Sherman the epibenthic sled for rough terrain.

Mark Lewis
October 2009

CSIRO Marine and Atmospheric Research Paper 029

www.csiro.au

ISBN: 978-1-921605-43-7

ISSN: 1835-1476

Enquiries should be addressed to:

Mark Lewis

Phone: +613 6232 5384

CMAR GPO Box 1538 Hobart 7001

Email: mark.lewis@csiro.au

Copyright and Disclaimer

Important Disclaimer

National Library of Australia Cataloguing-in-Publication entry

Author: Lewis, Mark, 1963-
Title: Sherman the epibenthic sled for rough terrain [electronic resource] / Mark Lewis
ISBN: 9781921605437 (pdf)
Series: Technical report (CSIRO Marine and Atmospheric Research paper (Online) ; 029
Notes: Bibliography.
Subjects: Sherman (Sled).
Marine machinery--Design.
Benthos--Monitoring.
Dredging (Biology).
Other Authors/Contributors:
CSIRO. Marine and Atmospheric Research.
Dewey Number: 623.812

CONTENTS

List of Figures

EXECUTIVE SUMMARY

Sherman, a rough terrain epibenthic sled was initially developed to sample the invertebrates from seamounts in 1997 by CSIRO. During the first voyage the sled successfully sampled at 48 stations and the initial design is given in Lewis (1999). During this first voyage Sherman suffered extensive damage and this initiated a redevelopment to cope with the harsh terrain encountered. The design outlined in this report is the end product of over 10 years of usage and development. Sherman now stands up to most terrains and we have only lost one sled (when a hammerlock on the towing warp parted on a trip in January 2008). We attribute this fact to the bridle system that tows the sled from the rear and incoropates four different break-away points.

INTRODUCTION

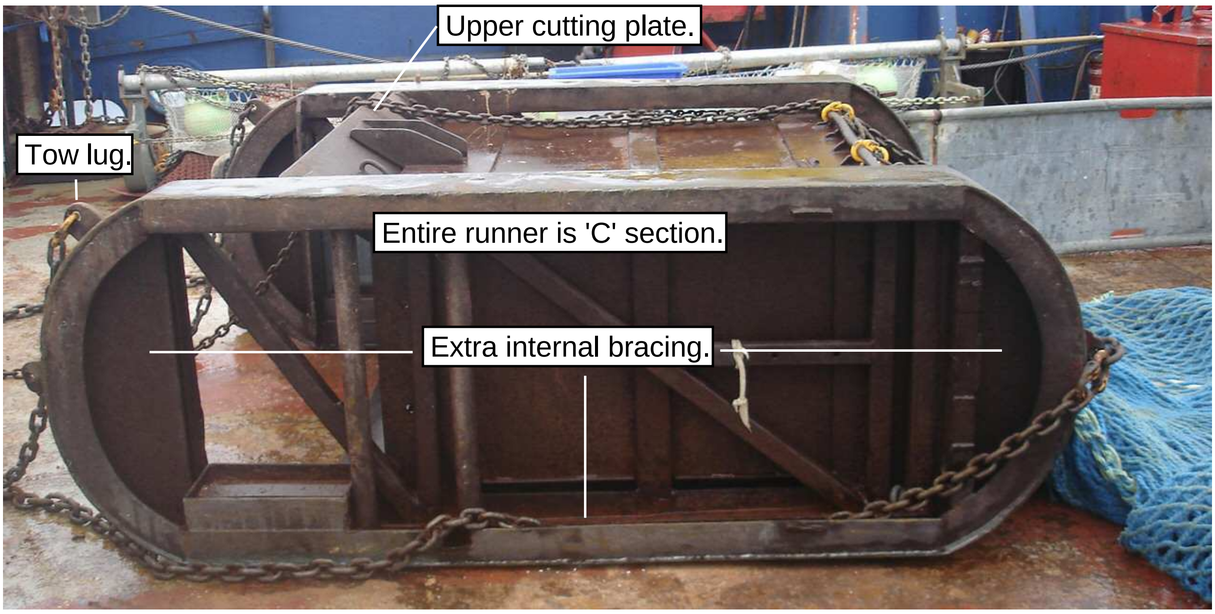
Prior to the Seamounts trip in 1997 there were no suitable samplers for collecting invertebrates from the ruggard terrain of seamounts. Pipe and rock dredges have been used but they return a very small sample and were frequently lost. After a literature search and talking to several researchers Sherman (CSIRO-SEBS) was developed ‘in house’. After the damage suffered by Sherman during the first voyage in 1997 it was obvious that Sherman needed strengthening. This report is an update of Lewis 1999 to give an accurate description of Sherman’s current form. In brief the steel in the runners has been upgraded from 10 mm to 12 mm thick and the bracing increased in each end as well as down the sides, the mouth area reamains the same at 1200 * 600mm (0.72m^2). The forward tow points have been moved to lugs welded to the front of the runners and the chaffing protection has been upgraded. A pair of cutting plates has been bolted to the mouth area and there is an optional infauna collector. The original tow chain design remains unchanged except that the attachment point for the front breakaway chains in now on a forward lug on the runner. This has made the sled more stable in the water and the chain less likely to be damaged when pinned up. A positioning beacon (sonardyne) is now mounted inside the mouth area and allows the targeting of features on the seafloor. These improvements have greatly enhanced Sherman’s life expectancy and functionality.

