TUORs for marine monitoring

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The use of towed undulating oceanographic recorders (TUORs) is seen as a key activity in monitoring long-term trends within large marine ecosystems (LMEs).

Chelsea Technologies Group (CTG) has delivered an instrumented towed undulating oceanographic recorder (TUOR), Nv-Shuttle, to the Marine and Coastal Management Group of the Department of Environment and Tourism, Cape Town, South Africa. The sale of the system, which is to be utilised within the Group's ongoing and future monitoring programmes in the Benguela system, was assisted by SMD Telecommunications of Cape Town, CTG's representative within South Africa.

The acquisition was funded by the Benguela Current Large Marine Ecosystem (BCLME) Programme, which, together with the Global Environment Facility (GEF), identifies and manages regions of the world's seas where LMEs are of key importance to surrounding countries. When possible, funds are provided via the World Bank to both developing nations and those of economic transition, to monitor and manage such resources. There are a total of 64 LMEs that have now been defined, involving some 126 separate nations, including the BCLME, which has been in operation since 2001, and includes Namibia, Angola and South Africa. The BCLME is run from a Project Co-ordinating Unit centred in Windhoek and governed by a Project Steering Committee, with the assistance of the United Nations Development Programme (UNDP) and United Nations Office for Project Services (UNOPS).

Left: The use of TUORs is seen as a key activity in monitoring long-term trends within LMEs. Above: Nv-Shuttle fitted with a MINIpack CTD-F to measure conductivity, temperature, depth and fluorescence, as well as an APS.

TUORs to boost monitoring programmes

The use of towed undulating oceanographic recorders is seen as a key activity in monitoring long-term trends within the world's 64 LMEs. It has been recognised since the early 1990s that such tools can provide very large datasets over large areas at reduced costs using research vessels. The value of such datasets is clearly demonstrated at the US National Marine Fisheries Service (NMFS), Narragansett Laboratory, Rhode Island, where the continuous plankton recorder (CPR) surveys have been running since the late 1960s to the present.

Instrumentation

The Nv-Shuttle was developed during the late 1990s in a collaboration between CTG and Plymouth Marine

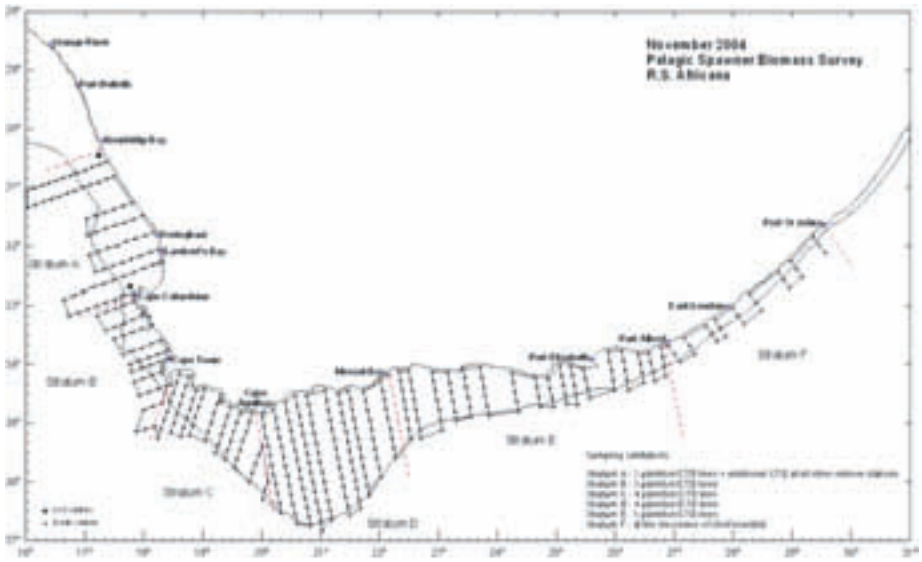

Figure 1. Typical pelagic spawner biomass cruise track chart, where the TUOR may be deployed in tandem with the underway hydroacoustics and a continuous underway fish egg sampler (CUFES).

