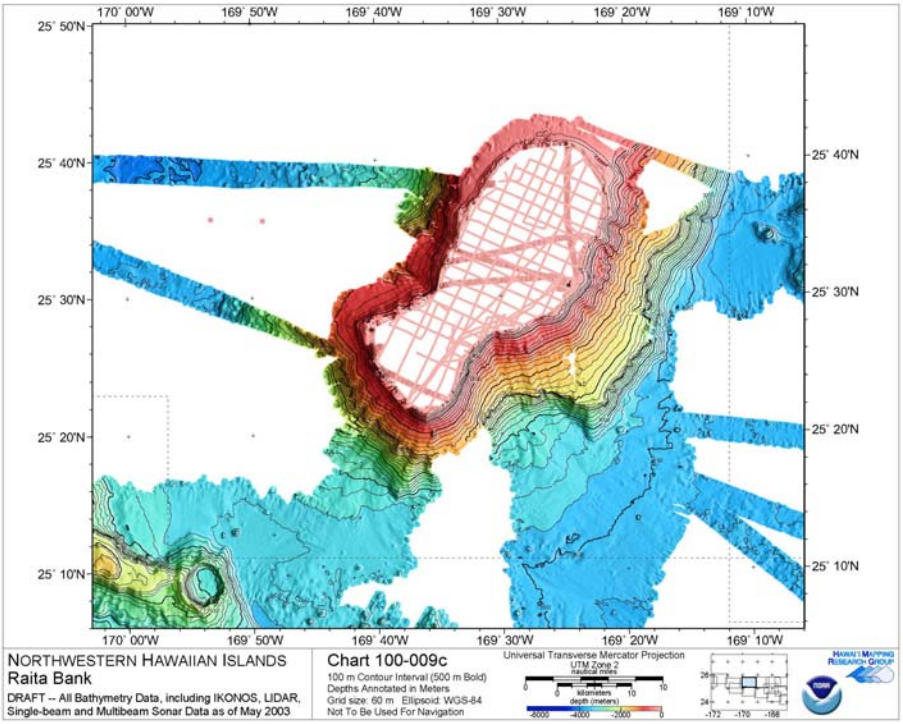
Data Synthesis and Cruise Planning

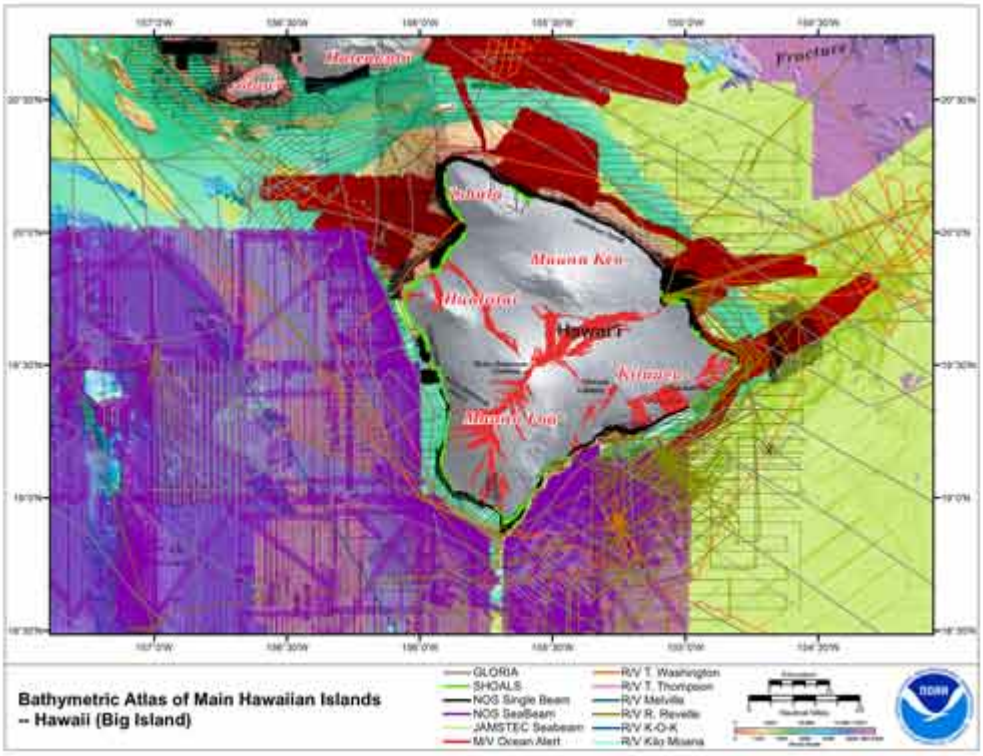
Data Synthesis

In order to plan for upcoming operations, it is important to understand the location and quality of existing data. One of the more challenging aspects of survey preparation is continually updating existing bathymetric grids to reflect recently collected data. This is particularly difficult in the Hawaiian archipelago where several mapping cruises may occur each year. Work on data syntheses is ongoing.

