The CSIRO 4m Beam Trawl

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EXECUTIVE SUMMARY

A four metre beam trawl has been developed between 2004 and 2007 to sample invertebrates and fish from flat to low relief seafloor during ecosystem studies around Australia. The trawl has a mouth area of 2 m^2, (4 m wide and 0.5 m heigh). It is towed from a single warp and has a mesh size (bar length) of 12 mm in the mouth and 10 mm in the codend. The beam trawl was used successfully during 4 ecosystem surveys from south eastern to western and northern Australia retaining specimens in good condition from a variety of predominantly soft substrates. This document describes the design and application of the four metre beam trawl.

INTRODUCTION

Biodiversity surveys off the continental slope of Australia require a sampling tool for invertebrates from medium to soft substrates. Our epibenthic sled “Sherman” is good at sampling invertebrates from hard or rough terrain, and otter trawls are good for sampling fish. During a new series of biodiversity surveys we needed to collect invertebrates from less challenging seafloors and after experience with the French beam trawl (Forrest 1981) it was decided to design and build a beam trawl.

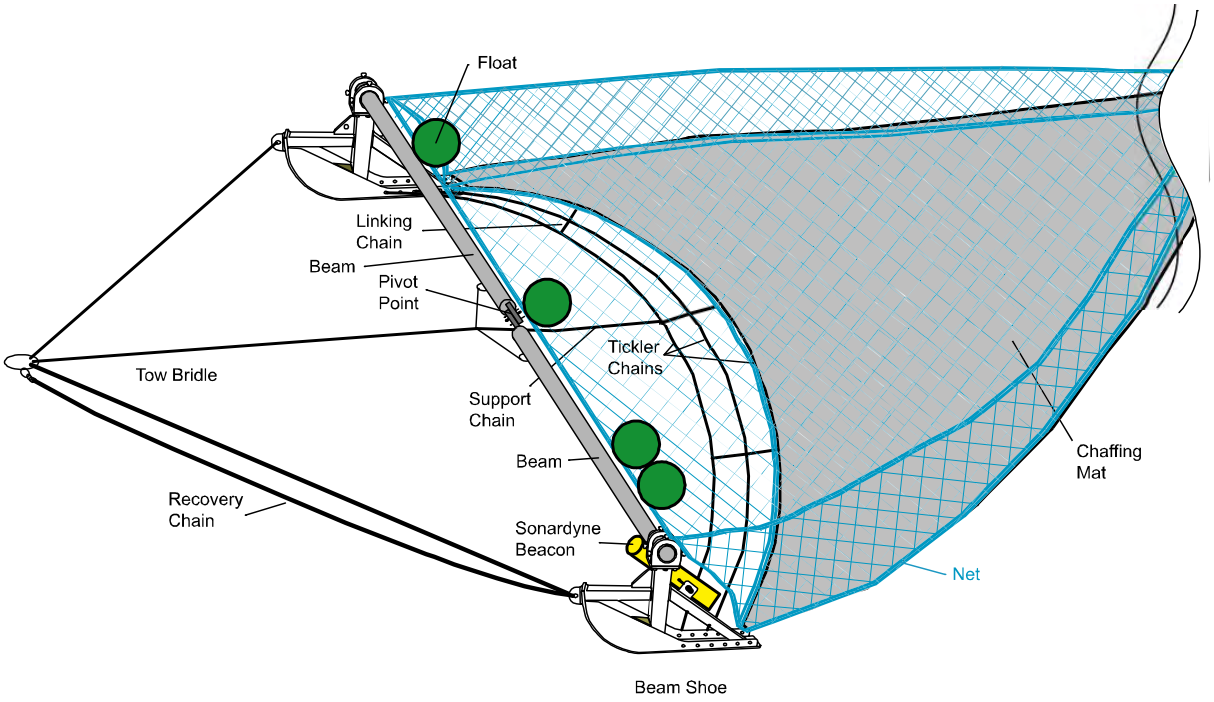
CSIRO 4M BEAM TRAWL DESCRIPTION.

