TIGHAR TRACKS

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About TIGHAR

TIGHAR (pronounced "tiger") is an acronym for The International Group for Historic Aircraft Recovery, a 501(c)(3) non-profit educational foundation.

TIGHAR's activities include:

- Investigating aviation and aerospace historical questions and mysteries through archival research, forensic data analysis, and archeological expeditions.
- Producing papers, publications, and videos to further the foundation's educational mission.
- Providing expert historical and archaeological research to government agencies for evaluation of cultural resources related to aviation/aerospace.
- Advocating for accuracy, integrity and professionalism in the field of aviation historical investigation and the preservation of the material culture of flight.

TIGHAR's activities are conducted primarily by member volunteers under the direction of a small full-time professional staff. The organization's research is publicly available via the TIGHAR website.

On the Cover

TRV-M Remote Operated Vehicle (ROV) goes over the side of R/V *Ka'Imikai-O-Kanaloa* (KOK) at Nikumaroro to search for signs of the Earhart Electra during TIGHAR's $2,000,000 Niku VII expedition in 2012.

On the Web

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The Search So Far

Over the past thirty years, TIGHAR has conducted extensive underwater search operations at Nikumaroro looking for Lockheed 10E Special NR16020. This is a summary overview of those operations.

Early Searches

In 1989, divers did a cursory search of the reef around the entire periphery of the island down to about 45m (150 feet). Nothing of significance was found.

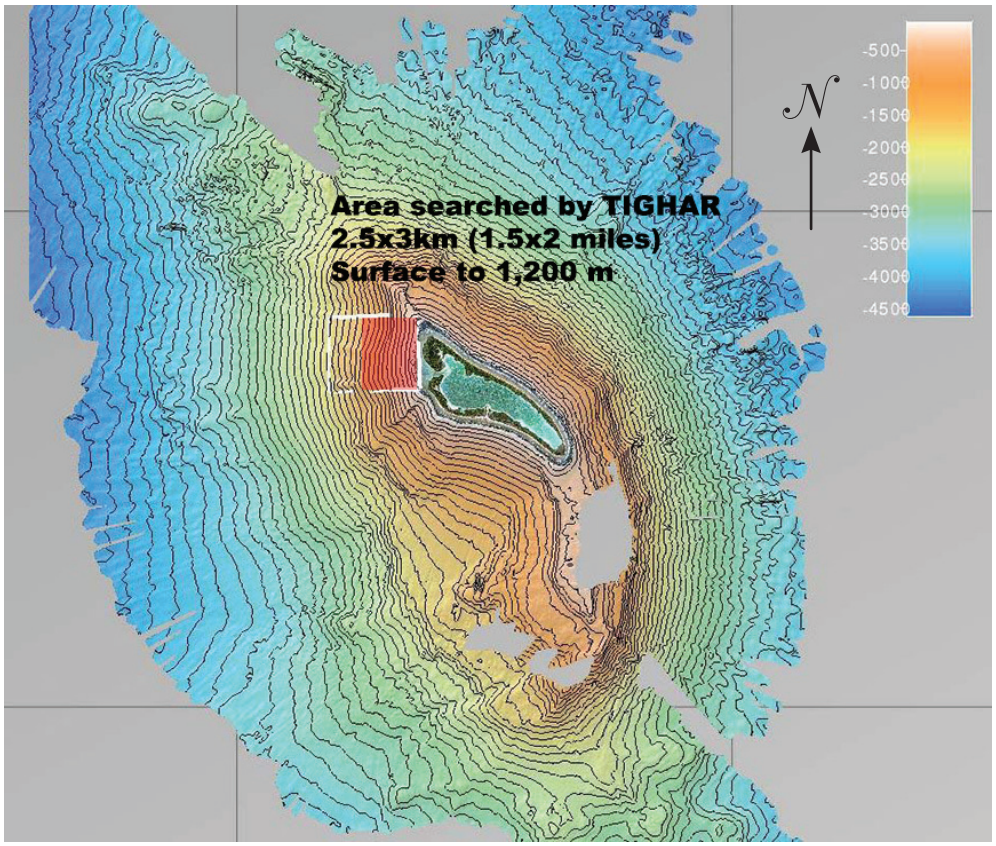
In 1991, Oceaneering International did a single pass, towed-array side-scan sonar sweep around the entire island except the west end, where the sonar "fish" struck an underwater obstacle and was lost. Nothing of significance was found.

The 1997 expedition did an electro-magnetic and magnetometer search of some parts of the lagoon, supplemented by divers with underwater metal detectors. Nothing of significance was found.

