UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Response and Restoration
Silver Spring, Maryland 20910

# CRUISE REPORT[1]

**VESSEL:** *Hi'ialakai*, Cruise HI-06-14

**CRUISE PERIOD:** November 08-13, 2006

**AREA OF OPERATION:** Kalohi, Pailolo, and Auau Channels between the Islands of Maui County and the west coast of Hawaii Island

**TYPE OF OPERATION:** Personnel from NOAA's Pacific Islands Fisheries Science Center (PIFSC), Coral Reef Ecosystem Division (CRED), along with representatives from the NOAA Office of Ocean Exploration (OE), the NOAA/NOS Biogeography Program (BIOGEO), the University of Hawaii (UH) Hawaii Mapping Research Group (HMRG), the UH Hawaii Undersea Research Laboratory (HURL), the State of Hawaii Division of Aquatic Resources (DAR), personnel from Scientific Applications International Corporation (SAIC), and tech reps from IXSEA Corporation (IXSEA) and Oceanic Imaging Consultants (OIC) conducted a test of Laser Line Scanning (LLS) technology in coral reef ecosystems. Multibeam surveying was conducted in conjunction with LLS surveying. On November 10, the LLS towfish hit the seafloor and was lost. After searching for the towfish and surveying the site, the *Hi'ialakai* proceeded to the Island of Hawaii and conducted multibeam surveying of essential fish habitat, and of epicenters from the magnitude 6.7 earthquake that struck the island on October 15, 2006.

**ITINERARY:**

08 November — Start of cruise. Embarked John Rooney (CRED), Scott Ferguson (CRED), Emily Lundblad (CRED), Francis Lichowski (CRED), Joe Chojnacki (CRED), Roger Davis (HMRG), David Sallis (OE), Stacy Ladnier (OE), Chris Kelley (HURL), Anthony Montgomery (DAR), Charles Menza (BIOGEO), Seth Mogk (SAIC), Blake Martin (SAIC), Robert Wilson (SAIC), Paul Trakimas (SAIC), John Stange (SAIC), Barry Brake (IXSEA), and Jediah Bishop (OIC). Departed Honolulu at 0836, en

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route for Kalohi Channel north of the Island of Lanai. A science party meeting and shipboard orientation was held. Conducted abandon ship and fire drills. A meeting was held to discuss the deployment of the over-the-side hydrophone pole. Hove to at 1620 and deployed the hydrophone pole. Conducted a conductivity-temperature-depth (CTD) cast to provide a sound velocity profile and then commenced multibeam surveying. Deployed the FOCUS tow vehicle on which the Laser Line Scan (LLS) instrument was mounted at 1734 and commenced testing and troubleshooting the LLS system, and surveying.

09 November

Began surveying along the edge of a ledge at the northern edge of the Auau Channel, heading eastward. Troubleshooting of problems with communications between different instruments associated with the LLS system and computer system crashes continued. At 1043 the FOCUS tow vehicle and LLS instrument were recovered to check for bad connections that might have been responsible for the many problems encountered. Another CTD cast was conducted to update the sound speed profile. Several minor problems with the LLS system were resolved while the towfish was on deck, but the primary source of the problem was eventually determined to be a bad connection between optical fibers in a junction box on the deck winch. Once this problem was resolved the ship needed to travel some distance to the deployment site and SAIC spent the time debugging problems with the towfish altimeter, an important source of navigation data. That problem was apparently related to a poor connection as well. At 1910 the towfish was returned to the water and data collection resumed. The data quality was much improved and the night was spent collecting data at a location known for high catches of groundfish off the north coast of Maui.

10 November

LLS surveying continued as before, with good quality data being collected. Surveying was broken off for several hours in the early morning to avoid tug and tow traffic that was transiting around the northern end of Maui. The ship was forced to steam several miles to the west in the process of avoiding the traffic. After the tugs passed, surveying resumed while the ship headed eastward onto the insular shelf before turning to the southwest to survey along the shelf. At about 0830 on November 10 the tow cable jerked and the laser data stream was interrupted and recovery of the towfish commenced. At 0841 the bridge was notified that the towfish had apparently struck the seabed. At 0842 SAIC retrieved the towfish and determined that much of it had been lost when the towfish frame was torn from the towfish control bottle. At 0843 ship personnel and scientists began looking for the towfish frame. The