Overview

A schematic diagram of the beam trawl is shown in Figure 1. The beam trawl is rigged with three tickler chains and a triple tow bridle. There is also a strengthening chain running from the central tow bridle to support the foot rope. An extra float is used on the port side to compensate for the weight of a Sonardyne positioning beacon and it’s housing. The beams used are 75 mm water pipe with a pivot plate utilising breakaway bolts. The pivot plate works in the vertical plane as the main force appears to be when the foot rope gets caught, drawing the shoes in towards each other. The tow chains are all grade 8 lifting chain with 10 mm on one side and 8 mm on the other and a central chain of 8 mm that is secured to a loop between lugs on either side of the pivot plate. The tickler chains are 10 mm galvanized chain fastened using hammerlocks. The floats are secured to the headline only. If they are secured to the beam there is a greater risk of damage to the net when the weak points bend or break (Figure 3). Good chaffing protection is essential for the nets; a matt of 1000 dennier complas mat (truckies tarpaulin, or similar) lashed to the footrope is recomended. The unit is attached to the trawl warp using a swivel (5 tonne capacity) to protect the trawl warp and the net. A recovery chain (10 mm lifting grade 8) is attached to the towing lug on the port shoe and to the ring of the tow bridle with a sister clip, for ease of removal. The tow chains are 4.1 m long the retrieval chain is 4.4 m long. The recovery chain is used to bring the beam trawl up the ramp sideways as shown in Figure 2.

The Beam trawl is shown in Figure 1.

Figure 1: A schematic diagram of the beam trawl.