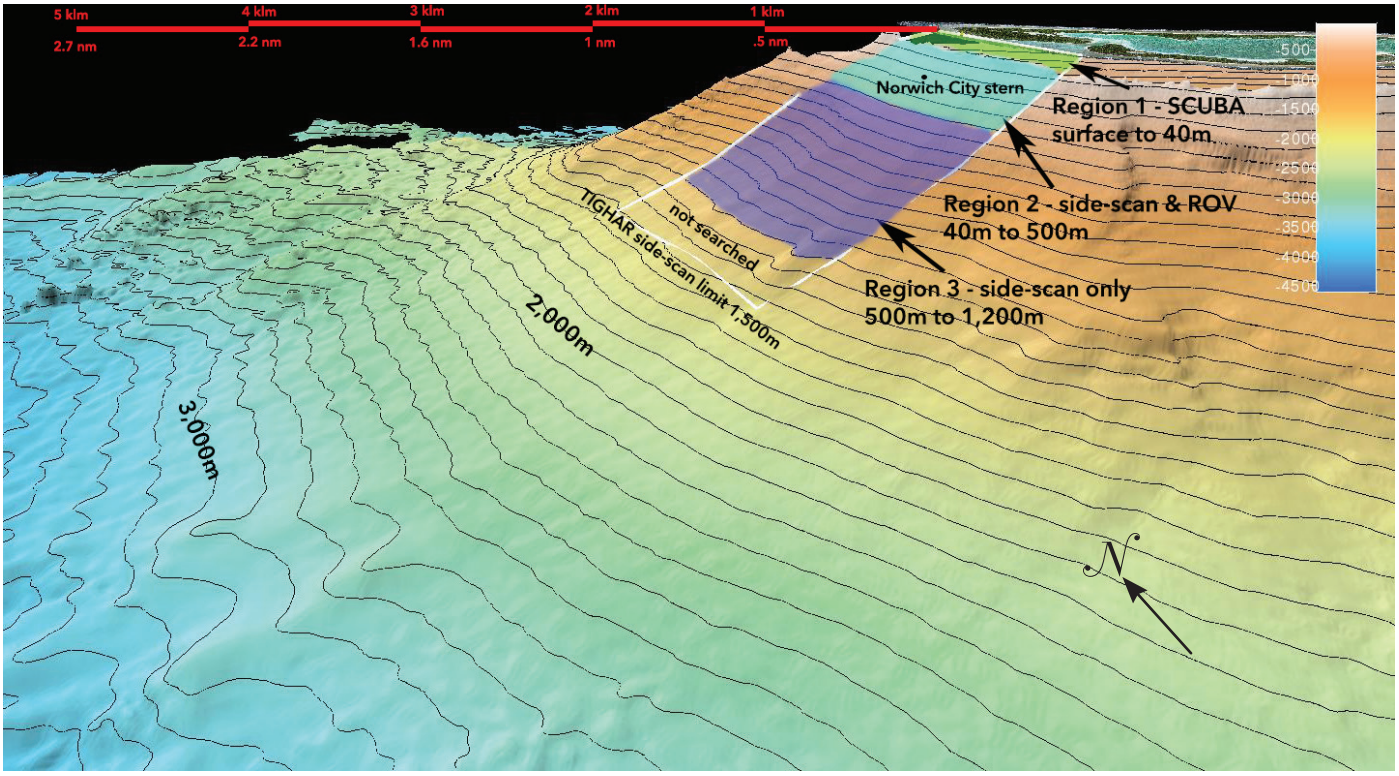
By 2001 we had identified the western reef slope as the most likely place the plane went over the edge. Divers searched the area down to about 45m (150 feet). Nothing of significance was found.

Since 2010, our underwater search area has been a box measuring roughly 2.5 by 3 kilometers (1.5 by 2 miles) on the surface and down to a depth of 1,200 meters (about 4,000 feet) based on the premise that the Bevington Object (aka Nessie) represents the Point Last Seen – the place where the aircraft went over the reef edge and into the ocean.

Maps based on multi-beam sonar imagery provided by HURL. Contour interval 100m.



