

## **The standard trawl gear deployed by the FRS *Africana* for demersal swept-area surveys**

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### **Background**

The *Africana* was commissioned with 32 mm trawl wire, which is a non-standard size. The *Africana*'s winch system is a combination of finger capstans that take the load and storage reels below decks. During the commissioning trials it was established that one warp had to be left-hand lay and the other right-hand lay to prevent the wire twisting (Payne & Boonstra, 1986). The trawl gear that was used during the commissioning trials was described as "standard 180ft German trawl" (Payne & Boonstra, 1986).

In the mid 1990s Ralton Maree started a project using acoustic techniques to measure the amount of hake passing over the headline of the net. Early in the project he noted that the footrope of the trawl was lifting off the seabed, which prompted an investigation into the behaviour of the trawl gear used for the swept area surveys. Sea Fisheries Research Institute acquired net monitoring equipment (a SCANMAR system) to deploy on the gear. This showed that mouth of the net was a wide, flat oval instead of a more desirable narrower taller oval, i.e. the net was over-spread. The over-spreading was the result of setting the doors at a high angle of attack (which increased the lateral forces) to compensate for the heavy 32 mm trawl warps. The strong lateral force was too much for the small, light trawl so that the headline was pulled down to a vertical mouth opening of only 1.5 to 2 m and the relatively light footrope periodically lifted off the seabed.

At a meeting of the Demersal Scientific Working Group (DSWG) held in 1998, Leslie and Smith (1998) argued that the trawl system (vessel, warp and net) used for the demersal surveys was unbalanced and that the trawl gear should be replaced. The DSWG agreed and Chris Smith was charged with investigating suitable alternatives.

At the time the trawl wire on the *Africana* needed replacement. The 32 mm wire was very substantially more expensive than 26 mm or 28 mm wire, not just because thicker wire required more material, but because 32 mm was a non-standard thickness and had to be specifically made to specifications. In 1999 the DSWG decided to change to thinner trawl wire at the same time as the trawl gear was changed so that there would be only a single break in the survey time series.

### **Comparison between the Old and New trawl gears**

Prior to the work aimed at selecting a suitable replacement trawl I never realised the myriad ways that a Fishing Master could "tweek" the rigging of the trawl gear, nor the impact that such changes could have on the catching efficiency of the gear. I don't know whether the Fishing Masters had a specific set of instructions precisely specifying the standard rigging of the old trawl gear for undertaking swept-area surveys, but the Cruise Leaders certainly did not have such a document or pre-sailing check list to ensure that the gear was rigged in a standard way. What is known is that the "Old" gear has changed slightly over the 20 years that it was used.

The objectives for the new trawl gear were that there should be no escapement under the footrope and that the sweep length should be minimised to reduce the effect of herding. The initial suggestion was that we should adopt the Gisund Trawl as used by the Nansen so as to standardise the trawl gear used in the Region. However advice received from contacts within the ICES (International Council for the Exploration of the Sea) Working Group on Fishing Technology and Fish Behaviour was that the Gisund trawl is complicated with many possibilities for "tweaking" and that we would do better to adopt a different gear design. We decided to stay with a German trawl so that the differences between old and new gears (and hopefully performance) would be limited.

The true width of the swept area will be some value between the doorspread and the wingspread, depending on the amount of herding. The amount of herding is not constant but varies with bottom sediment (greater when larger dust cloud) and dissolved oxygen (greater when higher oxygen levels), see for e.g. Engås *et al.* (2000, 2001).

Table 1: Comparison between the old gear(s) and the new gear

Item	Old gear(s)	New gear
Net	2-panel German 180 ft trawl with 75mm mesh codend fitted with a liner. Sometime in the 1990s the lower wings were removed.	4-panel German 180 ft trawl with 75mm mesh codend fitted with a liner.
Footrope	Simple rope-wrapped chain for all surveys except for 1983 – Jan 1985 on West Coast (bobbin gear used) and 1986 on South Coast (rockhopper used).	Modified rockhopper gear. Diameter of the hoppers only 1 inch greater than that of the spacers so that no gap under the footrope.
Doors	Initially 1500kg polyvalent doors on West Coast and 7.5m <sup>2</sup> x 1500kg V-doors on South Coast. Later V-doors on both coasts. Date of change not certain.	5.5m <sup>2</sup> x 1600kg Morgere semi-pelagic doors used for both coasts (also for both pelagic and demersal gear).
Sweeps	Sweep length 100m for stations deeper than 100m isobath and 50m for shallower trawls	Sweep length 8 m to minimise herding
Door- & wingspread	Doorspread with 100m sweeps about 120m. Wingspread fixed at 26m. Therefore large potential for noise from variable herding	Both door- and wingspread measured (variable). Doorspread about 66-72 m and wingspread about 28m.
Headline	It was 150 kg of lift at the end of the time series, but it is not known whether the amount of floatation added to the headline was kept constant over the time series.	330kg lift
Vertical	Vertical mouth opening about 2 m	Vertical opening 4.0-4.5 m

#### Calibration between old and new gears

- The standard way of calibrating between two trawl systems on a single vessel is to complete a (large) number of tows with the vessel alternation between the two trawls to generate a number of trawl pairs.
- This option was not possible because the trawl warps were changed at the same time.
- However the effect of the different trawl wire was expected to be very small, hopefully negligible.
- There was a requirement to calibrate the FRS *Africana* against the RV *Dr Fridjof Nansen* to enable surveys conducted by the former vessel off South Africa with those conducted by the latter off Namibia.
- Calibration would be needed between the RV *Dr Fridjof Nansen* and the FRS *Africana* using both her old and new gears.
- This work would then enable the old and new *Africana* gears to be compared indirectly using the *Nansen* as a standard.
- This was not an ideal way of determining a calibration factor for the old and new gear because the Gisund shrimp trawl gear used by the *Nansen* is very different to the German otter trawl used by the *Africana*.
- In the ideal case when using a second vessel to compare two trawl systems, the second vessel should use one of the gears being tested throughout so that on one comparison the vessels would be using different gears (i.e. both a trawl and a vessel effect) and on the other comparison both vessels would use the same gear (i.e. only a vessel effect). But in this case there will be a trawl and vessel effect on both comparisons.
- Although not an ideal method of calibrating between the old and the new trawls, it was considered adequate as a temporary factor as it would ultimately be replaced by direct comparison between the time series of abundance estimates obtained with the two gears once the time series with the new gear was long enough.
- To strengthen the direct comparison between the time series obtained between the two gears, it was decided to conduct the survey using the old trawl gear every third year to provide an overlap between the time series with old and new gears.

#### Conclusions

Some difficulty has been experienced in calibrating between the old and the new gears because of differences in size selectivity between the two gears. Some members of the DSWG suggested reverting to the old gear as that time series is longer (20 versus 10 years). I think that reverting to the old gear would be a huge mistake for two main reasons.

Firstly it is known that the old gear was overspread and that the footrope periodically lost bottom contact which will result in an unknown and variable amount of escapement under the footrope thereby increasing inter-trawl variability. While this defect could be addressed by changing the angle of attack of the trawl doors and increasing the weight of the footrope, those changes would themselves break the time series.

Secondly, as shown above the 20-year historic time series is not homogenous in that the gear has undergone some modifications (eg trawl doors, removal of the lower wings) and the timing of these changes was not documented. In addition there could have been other unknown minor changes affected by different Fishing Masters. I suspect that Cpt Derek Kriege, the Master of the Africana from her commissioning in 1983 to his death in 1994, would have ensured that the gear was rigged in a standard manner

### References and Further Reading

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