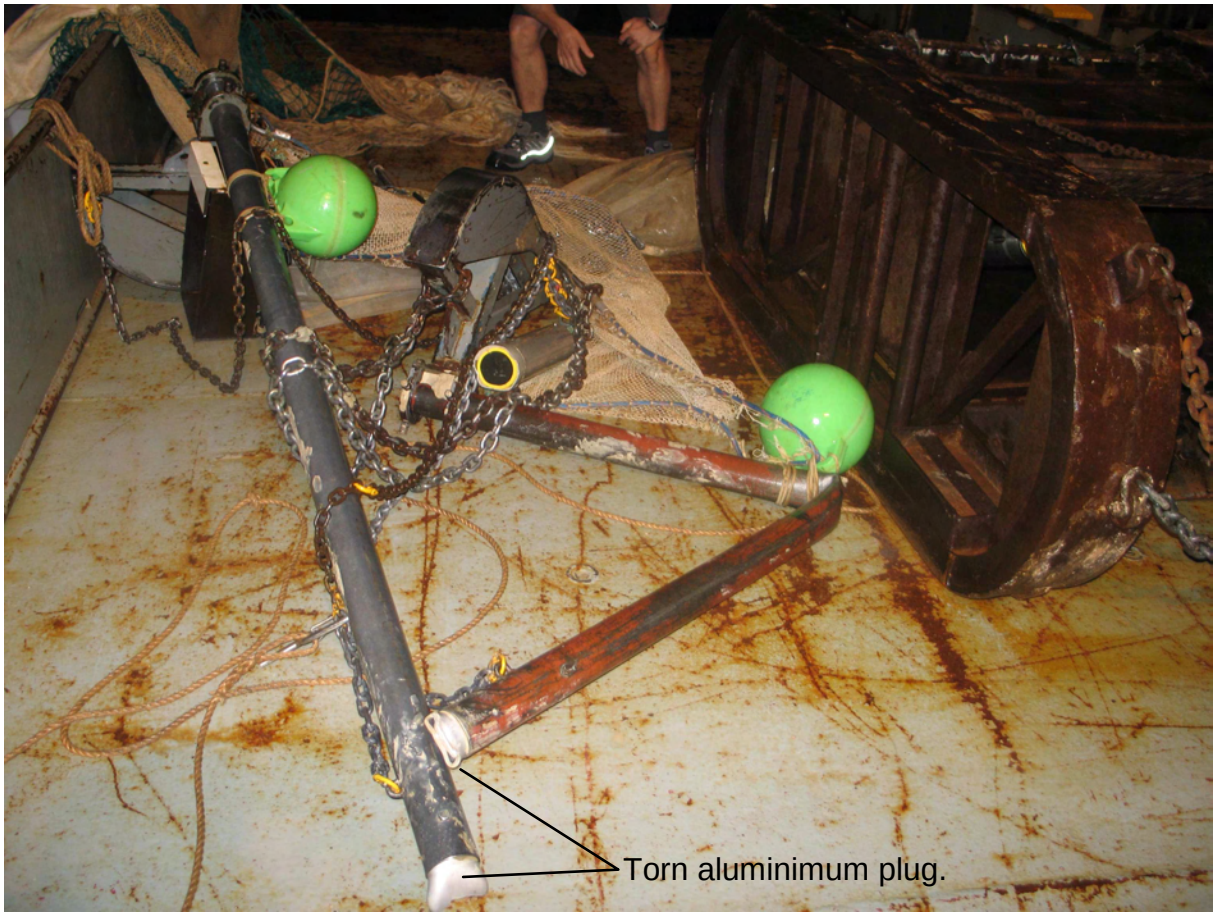


Pivot Points (break-aways)

Pivot points are needed to give the system a weak point to bend when it runs into an obstacle on the seafloor. This is also the reason for the differing diameters of chain in the tow bridle. Figure 2 shows the Beam Trawl being retrieved using the recovery chain and shows a slight bend in the pivot point. The pivot plates were initially placed in the horizontal plane as it was assumed that the main stresses would occur when the net ran into an obstacle. The bars were bent on the horizontal very few times (Figure 3 shows one example) and even then the aluminium plug has been torn at 90 degrees to the bent bar. It was after the slight bending seen in Figure 2 that we concluded that the main stresses occur when the tickler chains run into an obstacle or dig in so tend to pull the shoes together. The pivot plate was then turned from being horizontal to being in the vertical plane. This helped a great deal and there were very few bends after this.

Figure 2: The beam trawl being retrieved using the recovery chain.

Figure 3: The beam very bent. Note the torn aluminium plug used as a weak link.



Tow and Tickler chains.