ship's small boat (HI-1) was deployed at 0905 to assist in the search. At 0915 two pieces of towfish floatation were recovered by the small boat crew. No further equipment or debris was located and the towfish navigation beacon reported that the towfish frame was likely to be on the sea bed. At 1030 the search for debris was terminated, the small boat was recovered, and the ship and scientific party began to characterize the site to assist in the recovery of the equipment. A CTD was taken to develop an updated sound velocity for the USBL navigation system and a pattern of lines run over the beacon to provide an accurate estimate of the towfish beacon's geographic position and depth. Later in the evening a detailed multibeam survey was run to characterize the seabed in the vicinity of the crash site and of the beacon location. During the day, SAIC had been conferring with their home office and the decision was made to get most of their operations staff off the ship since they could no longer conduct a survey.

At 1632 five SAIC staff members, Blake, Trakimas, Stange, Brake, and Bishop, as well as one other scientist, Kelley, were transferred ashore by small boat in Lahaina, Maui. From there they made their way home. Seth Mogk and Bob Wilson from SAIC remained onboard to demobilize equipment. At 1930, after completing the multibeam survey of the crash site, the *Hi'ialakai* left the crash site to conduct multibeam surveys off the west coast of the Big Island of Hawaii.

11 November

The *Hi'ialakai* arrived of the northwestern side of the Island of Hawaii at approximately 0300. A CTD cast was conducted and multibeam surveying to fill gaps in existing coverage commenced at 0410. After sunrise surveying continued to the south along the west coast of Hawaii, navigating as close as possible to the shoreline to take maximum advantage of daylight and the very favorable weather conditions. By 1730 surveying had been completed down to approximately 9 miles north of South Point. The ship's CHT tank was full at that time so the *Hi'ialakai* headed offshore to pump out the holding tank. Following that the ship headed back to the north, filling offshore gaps in existing multibeam coverage. A CTD cast was made, to a depth of 300 m. A survey of the area surrounding an epicenter from the 10/15/06 earthquake, located 6 miles northwest of Kawaihae, was started.

12 November

Continued surveying in the vicinity of the offshore epicenter until daylight, at which time the *Hi'ialakai* headed east and began filling gaps in multibeam coverage in the vicinity of Kawaihae Harbor.

Gap filling continued to the south, and the epicenter of the largest tremor (magnitude 6.7) from the recent earthquake was resurveyed as well. After dark, the ship proceeded offshore to finish surveying around the epicenter of the smaller tremor.

13 November — Surveying was completed around the offshore epicenter, and the transit back to Oahu commenced at 0100. Swath editing of multibeam data collected during the cruise was completed. HMRG software engineer Roger Davis conducted training in processing of LLS data using some of the programs he wrote prior to and during the cruise. Arrived at Honolulu at 1840 and disembarked Rooney, Ferguson, Lundblad, Lichowski, Chojnacki, Davis, Ladnier, Menza, Mogk, and Wilson. End of cruise.

**MISSIONS AND RESULTS:**

A. Test the capability of laser line scan technology to collect high-quality, accurately geo-registered visual data in large quantities across a spectrum of coral reef ecosystem habitats

1. Data were collected over flat and sloping sandy substrate and across reasonably flat rocky substrate. A variety of fish, corals and alga were imaged, along with the substrate they were associated with. Preliminary results from the periods when the system was operating properly have yielded images that clearly depict the seafloor and organisms living on or near it and are quite promising (Appendix A). Post-processing, scheduled for early January 2007, will enable a more thorough analysis of the quality of imagery that can be obtained using LLS technology.

2. A number of lessons were learned from this test (Appendix B) that may be of use for future deployments of existing LLS systems and for the design of new ones.

3. The week following the end of this cruise the Hawaii Undersea Research Laboratory (HURL) had a series of submersible dives scheduled in the Auau Channel. SAIC contracted with HURL for a day of ship time and submersible diving to try to recover the lost towfish. An attempt was made to locate the towfish using a remote operated vehicle (ROV), and the LLS towfish was located within a few minutes. During the subsequent submersible dive, a line and float was attached to the towfish. Within a few hours, the towfish and all of its associated equipment were successfully recovered and on deck. The towfish itself received significant damage, but the pressure vessels holding the LLS and other instruments were all dry inside and appear intact. As of this writing the instruments have not been energized and tested.

