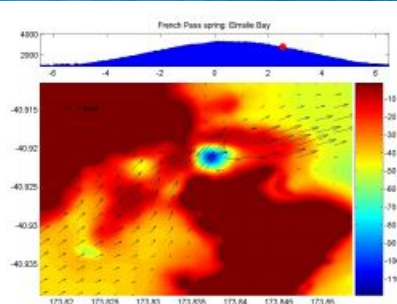


WESTERN ROSS SEA, ANTARCTICA

Surveying in the Extremes



In 2007, the National Institute of Water & Atmospheric Research's (NIWA) deepwater 70m research vessel *Tangaroa* returned from a voyage to Antarctic waters. It had here continued hydrographic survey work begun in 2001 for New Zealand's national hydrographic authority, Land Information New Zealand (LINZ). It had also completed a biodiversity study of the north-western Ross Sea and around the Balleny Islands (from a depth of about 50m down to about 700m) for the Ministry of Fisheries.



services in coast, oceans, freshwater, fisheries, atmosphere and climate. In recent years it has completed five voyages to Antarctic waters. Two of these involved hydrographic surveys for LINZ, which is responsible, among other tasks, for providing nautical charts.

The First Voyage

Tangaroa's first hydrographic voyage was undertaken in February - March 2001. LINZ required hydrographic survey work to be completed for the production of nautical charts of Cape Adare to Cape Hallett, including the Possession Islands and the Balleny Islands. These were required to ensure safe passage and anchorage for the increasing number of vessels visiting the area. The lack of authoritative hydrographic charts constituted a considerable risk for stranding, holing or sinking of these vessels, which could, given the extreme nature of the Antarctic, easily result in a major human and/or environmental disaster. The 2001 survey resulted in the production of four new charts - NZ 149006, 149007, 149008, and Balleny Islands chart NZ 149012, which is still to be published.

Surveying in the extremes and at the frontiers requires a considerable amount of planning and risk mitigation. Other than the occasional fishing, research and cruise vessel, help is often more than eight days away. There is no air support or means of evacuating any personnel. As a result, the preparation for such a voyage includes the commissioning of an ice pilot and medical doctor as part of the crew. Appropriate hospital facilities have to be made ready aboard *Tangaroa*. All expeditioners must be required to complete rigorous medical and dental examinations and cold-weather survival training; a self-sufficient survival container is installed on *Tangaroa*'s deck. In addition, ice assessment studies are commissioned, along with daily ice and weather specialist support and individual personal and group survival kits are provided modelled on IMO Guidelines for Ships Operating in Arctic and Antarctic Ice Covered Waters.

Second Voyage

Tangaroa's second hydrographic voyage left Wellington on the evening of 27th January 2004, after three days of mobilisation and system calibration tests, with a team of 43 surveyors, scientists, and crew. It arrived at Cape Adare, in the north-western Ross Sea on 3rd February. The team carried out hydrographic and biodiversity work on an equally shared basis along the Cape Adare to Cape Hallett coast until 1st March, before moving to the Balleny Islands. The vessel arrived back in Wellington on 13th March. The NIWA-led survey was a multinational and multi-skilled one, with specialists from NIWA, Thales GeoSolutions Australasia (now Fugro), consultant hydrographers from New Zealand and Canada, New Zealand Defence Force, Italian

biodiversity researchers, and biodiversity scientists from the UK and the University of Otago.

Generally the ice conditions were good as most of the survey area could be accessed, if not immediately then later in the survey period. The ice encountered was mainly second-year and multi-year ice with lots of icebergs, bergy bits, growlers and brash. At times, high ice concentration and bad weather disrupted progress. Two storms, both about four days long, provided consistent winds of over 65 knots, with gusts of 95 knots, and seas of 12m, requiring the *Tangaroa* to either dodge south into calmer waters or to seek shelter.

Survey Equipment

The hydrographic survey gave complete coverage of the seabed in depths over 75m, with *Tangaroa*'s hull-mounted 30kHz Simrad EM300 multi-beam echosounder. In areas shallower than 75m, single-beam echosounding was undertaken with an Echosac DF3200 echosounder from the NIWA survey launch *Pelorus*. The single-beam areas were also surveyed with side-scan sonar. *Tangaroa*'s 300kHz Simrad EM3000D high-resolution multi-beam echosounder was also used during the inshore operations, mainly for safety reasons. Motion sensing was by an Applanix POS-MV on *Tangaroa* and TSS DMS 2-25 on *Pelorus*.

A primary tide station was established on Possession Islands and recorded some data before a major storm destroyed the unit completely. Sufficient data was captured, along with data from the NIWA Scott Base sea-level recorder to calibrate the Ross Sea Tide Model. Storm surge was applied to the tide-model data before being used to reduce the bathymetric sounding data. Positioning of *Tangaroa* and *Pelorus* was done using Thales Skyfix XP system as the primary positioning system and Thales WADGPS as the secondary system. A temporary differential base station was established at Scott Base, which provided differential information to the Thales wide area network. Both vessels received differential corrections via POR and Sat B satellites. Corrections were also broadcast from *Tangaroa* to *Pelorus* to enable *Pelorus* to work close in-shore, where satellite masking could occur from the surroundings. Skyfix XP provided sub-meter accuracy while WADGPS provided 2-3 metre accuracy. Some 3,100km² of multi-beam and 600km of single-beam echosounder data was collected, processed and will be delivered to LINZ for maintenance of the nautical charts and inserts.

Biodiversity Research

The biodiversity research looked at marine communities on the north-western Ross Sea shelf (Cape Adare to Cape Hallett) and Balleny Island seamounts. The study was carried out to assess and document the biodiversity of the region and to sample and describe species on the seafloor. Results of the survey will contribute to the conservation and sustainable management of the marine resources of the Ross Sea region. The biodiversity team sampled five transects in the western Ross Sea to quantify levels and variation of biodiversity using grab, sled and trawl gear and catching a large variety of animals. Maps of the seabed topography produced from the multi-beam sounding systems were used to support sampling operations and will also enable characterisation of seabed bottom sediment type, the locality and extent of iceberg scours and how these seabed features influence the distribution and diversity of the animals and plants sampled.

A considerable degree of flexibility in the hydrographic and biodiversity study areas ensured that maximum benefit was made of vessel time while in the survey area. Both the hydrographic and biodiversity teams met their objectives, obtaining substantial amount of data and benthic samples.