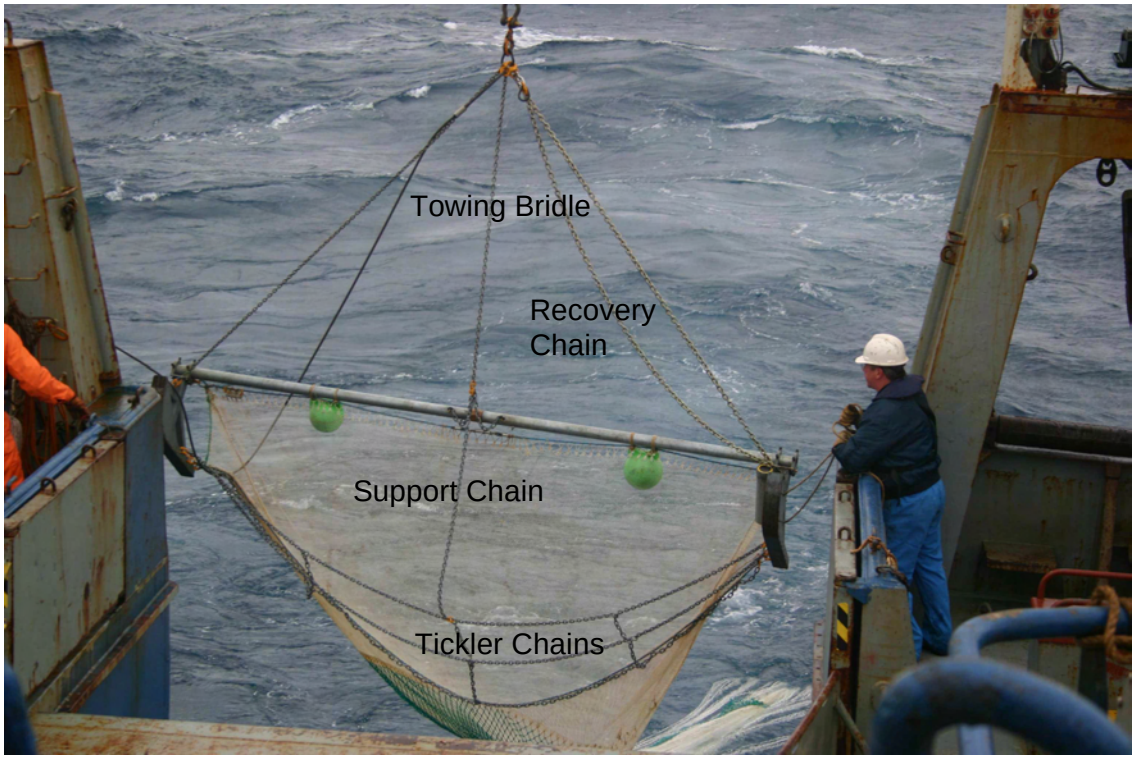
The beam trawl is towed via a three chain bridle attached to the trawl warp via a 5 tonne swivel (Figure 4). The tow chains are 4.1 m long, with the port chain being 10 mm and the starboard chain 8 mm high tensile chain. The centre tow chain is 8 mm high tensile chain (3 m long), attached to a bridle of 8 mm galvanized chain (each bridle is 0.28 m long).
A recovery chain (4.4 m long) is attached to the port side and sister clipped to the tow ring. This can be unclipped when the net is brought up to the block on the trawl warp and attached to the Gilson wire to enable the net to be retrieved when the trawl deck is less than four metres wide (Figure 2). Connected to the centre chain (at the join to the 8 mm bridle) is a support chain for the tickler chains. This chain is 1.87 m long and reduces the in-pull on the shoes when the ticklers encounter an obstacle or dig into soft sediment.

There are three tickler chains;

First Tickler chain (4.3 metres)
Second Tickler chain (4.63 metres)
The third tickler is 5 metres long and lashed to the footrope.

There are three Linking chains between the tickler chains attached by hammerlocks.

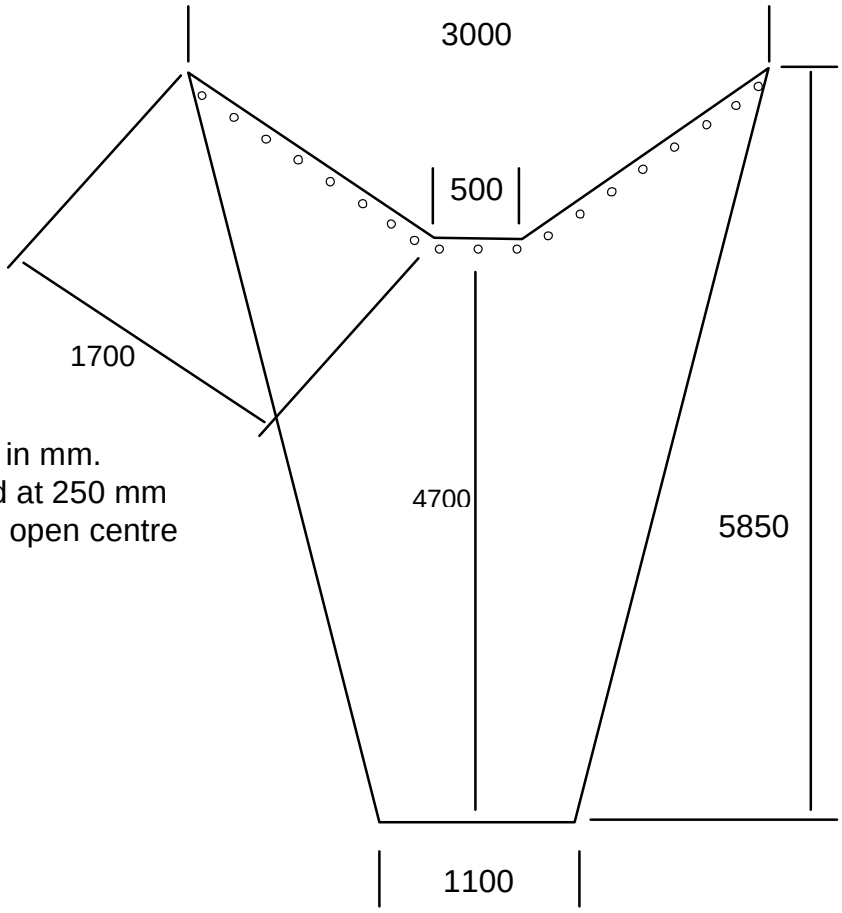
Figure 4: Lay out of the tow and tickler chains.