B. Collect laser line scan data to help address management and research questions regarding groundfish habitat, deep scleractinian corals, black corals, deep algal beds, and other coral reef ecosystem features, and the demersal populations associated with them.

The laser system was towed over approximately 190 linear kilometers of seafloor. For part of that time the towfish was deliberately towed high above the seafloor, while the ship was maneuvering or troubleshooting was taking place. Over another significant fraction of that distance there were problems with the altimeter, with communications between instruments, and with triggering of the laser itself. Until post-processing is completed the surface area or linear distance of seafloor that was successfully imaged will not be known. Several survey lines were completed over a highly productive groundfish fishing area that may contribute to the management of that site. For example, if juvenile groundfish are found in the processed imagery, they will provide evidence in support of the hypothesis that the area functions in part as a groundfish nursery area. Imagery of deep corals and alga may help address management and research questions associated with these organisms as well. However, the untimely loss of the LLS on the third day of the cruise, preceded by problems with it that were mentioned above, have resulted in less imagery collected than was originally expected and none over the historic aircraft wreck or deep scleractinian and black coral beds.

C. Collect multibeam data to support the evaluation of laser line scan data and to contribute to the ongoing NOAA-University of Hawaii synthesis of multibeam data coverage for the main Hawaiian Islands.

Because more time became available for multibeam surveying, much more of these data were collected than was anticipated. In the Auau Channel, 30 $km^2$ of multibeam data were collected. On the Island of Hawaii, 36 $km^2$ of multibeam data were collected in the vicinity of an offshore epicenter, and an additional 90 $km^2$ were collected in nearshore regions, most of which include essential fish habitat (EFH) for bottomfish.

**SCIENTIFIC PERSONNEL:**

John Rooney, Chief Scientist, University of Hawaii (UH), Joint Institute of Marine and Atmospheric Research (JIMAR) and Pacific Islands Fisheries Science Center (PIFSC), National Marine Fisheries Service (NMFS)
Scott Ferguson, Logistics Coordinator, PIFSC-NMFS
Emily Lundblad, Mapping Team, UH-JIMAR, PIFSC-NMFS
Joseph Chojnacki, Mapping Team, UH-JIMAR, PIFSC-NMFS
Frances Lichowski, Mapping Team, UH-JIMAR, PIFSC-NMFS
Roger Davis, Software Engineer, UH, Hawaii Mapping Research Group (HMRG)

David Sallis, Education and Outreach, Office of Ocean Exploration (OE), National Ocean Service (NOS)
Stacy Ladnier, Education and Outreach, OE-NOS
Charles Menza, Mapping Team, Biogeography Program (BIOGEO), NOS
Anthony Montgomery, Marine Biologist, Hawaii Division of Aquatic Resources
Chris Kelley, Marine Biologist, UH, Hawaii Undersea Research Laboratory
Seth Mogk, Laser Line Scan Supervisor, Scientific Applications International Corporation (SAIC)
Blake Martin, Laser Line Scan (LLS) Operator, SAIC
Robert Wilson, LLS Operator, SAIC
Paul Trakimas, LLS Operator, SAIC
John Stange, LLS Operator, SAIC
Barry Brake, Underwater Navigation, IXSEA Corporation
Jediah Bishop, LLS Operator, Oceanic Imaging Consultants (OIC)

(/s/John Rooney)

Submitted by: _____
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Attachments