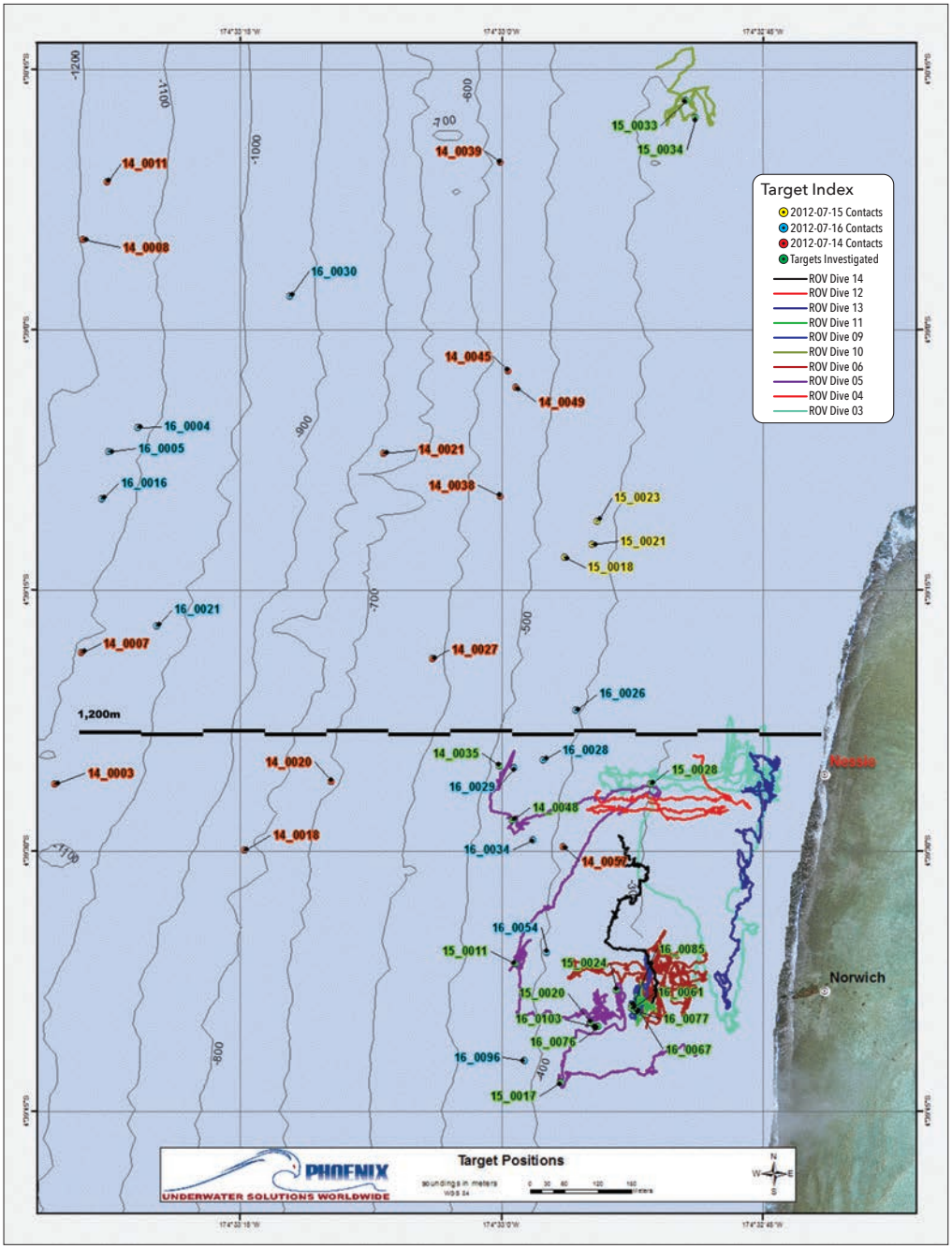
For this summary, the search box is divided into three regions.



- Region 1 is the portion of the area searchable by SCUBA – roughly from the surface down to about 45 meters (150 feet). It is, by far, the most thoroughly searched region. Dive teams on several TIGHAR expeditions have examined the region, including a systematic grid search during the 2015 trip. Divers conducting biological surveys on several New England Aquarium expeditions have also watched for any sign of aircraft debris. Nothing of significance has been found. There might be small, hard to spot, pieces of aircraft debris