The first step toward a NWHI data synthesis was taken in 2002, when NOAA funded a 25-day mapping cruise aboard UH's R/V *Kilo Moana*, which was newly outfitted with two multibeam sonars (Kongsberg/Simrad 100-kHz EM1002 and 12-kHz EM120). The ship was tasked with collecting data at the 25-, 50- and 100-fm isobaths on many of the banks and islands in the NWHI; this mapping was needed to define important NWHI CRER boundaries where no up-to-date bathymetric data existed. The resulting data were combined with other available multibeam data and with NOAA single-beam data, lidar data, and derived depths from IKONOS satellite data to produce the *Bathymetric Atlas of the Northwestern Hawaiian Islands: A Planning Document for Benthic Habitat Mapping. February 2004*. This atlas was published jointly by NOAA's CRED and the NWHI National Marine Sanctuaries Program (NMSP) and an atlas website was created in December 2003. Thirty charts displaying the actual multibeam data were created; these charts stretched from Kure Island to Nihoa Island with data presented at 60 m grid resolution. These 60 m grids were also made available for download at http://crei.nmfs.hawaii.edu/BathyAtlas/.



In early 2005 PIBHMC scientists also worked to create a similar synthesis project for the MHI, where data access is a much more sensitive issue because of the much greater number of management agencies and scientists doing research in the area. There is also a much larger body of bathymetric data that has been collected in the MHI on more than a dozen platforms using a wide range of instruments including the towed GLORIA sonar, SHOALS lidar, single-beam, and nine multibeam sonars. This synthesis is presented in a slightly different manner with tracklines showing the source of the data displayed over cumulative gridded data. This website provides links to individual data sets, rather than data download capability. This Interactive Bathymetric Atlas of the Main Hawaiian Islands is available at http://www.pifsc.noaa.gov/cred/himap/.



Work is on-going to update and combine these two products. Current work at UH by scientists associated with PIBHMC is developing a much more comprehensive synthesis of MHI data and integration of MHI and NWHI products.

Cruise Planning

Operating an extensive field program requires state-of-the-art data collection systems and but also a database that supports planning, data processing, and data analysis activities. A variety of data layers must be integrated to support planning and preparation.

- Survey plans, based upon existing bathymetry and charting data
- Predicted and observed tides
- Satellite and aerial photographic, imagery, and depth data
- Data syntheses of existing bathymetric information from various sources

On many cruises, a PIBHMC staff member serves as Chief Scientist, coordinating all planning activities between the ship and NOAA and UH administrative offices. As part of this cruise planning and execution, the Chief Scientist is required to:

- Prepare cruise instructions 90 days prior to the cruise. These instructions include the amount and type of equipment that will be carried aboard ship, the types of operations planned, descriptions of all areas to be visited, and a preliminary cruise schedule. Changes to the preliminary plan are made as amendments and a final cruise instruction is required 30 days prior to the cruise.
- Arrange for permits well in advance of the cruise (90 to 120 days) with individual responsible agencies such as NOAA's NWHI Coral Reef Ecosystem Reserve (CRER), the U.S. Fish and Wildlife Service (USFWS), Hawaii's Department of Land and Natural Resources (DLNR), and appropriate agencies in the Territories of American Samoa and Guam, and the Commonwealth of the Northern Mariana Islands (CNMI).
- Ensure that all personnel are cleared for sea-going duty and that all necessary approvals have been received.
- Arrange for overtime, travel requests, and deployment compensation for cruise participants as required.
- Assemble the necessary material safety data sheets (MSDS) to document any hazardous substances to be carried aboard the vessel.
- Prepare detailed dive plans, if required.
- Ensure that all scientific equipment is in working order and that spares are available.
- Submit weekly activity reports during the cruise and a detailed cruise report within 30 days of cruise completion.
- Arrange for pre- and post-cruise meetings with ship and scientific staff.

PiBHMC performs multibeam survey planning with SAIC's ISS-2000 planning software. Estimates of the time required by a survey are obtained by creating sets of lines at appropriate line spacing; usually multibeam survey lines are planned at a spacing of five times the water depth because this is a reasonable estimate of the multibeam swath coverage for most sonars. Figure 3 shows a typical survey plan at French Frigate Shoals; all remaining survey in this area would be done by the R/V *AHI* in order to minimize danger from shoals for the deeper draft *Hi'ialakai*.

Nautical charts and existing bathymetric data serve as the base layers in the survey planning software. Frequently in remote areas where surveys are being conducted, individual soundings or entire nautical charts are offset from their actual position; these offsets can make surveying in these areas hazardous. In other areas, almost no soundings exist around remote islands, and it is difficult to estimate exactly how long it will take to survey an area. (See Figure 4)