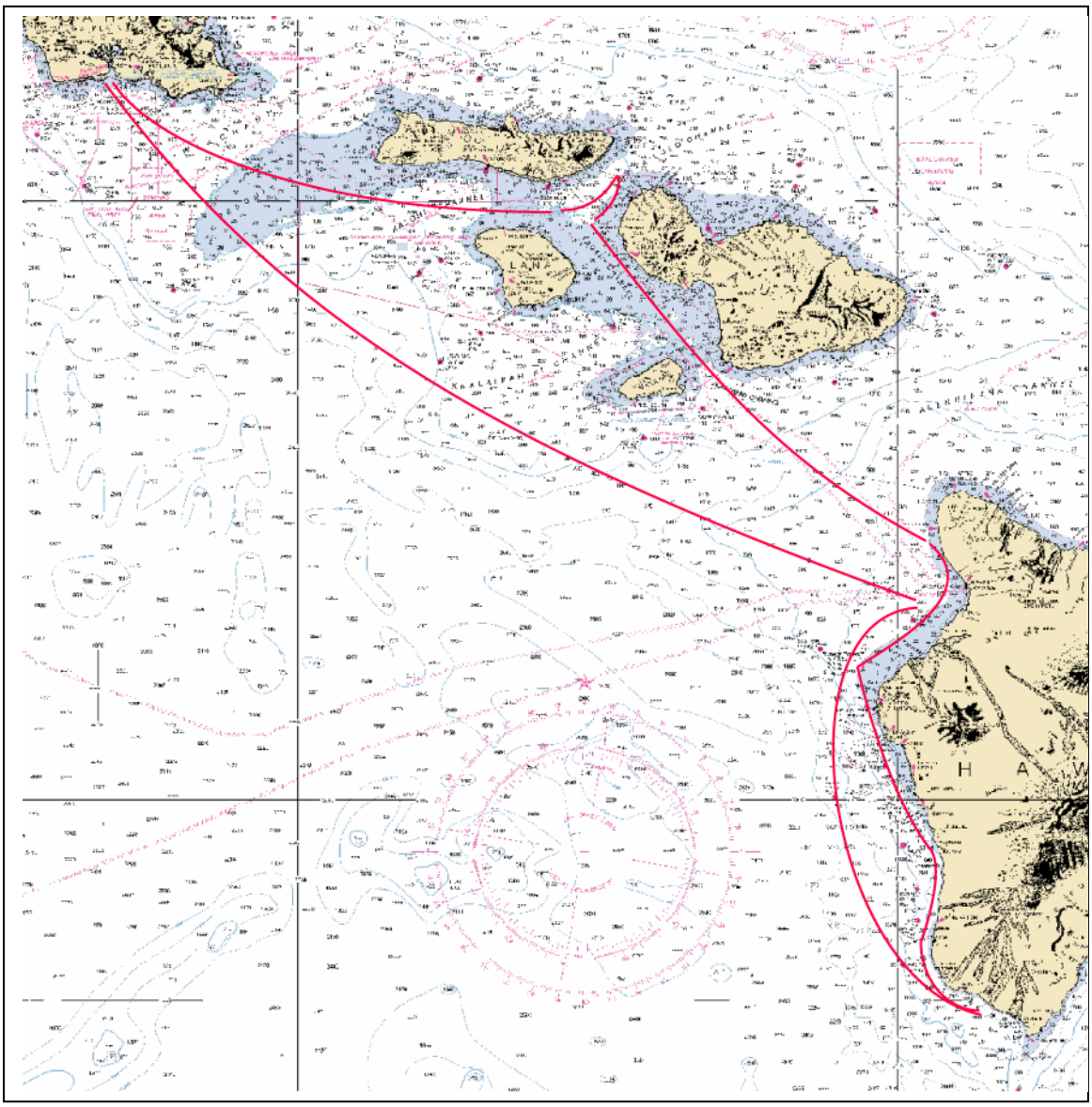
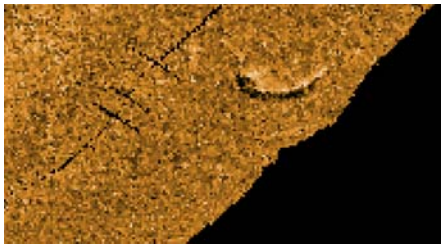
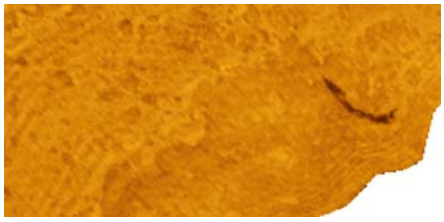


Figure 1.--Track of the NOAA ship *Hi'ialakai* Cruise HI-06-14, November 08-13, 2006.

