DEVELOPMENT OF ACOUSTIC METHODOLOGY FOR ZOOPLANKTON BIOMASS ASSESSMENT

LMR/PEL/09/08

2010 – 2013
Budget = 45 000 US$

BCC Annual Science Forum, Windhoek Sept 2013
Importance

- Many studies focus on the relationship between fish and the environment, particularly temperature.
- However, fish do not eat temperature.
- To understand the effect of the physics (and possible changes therein) on fish distribution patterns, it is important to first understand the intermediate relationships with zooplankton.
- Most zooplankton sampling is done through net sampling and since macrozooplankton easily avoid nets accurate information of this component is scarce.
- Furthermore, data needs to be collected at higher spatial resolution to match that of data on fish and the physics.
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.
Example of different patterns emerging at the various acoustic frequencies.
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 (euphausids, 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 further discrimination between other small organisms.
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) – completed March 2012

2. Derivation of algorithms – IRD expertise required

3. Training workshop
   - Training of local scientists in acoustic data processing and derivation of classification algorithms.
   - This will focus on noise removal methods and frequency differencing methods
Derivation of algorithms

- Vessel and transducer setup
- Noise filtering
- Fish removal
- Fluid like zooplankton extraction

This removed too much signal!!
Start again in 2013
Post doc Student (IRD funding)

A new tool developed

Echopen

Echopen V1.6. South Africa: Organizational chart

STEP A

EK5 files

RAW files

Reforming
(Manual bottom line correction)
(Read bottom line from echoview)

Reformatted data

STEP C

Resampling
(Noise removing)
(Manual bad regions)
(Use bad regions from echoview)

Cleaned and resampled data

STEP D

Histo 1D

Histo 2D

Class by difference

« Colour » echogram

Algorithm

Classified data

Movies 3D &

To apply noise filter

Data file

Legend:

Process (option)
AFRICANA_38 KhZ_interference
AFRICANA_120 KhZ_interference
200kHz cannot be sufficiently cleaned without removing too much signal
Discrimination between organism type -

Rates of change in $\Delta \text{MVBS}_{200-38}$ allows discrimination between smaller (copepods) and larger (euphausiids) organisms -Not possible from Africana data until data quality @ 200kHz improves
Applying the latest algorithms:

120 kHz

Fish (38 KhZ)

Macrozoopk (120 KhZ)

'Others' (120 KhZ)

euphausiids, copepods, salps and siphonophores (without gas inclusion)
gas-bearing small organisms (fish larvae, siphonophores), some gelatinous organisms
Further work

- Ground truthing with net samples already analysed

- Training workshop led by Anne Lebourge Daussy / Arnaud Betrand (IRD) will be presented early in 2014

- Post doc to be continued for 1 year – available to assist with implementing the algorithms to local/regional data sets

- Now possible to investigate interactions between fish-macrozooplankton-physics at fine spatial resolution for all SA surveys since ~2000 and for Angolan surveys since mid 1990s.

- Namibia will start to collect data at 38kHz and 120kHz soon (R.V. Mirabilis)