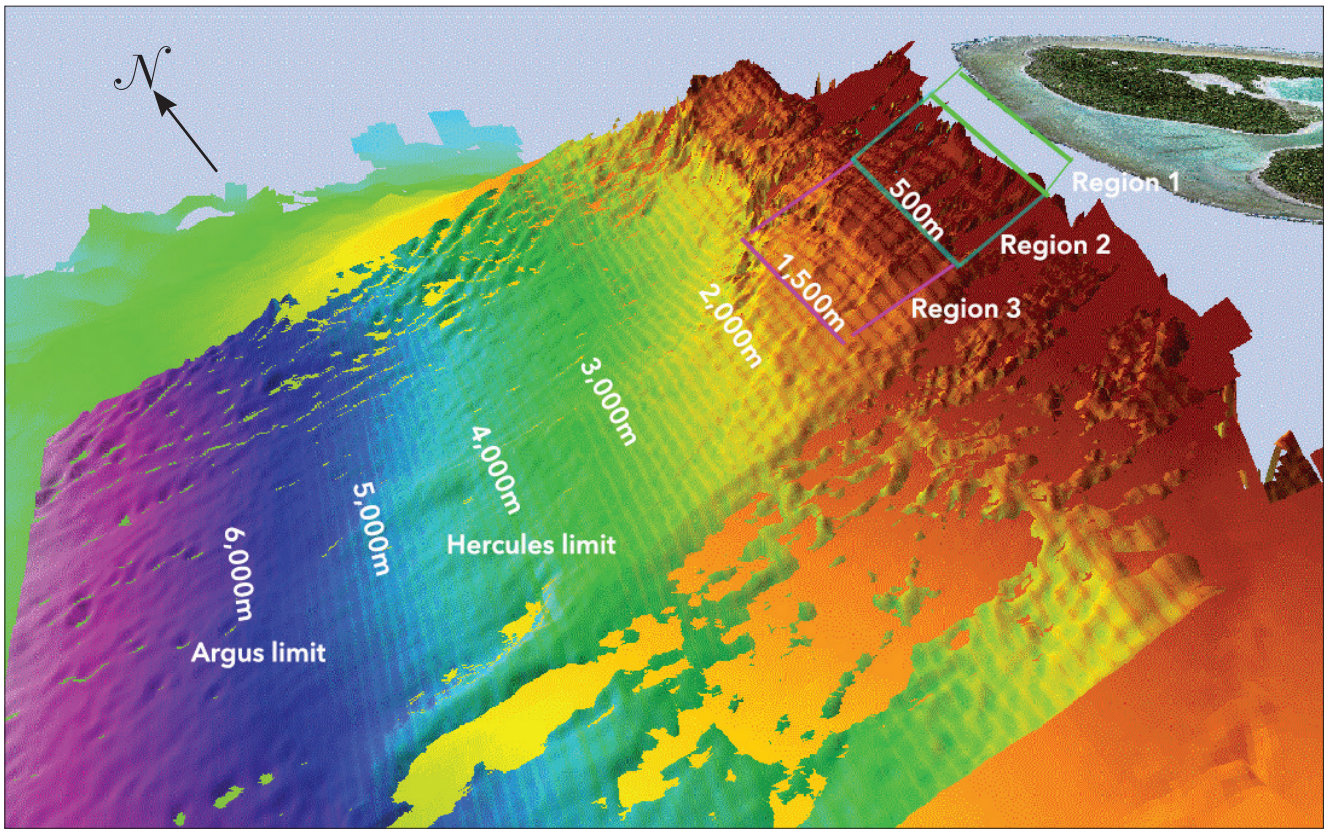
in Region 1, such as the elusive and still unidentified Embedded Object, but we can reliably say there are no large components of the airplane there.

- Region 2 extends from the bottom of Region 1, which varies in depth from place to place, down to about 500 meters (1,640 feet). Parts of Region 2 were searched visually with a small ROV in 2010. Nothing of significance was found. In 2012, Regions 2 and 3 were searched with side-scan sonar mounted on an AUV (Autonomous Underwater Vehicle) down to 1,200m (3,900 feet). Several, but not all, side-scan targets identified in Region 2 were investigated with a large ROV. All turned out to be natural features or *Norwich City* wreckage.



This map by search contractor Phoenix International shows sonar targets and ROV tracks for TIGHAR's 2012 Niku VII expedition.