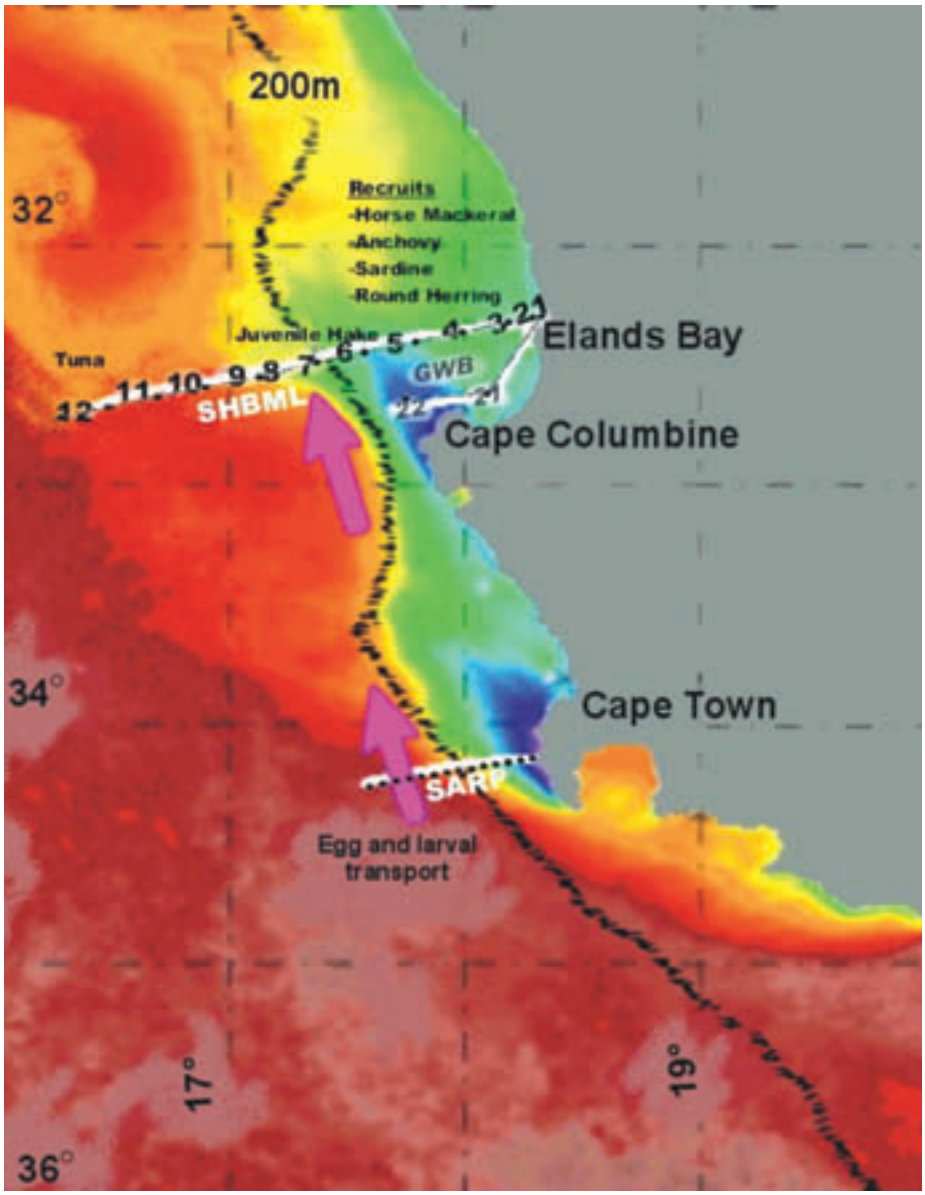

Figure 2. The St Helena Bay monitoring line superimposed on the thermal image of the southern Benguela.

Laboratory (PML), UK, and was part funded by the UK Department of Trade and Industry. It was a development from the Chelsea AQUAshuttle towed undulating vehicle, which was itself originally developed at PML. All three aims of reducing the manufacturing costs of such a TUOR, increasing the payload area, and improving undulation performance were all realised within this development programme.