Chaffing Mat

The chaffing mat, as shown in Figure 5, has reduced the wear on the net by reducing the friction between the net and the sea floor. This has reduced maintenance on the net (nets now last a minimum of two voyages intead of just one) and potential loss of catch. The chaffing mat is made of 1000 dennier Complas, (you could use any abrasion resistant material). It is a single layer and lashed to the footrope using the eyelets shown.

Figure 5: The essential chaffing mat.



Chaffing Mat
All dimensions are in mm.
Eyelets are spaced at 250 mm
and have a 10 mm open centre

Beam Shoes

The beam trawl shoe holds the poles in the top circular clamps and allows the net (headline, footrope and tickler chains) to be mounted via pre drilled holes. It is towed from the forward lug and has the front of the shoe filled with lead to help the unit sink and give good bottom contact. Figure 6 shows a photo of one of our beam trawl shoes and Figure 7 shows the dimensions.

Figure 6: A side view of the beam trawl shoe.

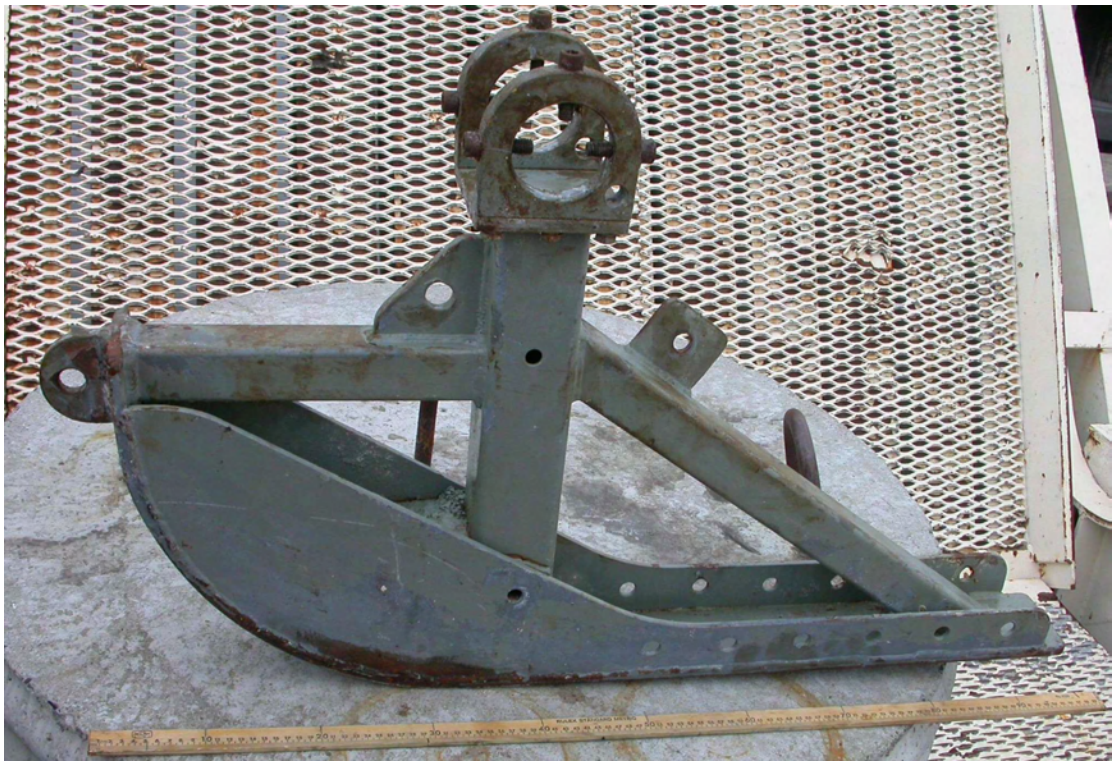
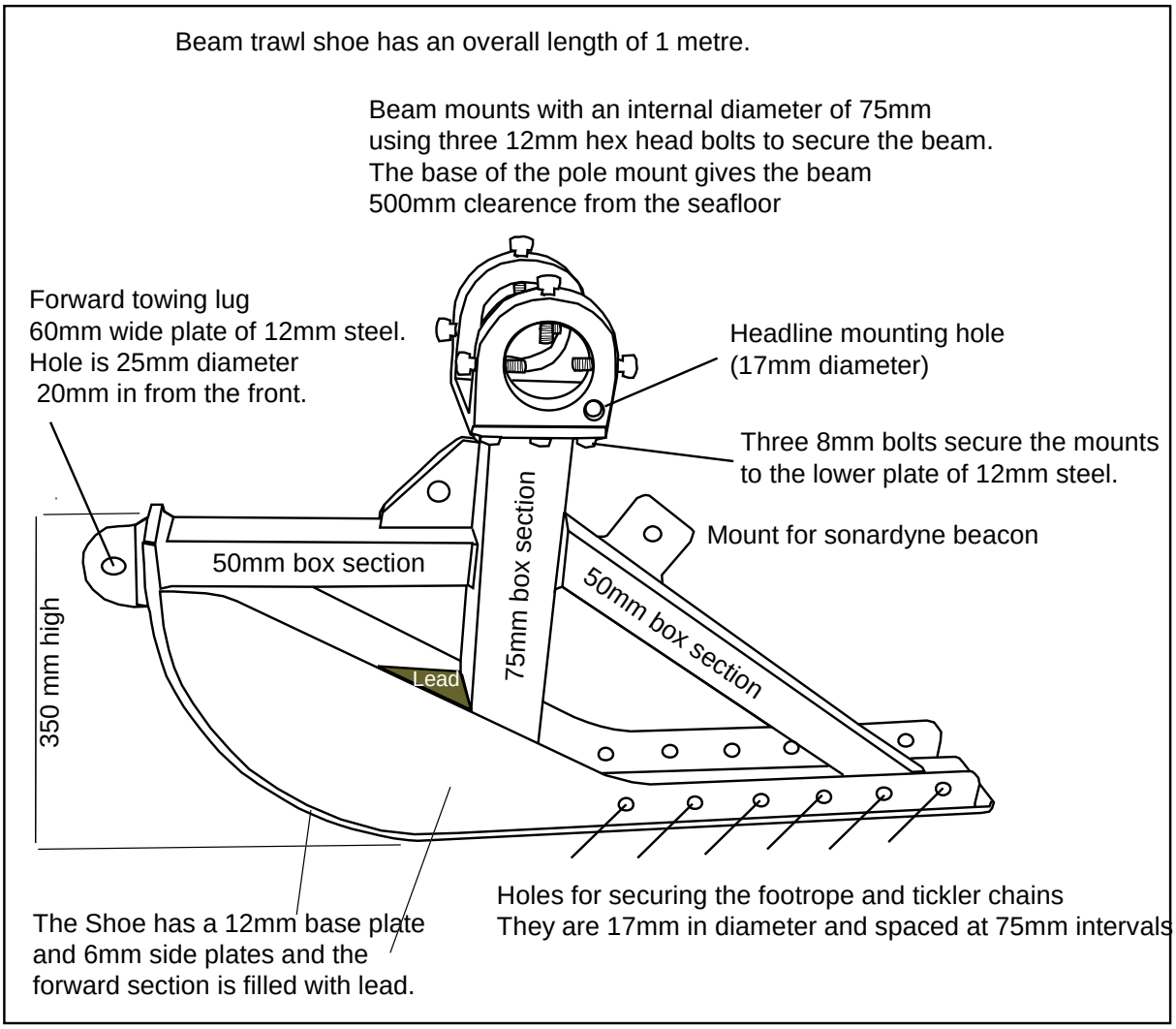


