ECOFISH WP 2 Task 2.2: “Improving understanding of variability in hake catchability and quantifying its effects on scientific and commercial CPUE data”:

Application of a trawl mounted instrument package for studying environmental effects on hake catchability

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Background

Environmental conditions effect the availability of hake (and other demersal fish species) to a bottom trawl, but ...

- CTD are not always performed at each trawl stations on resource monitoring surveys due to time restrictions
- Single CTD profiles may not represent the conditions encountered during the entire trawl track
- Usually no possibility to take CTD stations on commercial vessels or commercial fishing trips

A trawl mounted instrument package allows to record the data which otherwise would not be collected

Echograms off Cape Peninsula (Maree, 1999):

a): Bottom trawl catch for hake should be ok
b) Bottom trawl catch for hake ($\approx 0$) not representative
Technical specification

Sea-Bird SEACAT SBE-19plusV2 CTD (7000m titanium housing and SBE 5M titanium pump, 64 MB memory) with auxiliary sensors:

- Oxygen sensor SBE 43
- WetLabs deep (6000m) chlorophyll and turbidity sensor
- Biospherical QSP-2350L Quantum Scalar (4 pi) PAR (Photosynthetic active radiation) sensor, 2000m
- Custom designed and manufactured trawl mount frame (with additional high density rubber foam protection) by Fisheries Resource Surveys / Sea Technology Services, Cape Town
Applications

- Commercial (test) trip off Cape Peninsula:
  10 – 16 July 2013, 8 successful casts (out of 11 tows)

- SA west coast demersal survey:
  15 Feb – 19 March 2014,
  122 successful casts
  (out of 126 stations)

- SA south coast demersal survey:
  23 April - 24 May 2014,
  114 successful casts
  (out of 115 stations)
Data examples

Downward profile:
SA west coast, Febr. 2014, Shallow water (120 m), St. 39

Upward profile:
Data examples

Downward profile:

SA west coast, Febr. 2014, Deep water (500 m), St. 44

Upward profile:
Temporal and spatial resolution

Vertical: 1 m bins

Horizontal: 7 m at a towing speed of 3.5 kn (0.25 s recording interval)

Scientific 30 min tow

5.11 ± 0.01 °C at bottom

Commercial 4 hr tow

7.16 ± 0.72 °C at bottom
Commercial tow, July 2013, St. 10 (poor catch): demersal fish lifted off bottom during the tow, strong (25 kn) SE winds

Start (time: 6:55, depth 470 m)          End (time: 10:20, depth 376 m)

Surface PAR          7.65E-05          4.51E-01 μE/m²/sec
Surface layer fluorescence 14.40 45.04 mg/m²

Bottom temperature  7.91 9.52 °C
Bottom salinity     34.55 34.75 psu
Bottom oxygen       4.58 3.80 ml/l
Bottom turbidity    0.11 0.09 NTU (Nephelometric turbidity units)
Light level

Solar zenith angle (°)

4 6 8 10 12 14 16 18 20

SA west coast Feb/Mar 2014

Average atmospheric conditions, Clear sky

Average for upper 10 m
‘Chlorophyll’ distribution

SA west coast Feb/Mar 2014

Downward profiles:

Downward and upward profiles:

Numbers at symbols denote number of pairs within lag distance (max. distance 300 km, 20 lags of 15 km width)
‘Chlorophyll’ distribution

SA west coast Feb/Mar 2014

Downward profiles:

Downward and upward profiles:
Green water and hake catch rates

SA west coast Feb/Mar 2014

- Highest CPUE outside green water areas
- Chl concentration may have an (significant ?) effect on the horizontal distribution of hake catch rates in addition to other covariates such as depth, temperature, oxygen content, latitude and longitude

CPUE: t/nm²
(hake data provided by Tracey Fairweather, DAFF)
Conclusions

The instrument package

- allows the collection environmental information with a high spatial resolution
- provides mean and standard deviation of environmental variables for an entire trawl track in addition to point estimates for its start or end
- saves survey time (no reason to abandon collection of environmental information due to time restrictions, high cost efficiency)
- allows the collection of environmental data possible from commercial vessels without any extra time

- Turbidity may be used as an indicator for visibility / current strength on soft bottom (→ wind induced lifting off the bottom of hake)
- PAR observed vs. theoretical might be used as an index for light level (→ diurnal variation)

- makes novel process studies on hake behavior and trawl efficiency possible, in particular if combined with echo sounder recordings and bottom current measurements (ADCP)
Coming applications

• Trip on commercial fishing vessel (Nov. 2014)
  Off Cape Peninsula, contrasting wind conditions with recording of Simrad EK60 acoustic data

• Namibian hake biomass survey (Jan/Feb 2015)

• SA demersal west and south coast surveys
  2nd unit has been built for routine use at DAFF

• Ecofish 2 ????