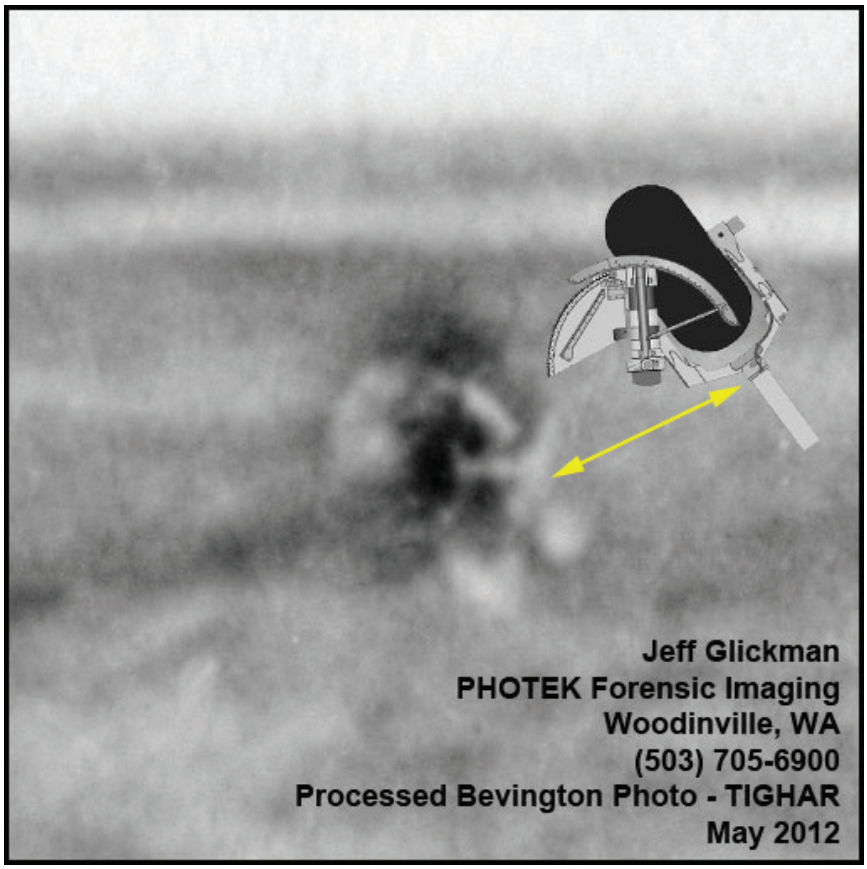
- Seventeen targets were identified in Region 3 but none were investigated because they were all too deep for the ROV. None of the targets looked particularly promising but, in theory, any of them could be airplane wreckage.
- The reef slope in Regions 2 and 3 is extremely steep and rugged, strewn with coral boulders, caves, and outcroppings. Underwater landslides are common. Side-scan sonar is difficult to use and unreliable in these regions. ROV operations are hazardous.
- Everything deeper than Region 3 is unexplored territory. If the airplane is in the unexplored depths, it somehow ended up at least a mile offshore. The rugged nature of the reef slope in Regions 2 and 3 would tend to prevent wreckage from traveling very far. The stern of *Norwich City*, infinitely heavier than anything on the Electra, is only about 275 meters (300 yards) out from the reef edge at a depth of about 250 meters (820 feet).