Figure 7: Dimensions of the beam trawl shoe.

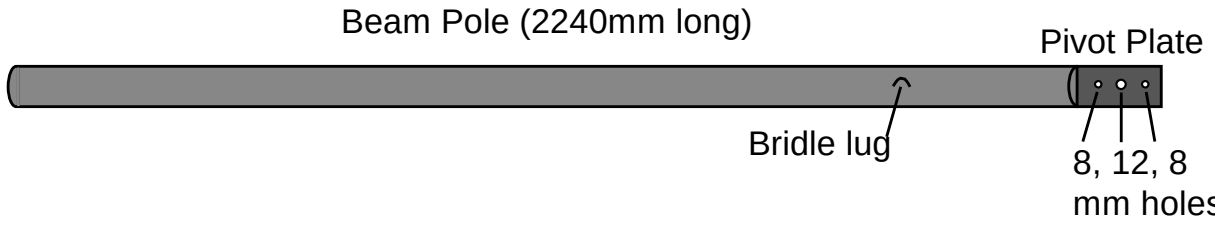
(Detailed drawings are available from CSIRO)



Beam pole.

The poles used in the CSIRO beam trawl are made from 75 mm diameter galvanized water pipe 2240 mm long (Figure 8). They have a pivot plate welded into one end that is 15 mm thick and protrudes 160 mm. There are three bolt holes in the pivot plate with centres starting 16 mm in from the end for the first breakaway bolt (8 mm diameter) and the next at 66 mm in (12 mm pivot hole) and the last breakaway bolt hole at 116 mm (8 mm). There is a lug (20 mm internal diameter) welded onto the pole 330 mm in from the end of the pole to mount one half of the central bridle chain to.

Figure 8: One half of the 'Beam' made from 75 mm water pipe.



The pivot and breakaway bolts are stainless steel with the central pivot bolt of 12 mm and the break-away bolts being 8 mm diameter. It is recommended that one break-away bolt is used initially and the second one installed if the first beaks regularly. The pole should be positioned with the plate in the vertical plane as the main stresses appear to come from the tickler chains digging in trying to bring the shoes together as discussed above.

Sonardyne Beacon.

A Sonardyne positioning beacon is used to accurately geolocate the Beam Trawl. The Sonardyne USBL (Ultra Short Baseline) system is an underwater acoustic positioning system used for reporting the location of underwater equipment relative to a vessel mounted reference transducer. The beacon is mounted inside a stainless steel tube (6 mm wall thickness) to give the transponder some protection. The tube is mounted on the port shoe of the beam trawl as shown in Figures 2 and 3. Its weight is counterbalanced by an additional float as shown in Figure 1.