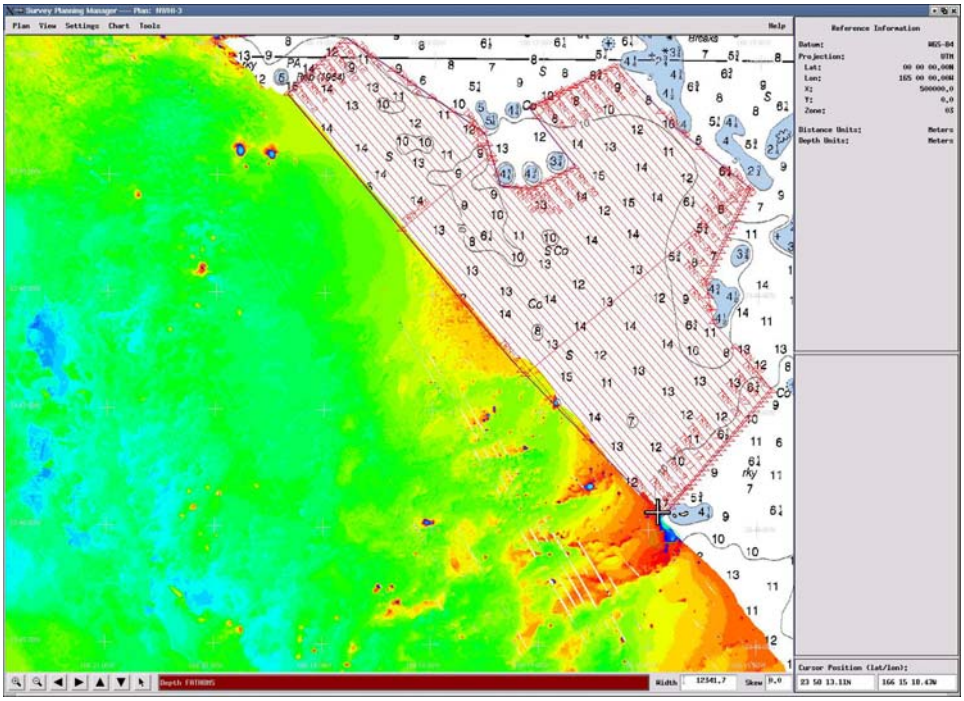


Figure 3. Typical survey plan of lines, shown in red, at 100 m spacing. Colored area at left shows data collected in 2005. Note some slight gaps (white lines) in survey coverage which can be seen to the left of the cursor.

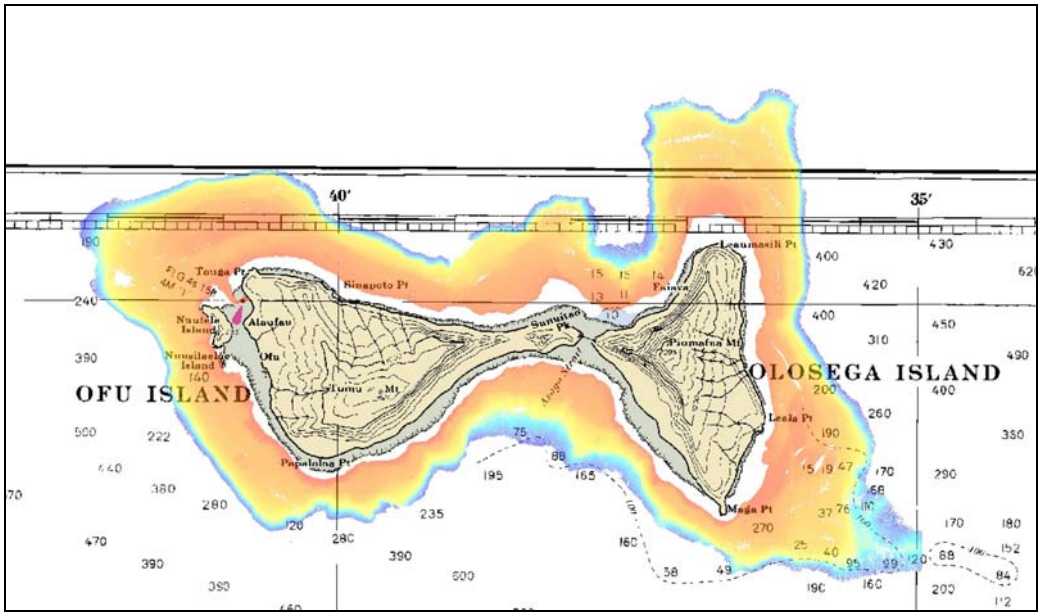


Figure 4. Multibeam data collected around Ofu and Olosega Islands, American Samoa, in 2003 is shown in color. Note that there are few existing sounding in depths less than several hundred fathoms on the existing nautical chart. Planning for

this survey was done using the islands' circumference and an assumption of 6 to 10 passes around the islands.

Predicted tidal correctors are applied to multibeam data during collection in order to miminize apparent offsets between multibeam swaths, which may be caused by tide offsets or may be due to problems with the multibeam system. Thus, another aspect of planning the cruise is to ensure that tide information is acquired from the NOAA Center for Operational Oceanographic Products and Services (CO-OPS). Using the ISS-2000 survey planning software, predicted tides are then generated for all tide zones in the survey areas. After the survey observed tide offsets, which can also be downloaded from CO-OPS after processing is completed, are applied to the multibeam data during data processing.