The Nv-Shuttle was launched in 1997 and quickly became popular among institutes and universities throughout the world. Part of the attraction of the Nv-Shuttle is its flexibility. As control of the vehicle is managed by its internal Servo unit, when communications are broken with the surface, the operator has the confidence to know that the vehicle will still be in control, as long as the power to the Servo unit is maintained from the impellor/alternator set at the rear of the vehicle. This allows the Nv-Shuttle to use an available winch on a towing vessel, as no slip rings are required to achieve real time data acquisition. This often reduces the overall cost of a system significantly.

The Nv-Shuttle has been fitted with a MINIpack CTD-F to measure conductivity, temperature, depth and fluorescence, as well as an autonomous plankton sampler (APS).

The MINIpack CTD-F was developed as a small, robust and high-performance CTD-F. It has become the central hub of all CTG towed vehicle systems, as well as finding applications on underway flow through systems such as the AquaLine Ferrybox, when used in conjunction with its flow-through manifold.

The APS was developed with PML as a modern replacement for such sampling mechanisms as that used by the CPR, and included improvements such as motorised advancement of the gauze (indexed advance) and programmable sampling routines. It was designed to maintain data compatibility with the CPR and other monitoring programmes, the hydrodynamics matching those of the Hardy mechanism.

Also, a great deal of interest has been placed in fitting the towed undulating vehicle with a fast repetition rate fluorimeter (FASTtracka). This will allow inclusion of primary productivity data with the main dataset. The FASTtracka has been successfully operated within the LME assessment Nv-Shuttle systems run from the NMFS* in Narragansett, and it may be considered as one of a number of optical instruments to be fitted in the future to the Nv-Shuttle. (*Please note, the use of the Nv-Shuttle by NMFS does not constitute endorsement by the US Government.)

Planned system use within the BCLME

Currently there are many ship-based monitoring and survey initiatives underway in the Benguela system. These include nationally-based fishery surveys, dedicated monitoring lines undertaken in the Benguela Environment Fisheries Interaction Training Programme and process-orientated cruises in the BCLME programme examining frontal boundary regions such as the Luderitz-Orange River Cone, the Agulhas Current/Agulhas Bank mixing area, frontal features between upwelled and oceanic waters and the Angola-Benguela Front.

Ship-time is extremely expensive; about US$10,000 to US$20,000 per day for the two largest vessels in the South African research fleet (the RV *Algoa* and the RV *Africana*). Any savings on ship-time would greatly assist in reducing the costs of monitoring while retaining the quality of the information required to document the variability associated with the Benguela ecosystem.

Pelagic fishery surveys (Figure 1) are conducted underway using acoustic and CUFES (continuous underway fish egg sampler) technology, but with approximately 100 fixed stations of an hour's duration at regular 10-nautical mile intervals for oceanographic information. Dispensing with the need for fixed stations, apart from midwater target identification trawls, would significantly reduce survey costs. However, there is limited operational experience with towed underway bodies in southern Africa; this project aims to rectify that gap and enable southern African scientists and technicians to develop expertise and significantly improve the oceanographic monitoring capabilities in the region.

The only two vessels currently capable of deploying a TUOR at present are in South Africa, hence the TUOR will first be used on the RV *Africana* and the RV *Algoa* to complement the routine St Helena Bay and Sardine-Anchovy recruitment programme (SARP) monitoring lines, which have been undertaken monthly since April 2000 (Figure 2). The classical monitoring at fixed locations will be complemented by either towing continuously back along the monitoring line or by towing between stations and retrieving the TUOR every 10 nautical miles. This will be repeated as often as possible for one year and the results from the TUOR will be compared to the fixed station data. Scientists from Namibia and Angola will be invited to Cape Town to participate in the cruises to enable them to build up experience in deploying, operating and retrieving the TUOR and analysing data collected at sea and in the laboratory ashore.

Next the equipment will be deployed on the monitoring line off Namibia on the RV *Welwitschia* and on the Namibe monitoring line in southern Angola during cruises of opportunity. The use of optical sensors for detection of phytoplankton groups or HABS and an optical plankton counter for zooplankton will be considered in the future as additions to the sensor payload. ■

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