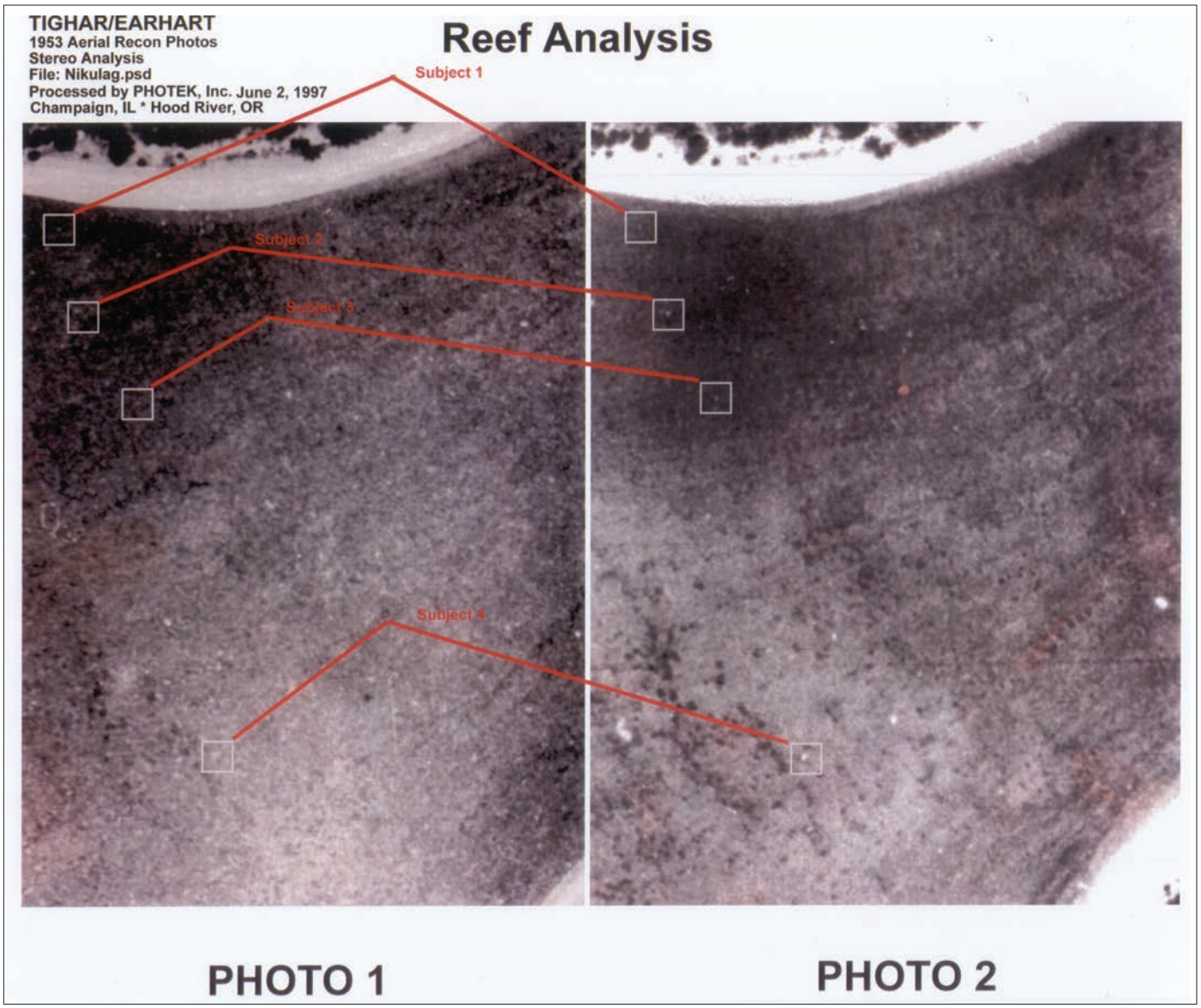


The most likely way for the airplane to end up a nautical mile or more from the island is to have floated there before sinking. The structure would have to be sufficiently intact to remain afloat for at least a half hour if it was drifting westward at a generous 2 knots. An Electra that ditched off Cape Cod in 1967 floated for 7 minutes, but it did not have the 10E Specials' big fuel tanks. TIGHAR has estimated NR16020, if largely intact, would float for about 18 minutes before the tanks flooded.

It has been suggested that the airplane could have sunk closer to shore and "glided" into deeper water as it sank. If that is possible, the entire structure including wings and tail would have to be intact. To end up a mile from shore it would have to glide west in more or less a straight line. In either case, it would not leave a debris field.

There is photographic and anecdotal evidence that the plane broke up, at least to some degree, in the surf at the reef edge. The Bevington Object and what appears to be light-color metal debris on the reef flat in 1953 aerial mapping photos suggest a violent end, as do the recollections of former Nikumaroro residents who speak of seeing aircraft debris on the reef flat.





In Conclusion:

- If there are small bits and pieces of airplane debris in Region 1 they are extremely difficult to find.
- There could be large pieces of aircraft debris in Regions 2 and 3 that were simply missed by our 2010 and 2012 searches or were buried by underwater landslides.
- A large section of the aircraft could be in the unexplored area.
- It is also possible that, after 81 years, there is nothing findable left.

Underwater Aviation Artifact Documentation and Recovery

"…that they might escape the teeth of time and the hands of mistaken zeal."

John Aubrey
Stonehenge Manuscripts – 1660

Historic aircraft submerged in salt water present unique challenges to archaeological documentation, recovery, and long-term preservation. Since the organization's founding, TIGHAR has striven to meet those challenges.

Japanese engine and propeller imbedded in the reef at Betio, Tarawa.

TIGHAR helped fund the world's first successful electrolytic treatment of an historic aircraft engine recovered from underwater. The stabilization of a Pratt and Whitney "Twin Wasp" radial aero engine was completed at the conservation laboratories of the Australian War Memorial, Canberra, Australia in December 1991.[1]

Pratt & Whitney R-1830 "Twin Wasp" before conservation. Austraian War Memorial photo.

TIGHAR volunteers recover part of a Republic P-47N "Thunderbolt" wing for corrosion testing. TIGHAR photo.

In 1992, in cooperation with the Dover Air Force Base Museum, Dover, Delaware, TIGHAR recovered the right inboard wing of a Republic P-47N "Thunderbolt" submerged in the Bombay Hook National Wildlife Refuge tidal salt marsh. The purpose of the recovery was to test and document methods of arresting corrosion in aircraft aluminum retrieved from salt water.[2]

From 2004 to 2014, TIGHAR worked with the Underwater Archaeology Branch of the U.S. Naval History and Heritage Command, and a conservator from Texas A&M University's Center for Maritime Archaeology and Conservation to survey and evaluate two Douglas TBD "Devastators" in Jaluit Lagoon.[3]

Douglas TBD-1 "Devastator," Jaluit lagoon, Marshall Islands. TIGHAR photo.

