DEVELOPMENT OF ACOUSTIC METHODOLOGY FOR ZOOPLANKTON BIOMASS ASSESSMENT

LMR/PEL/09/08

BCC Annual Science Forum, Windhoek Oct 2012

Budget = 45 000 US$
Aim

- The development of zooplankton discriminatory algorithms which allow for identification and estimation of zooplankton biomass will enable the derivation of a time-series of zooplankton estimates by size class in the region.

- Methods are based on the principle that different sized organisms reflect sound differently at different frequencies.
See the different patterns/layers emerging at the various acoustic frequencies.
Approach...

1. Analyses of zooplankton samples for ground-truthing of acoustic data
   - Hydro-bios multi net samples collected by MCM between 2004 and 2010 (45 stations x 5 nets ~ 18 months)

2. Training workshop
   - Training of local scientists in acoustic data processing and derivation of classification algorithms.
   - This will focus on two methods:
     - Multi-frequency multi-model inversion algorithm methods
     - Frequency differencing methods
Technician appointed in March 2011 to analyse multi-net samples. Analyses was completed April 2012.

94 multinet samples have been analysed
Wide range of organisms have periodically dominated samples: incl. small copepods, large copepods and euphausiids, siphonophores, chaetognaths, salps etc.

Example of the detail available for each station
Here the same station data is presented in terms of number per size class – this classification (rather than biomass per species) more realistically captures the degree of classification ultimately expected.
Data processing

The processing of these data is highly complex and reliant on in-depth knowledge of the acoustic scattering properties of different organisms.

As such the intention has always been to get specialist input from IRD to train and assist scientists from the region in analysing these data.

Unfortunately this has not yet materialised (see later).

Nonetheless, some preliminary work has been done....
Schematic representation of data processing steps already finalised

Vessel and transducer setup

Noise filtering

Fish removal

Fluid like zooplankton extraction

Don’t try to read – illustrative only of the many steps required!
Noise removal

Techniques have been refined and appear to be functioning well using the virtual module of Echoview.

Through a complex set of procedures, the background noise emanating from the ocean is removed (independently at each frequency) and the signal to noise ratio is optimised.

Original echogram at 200kHz

Resultant noise–reduced echogram

Alex De Robertis and Ian Higginbottom ICES Journal of Marine Science, 64: 1282–1291.
Exclusion of echoes from fish is achieved through utilisation of the principle that fish with swim bladders have a relatively flat response in the frequency range (18-200kHz) – unlike that of bladderless organisms.
Fish removal

Exclusion of echoes from fish is achieved through utilisation of the principle that fish with swim bladders have a relatively flat response in the frequency range (18-200kHz) – unlike that of bladderless organisms.
**Discrimination between organism type**

Linear increase in response between 38 and 120 KHz so that $\Delta MVBS_{120-38} > 0$ allows extraction of fluid like zooplankton (euphausiids, copepods, salps, siphonophores (without gas bladders) and other large crustaceans.

Further rates of change in $\Delta MVBS_{120-18}$ and $\Delta MVBS_{200-38}$ allows discrimination between smaller (copepods) and larger (euphausiids) organisms (next step currently being implemented).
Illustration of the basic idea

Small $\Delta$MVBS$_{120-18}$ for euphausiids compared to small copepods
Further work

- A post doc student has been appointed (independent IRD funding) to assist with further refinement of these techniques (2013) and to facilitate data processing.

- Training workshop led by Anne Lebourge Daussy / Arnaud Betrand (IRD) will be presented early in 2013 – following this, it should be possible to start implementing the algorithms to local/regional data sets towards end 2013.

- Extension of this project to 2014 for purposes of joint publications is necessary (although further funding not required).
Budget:

Only expenditure thus far – salary for student technician for analyses of net samples = R156 000

Detailed report to follow shortly

Thanking you in my absence...