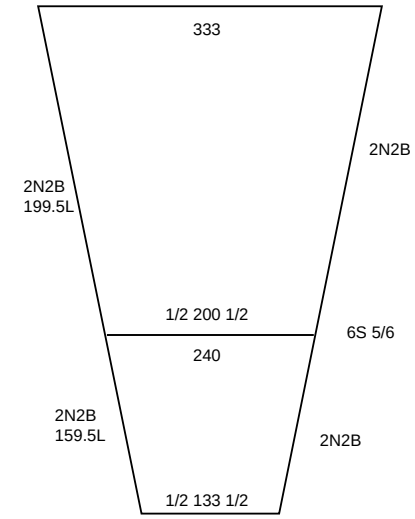
Net Plans

The headline is 4 m long and the net is 8 m long with a mesh size of 12 mm bar in forward section and 10 mm bar in the codend as shown in Figure 9.
Net plans for the nets used are shown in Figure 9. The net was designed by Hugh McKenna from Neptune Trawls to our specifications.

Figure 9: The net plan for the csiro four metre beam trawl

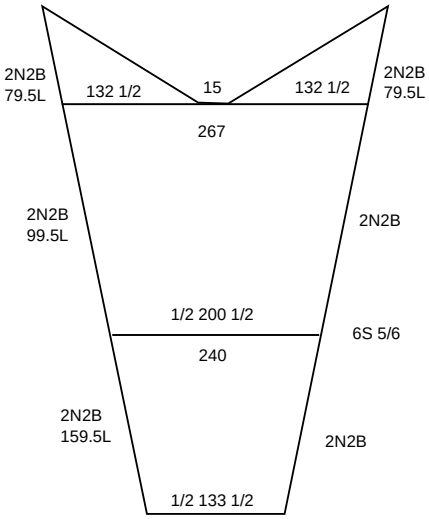
Upper panel

meshes (mm)	Twine	Stretched Length	Knots in selvidge
12.0	10	4.80	4
10.0	10	3.20	4



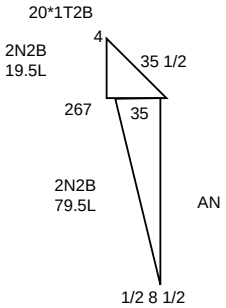
Lower panel

meshes (mm)	Twine	Stretched Length	Knots in selvidge
12.0	10	1.92	4
12.0	10	2.40	4
10.0	10	3.20	4



Side panel

meshes (mm)	Twine	Stretched Length	Knots in selvidge
12.0	10	0.48	4
12.0	10	1.92	4



Towing speeds and wire ratios.

The beam trawl is towed at 2 to 2.5 knots and for 20 to 30 minutes depending on the terrain. A wire out ratio of 2:1 is used in shallow water, to 200 m and 1.8 to 1.5:1 in deep water, to 700 m and > 700 m respectively. The sonadryne positioning system reports the depth and position of the unit in the water column. Without a positioning system it would be prudent to use wire out ratios of 2:1 for all depths to ensure good bottom contact.

Catches

Catches vary from less than a kilogram to several hundred kilos of sponges; they are generally in good condition. Figure 10 shows a sponge catch still in the net and Figure 11 shows a small catch of invertebrates and fish. When you compare the observed video images (from previous deployments of our camera system) to the catches it would appear that the net is a very effective sampler of stationary benthos, crustaceans and small fish.

Figure 10: Large catch dominated by sponges.

Figure 11: A catch from the 4m beam trawl in northern Australian waters

Acknowledgements

I am very gratefull for the assistance given by Dave Kube and his staff in our workshop here in Hobart for assistance with the shoe and beam designs. I would also like to acknowledge the input from Garry Poore (Museum of Voctoria) and Dr Bertrand Richer De Forges (Institut de Recherche pour le Développement). During the design phase I also scanned the published literature (the more relevant ones are listed at the end of this document).

The 4m beam trawl net was designed by Hugh McKenna from Neptune Trawls to our specifications and all enquiries about the net should be directed to Neptune Trawls (+613 6229 8806).

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