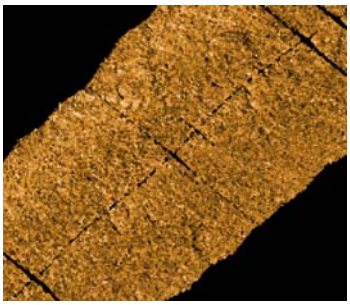
**Appendix A: A Sampling Laser Line Scan Images**



1a) Laser image prior to processing (5 cm pixel size). The semicircular object may be the shadow of a fish.

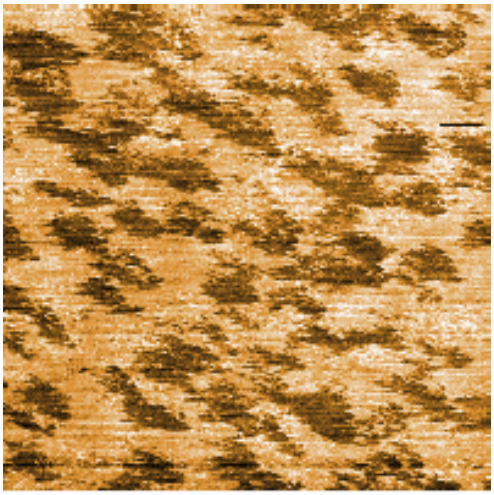


1b) The same laser image, after processing with OIC's Clean Sweep software.

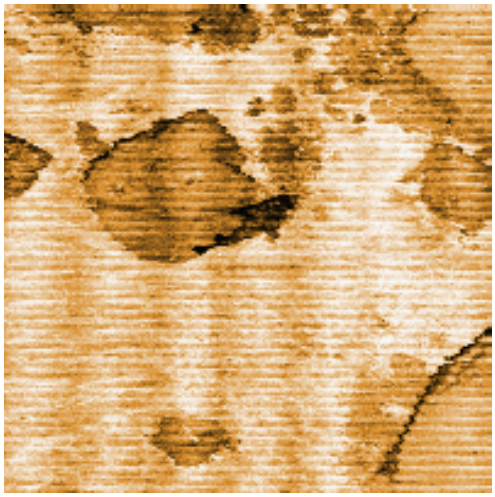


2a) Another laser image prior to processing (5 cm pixel size).

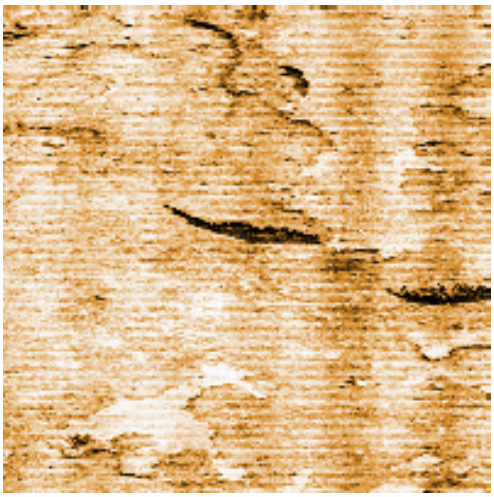
2b) The same laser image, after processing with OIC's Clean Sweep software.



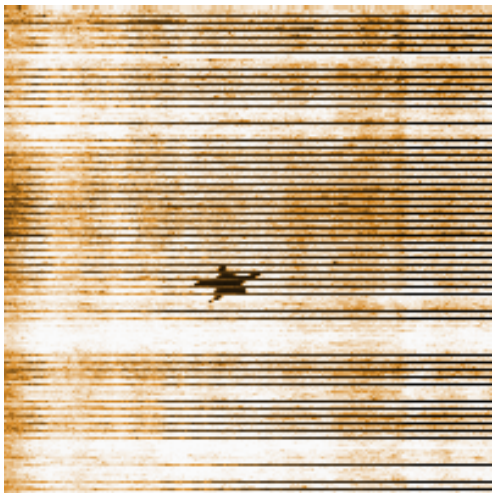
3) Unprocessed image of *Halimeda* sp. algae meadow.



4) Unprocessed image of a large fish near a boulder on the seafloor.



5) Unprocessed image of a fish and its shadow over a rocky seafloor.



6) Unprocessed image of a starfish. The horizontal lines in the image are noise in the data that were problematic during much of the LLS deployment.