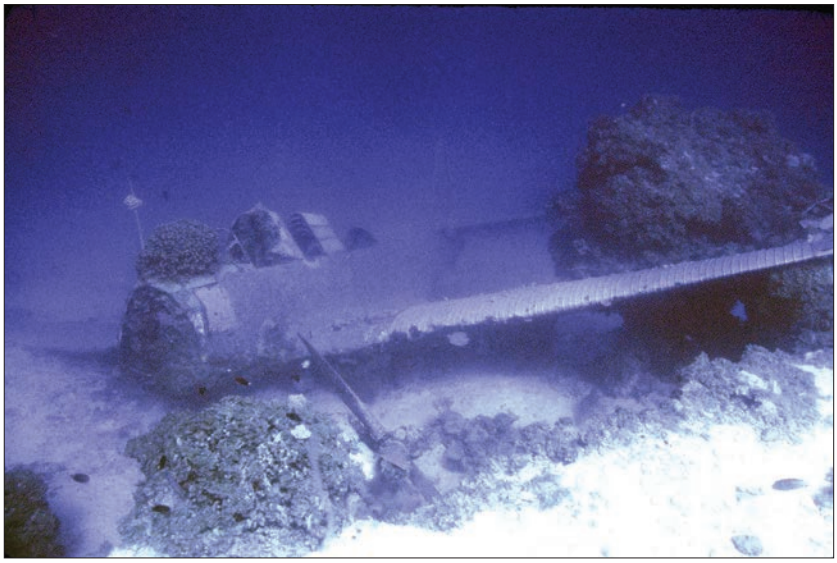
In 2007, TIGHAR conducted an archaeological survey of a Lockheed P-38F "Lightning" off Harlech Beach, North Wales, UK.[4]

The P-38 survived largely intact because it had been buried in sand until uncovered briefly by beach erosion. The sands soon returned and the aircraft is once more hidden and protected from the corrosive effects of exposure.

TIGHAR survey of Lockheed P-38F off Harlech Beach, North Wales, UK. TIGHAR photo.

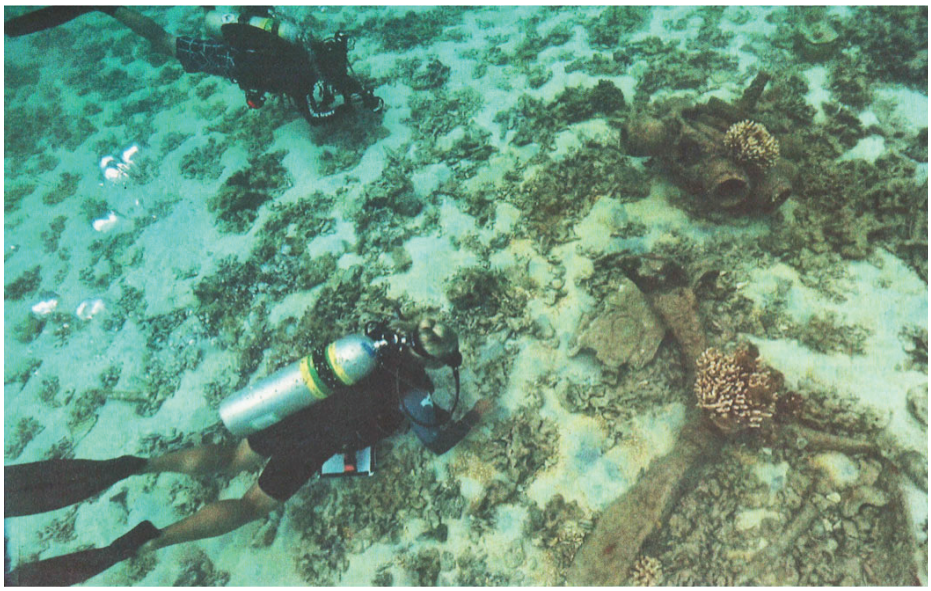
By contrast, this unidentified WWII wreck on the reef flat at Tarawa in 2001 demonstrates the fate of aluminum aircraft regularly exposed by the tide. (TIGHAR photo.)

Aircraft submerged in protected water can survive in excellent condition, as illustrated by this Douglas TBD Devastator at 50 feet in Jaluit lagoon, Marshall Islands after a controlled ditching in 1942. (TIGHAR photo.)



Submerged aircraft subject to the pounding of an ocean reef, even if resting on a flat bottom, fare much worse. These are the remains of a Brewster F2A Buffalo fighter lost off Midway in 1942 and photographed in 2012.

NOAA Marine Heritage photo.



Recovering the Electra

If conclusively identifiable pieces of the Earhart aircraft still exist and can be found, recovered, and preserved, they would arguably be the most historically significant underwater aviation artifacts ever discovered.

The locating of a submerged historic aircraft or its component parts is always difficult. The more momentous the discovery, the greater the temptation to immediately retrieve at least a piece of the prize, especially when the TV cameras are rolling; but haste makes waste, and discovery is only the first step. An archaeological survey of the site by an underwater archaeologist with aviation materials experience is essential to document the position and condition of the artifact(s) so as to permit the best possible reconstruction of historical events and provide the data necessary to determine whether and how recovery can be carried out.

