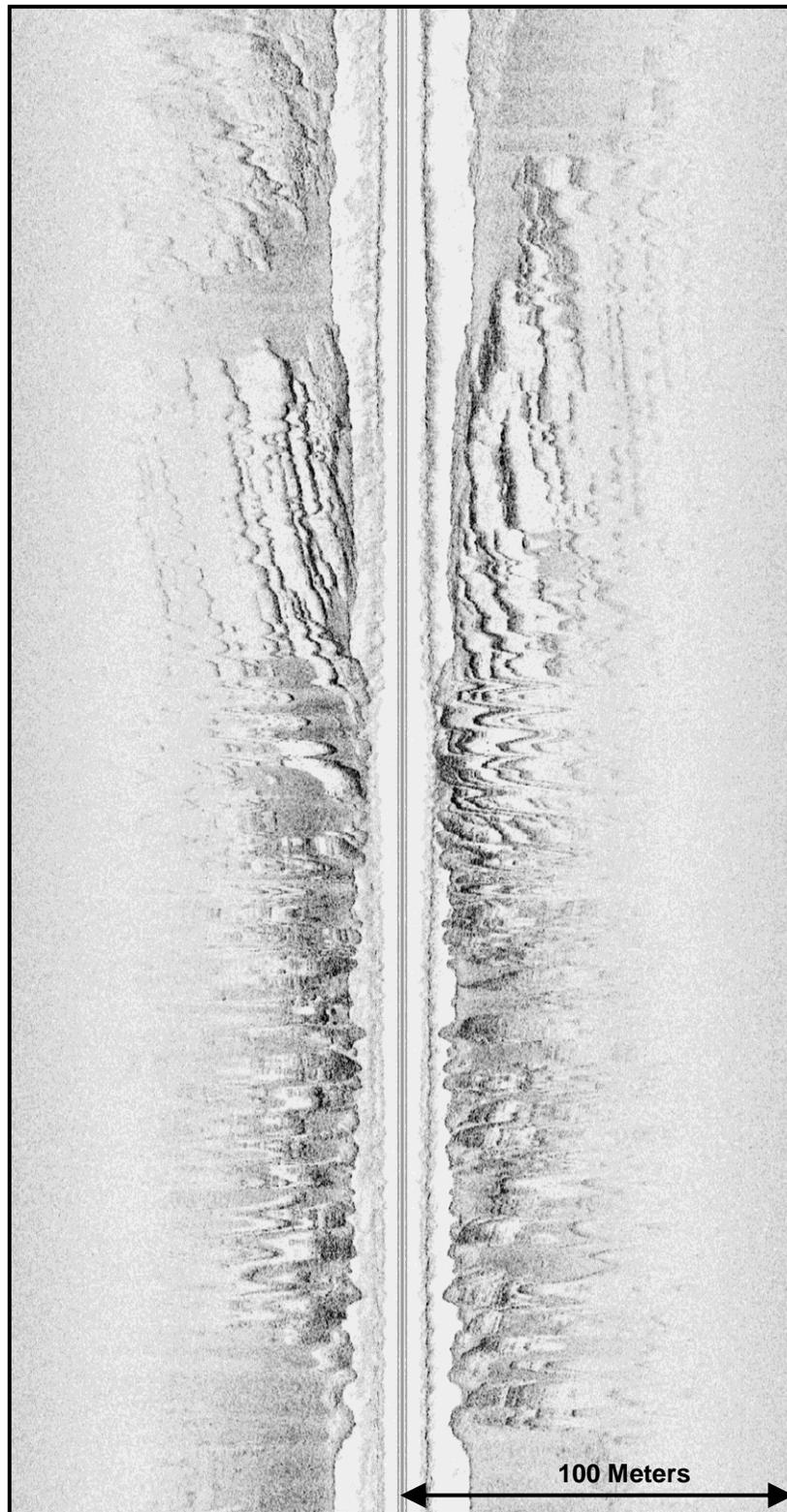
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**Chart 4: Acoustic Anomalies.**

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**Chart 5: Bathymetric Contour Map of the Survey Area.**

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**Figure 4: Acoustic Anomaly 30, Large Spur and Groove Reef Formation.  
(330 kHz @ 100m Range Scale)**

## **Conclusions and Recommendations:**

The remote sensing survey conducted by Geomar Research, LLC determined that it is unlikely that the *USS Dorado* is located on the continental shelf off Bahia de la Ascension. No acoustic targets consistent with the remains of a WWII submarine were located during the survey. The survey did identify 26 acoustic anomalies consistent with possible submerged cultural resources. In addition, the survey identified an extensive coral reef structure that extends to the edge of the continental shelf in this area. The survey determined that the reef extended out to a depth of approximately [REDACTED] feet where the bottom sloped away rapidly to a depth in excess of [REDACTED] feet.

One particular area of interest in the reef structure has been identified as anomaly 30. The center of it is located at [REDACTED]. It consists of a large spur and groove reef structure with spurs greater than [REDACTED] meters in height. It is fully possible that this was the feature on the sea floor that pilots had described as looking like a submarine's conning tower or sail. Due to the height of the formations, large shadows would be cast from these formations during the afternoon hours leading up to sunset. It is recommended that diver reconnaissance be conducted at the location of each of the acoustic anomalies to identify them.

If Dr. Campbell is interested in following up with his hypothesis that *USS Dorado* may lie somewhere in this area, Geomar's suggestion would be to perform the same acoustic and magnetic survey off Bahia del Espiritu Santo, the more southern of the two bays that exist in this area. Additionally, there is anecdotal evidence that the wreckage of a submarine lies off Banco Chinchorros at the southernmost point of Mexican waters.

## References Sited:

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1973 *Applications Manual for Portable Magnetometers*. Geometrics, Sunnyvale, California.

Campbell, Douglas E., Ph.D.

2006 Personal communication with the author.

## THIS REPORT EDITED FOR GENERAL RELEASE.

EDITING BY:

**CORAL REEF FOUNDATION, INC.**

&

**Dr. Campbell**

Disclaimer: The Coral Reef Foundation (CRF) has an agreement with Dr. Campbell that none of the technical information in the report can be disclosed at this time. That is why you see ■ in the data fields. CRF edited the report and Dr. Campbell made minor changes in formatting and has given his OK to this release.

The Coral Reef Foundation thanks Dr. Campbell for giving CRF the opportunity to work with him and the research team he put together. CRF "Having Dr. Campbell's permission" will be returning for a full invitation of the researched area starting with filming and grid mapping of the coral formation.

The initial project was done in June of 2007. As with all expeditions of this nature and size, it takes time to analyze the data that is collected, conclusions made, and reports compiled of the expedition. Extensive photos and film of the expedition will be available from CRF.

The Coral Reef Foundation is a non-profit 501(c)(3) organization and with Dr. Campbell's permission is hereby requesting tax-deductible donations to continue pursuing their mission of protecting and preserving the coral reefs of the world. Donations can be made to Robert E. Eastburn Jr., President & CEO, Coral Reef Foundation, Inc., 302 W. Fort Morgan Rd., Suite 103, Gulf Shores, AL 36542. A letter suitable for tax purposes will be mailed to you.