If recovery is judged to be warranted, long-term preservation must be the ultimate goal. "Aircraft recovered from salt water have little chance of long-term survival if not treated correctly. The materials of construction have become "polluted" with salts and metal residues which promote extremely rapid corrosion on exposure to the atmosphere unless they are kept in environments of low relative humidity and oxygen level. In most cases this is quite impractical. Hence, almost all "rescued" items are now corroding faster than if they had been left in the water.

Preservation of these objects requires treatments that remove the "aggressive" or "initiating" species from within the object, leaving it in a "passive" state. Surface coating or inhibitor treatments will not stop the long-term corrosion of the metals as all the necessary chemical species that are involved in the corrosion reaction are still present under the coating. Inhibitors may to some extent, delay the corrosion but eventually it will again take hold."[5]

Failure to stabilize aluminum aircraft and engines recovered from salt water inevitably results in the loss of most, or all, of the artifact. The usual remedy is to replace the infected aluminum with new metal and install a new engine, thus turning the historic aircraft into a replica of itself.

To date, only one historic aircraft has been recovered from salt water and stabilized for long-term preservation. In 2013, the Royal Air Force Museum recovered a World War Two German DO-17 bomber from 50 feet of water in the Thames Estuary in England. The aircraft had been in the water for 70 years. Prior to recovery, archaeological surveys of the wreck were carried out in 2008, 2009, and

2010. Funding and facilities for preservation were in place before the recovery took place in May 2013. After recovery, the preservation/stabilization was estimated to take five years. The aircraft is not yet on exhibit.[6]

Dornier DO-17

The Dornier immediately after recovery.

The Dornier undergoing preservation treatment.

Post-recovery conservation and stabilization of aviation artifacts is complex, time consuming, and expensive. No recovery should be attempted without assured funding for conservation, an agreement with a qualified lab to perform the work, and a plan for long-term curation. It is, of course, impossible to plan for recovery and preservation without knowing what is to be recovered and preserved, so recoveries during a search should be limited to small, expendable artifacts to confirm or deny the presence of a debris field or for materials testing to inform recovery and conservation planning.

References

1 https://tighar.org/Projects/Histpres/Corrosion_Report/perspective.html

2 https://tighar.org/Publications/TTracks/1992Vol_8/0803.pdf

3 https://tighar.org/wiki/To_Save_a_Devastator

4 https://tighar.org/Projects/P38/welshlightning.htm

5 *The Treatment of the BMW-801D-2 Radial Aero Engine Rescued from the Loiret River*, Christopher D. Adams, Conservation Scientist Australia War Memorial, 1992 (https://tighar.org/Projects/Histpres/Corrosion_Report/corrosion.html)

6 http://www.aeroresource.co.uk/news/rafm-cosford-dornier-do17-preservation/

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2001 TIGHAR expedition. Day 18. TIGHAR archaeologist Gary Quigg at the Seven Site. Temperature 112°F.

Field Notes: September 15. Excavated Unit M-1 by trowel and screened the material. Found charcoal, multiple bird and fish bones – many burned.

The Credit You Deserve

This month, Bob Ballard will try to find whatever is left of the Earhart Electra in the unexplored deep waters off Nikumaroro. Meanwhile, a land team led by National Geographic archaeologist Fred Hiebert will, once again, try to find bones at the Seven Site with the help of forensic dogs. We are not involved in the planning or execution of the expedition and this will be the first time a non-TIGHAR expedition has conducted Earhart-related research at Nikumaroro – but they'll be searching there because of you.

Such a high-profile endorsement of TIGHAR's thirty years of research is gratifying, but it's up to us to make sure you – the members of TIGHAR who have made it all possible – get the credit you deserve. A dramatic discovery will trigger a flood of curiosity about how TIGHAR identified the right place to look. We need to be ready to tell TIGHAR's story. If nothing of consequence is found it will be even more important to be ready to present our abundant evidence and continue our research.

Whatever happens will be featured in a two-hour television special titled "Expedition Amelia" scheduled to air on October 20, 2019. Under an agreement with National Geographic Partners, TIGHAR is providing information for the show, but we have no editorial control over how it is presented..

We're currently producing our own short video, suitable for spreading via social media, illustrating how TIGHAR used the principles of scientific investigation to discover the true fate of Amelia Earhart and Fred Noonan.

We need your help to meet the $8,000 cost. At this critical time for TIGHAR and The Earhart Project, your continued support is more important than ever. Please use the form below to make a donation, or donate on line at TIGHAR.org.

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