SHERMAN EPIBENTHIC SLED IMPROVEMENTS.

The runner upgrade.

The original runners made from 10 mm steel plate suffered during the initial survey. The upgraded version now has 12 mm plate with a lot more support. Figure 1 shows the modifications; the main improvement was to increase the bracing so that the flats of the runner faces were converted to C section with bracing on each side as well as a substantial central plate. All of the bracing in the new runners is 12 mm thick.

Figure 1: Sherman, side view showing the improved bracing.

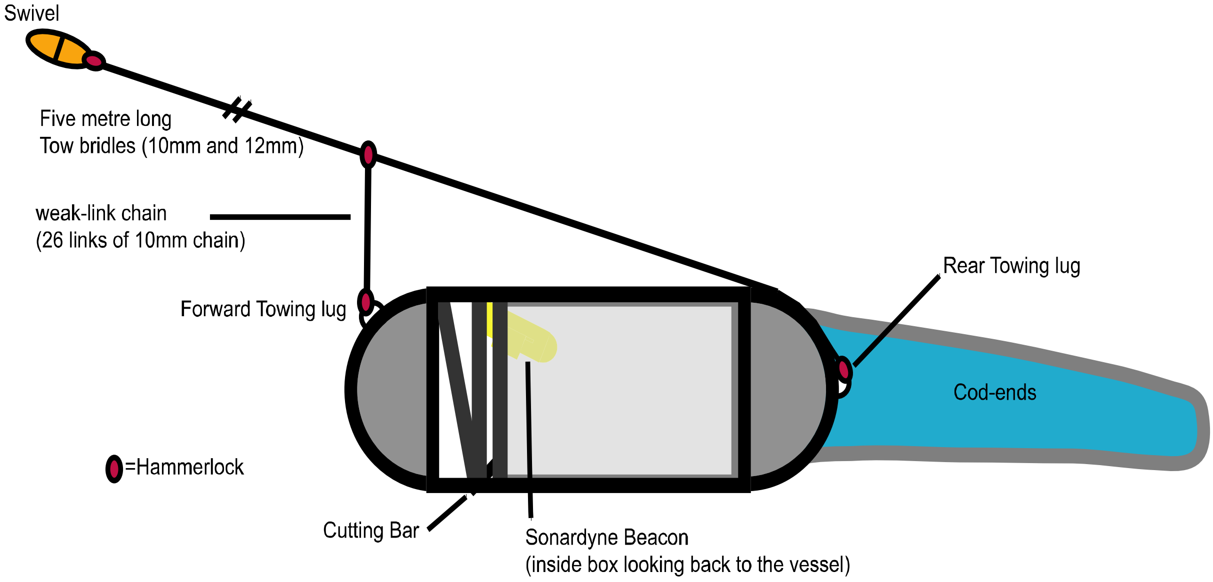


Tow bridle.

The bridle for Sherman is shown in the schematic diagram below (Figure 2). The tow chains are 10 mm and 12 mm lifting chain (grade8) and are five metres long. The weak-link chain is 10 mm galvanised ordinary chain (20 to 26 links to achieve a length of 1.2 meters). The sled is towed from the rear lugs and the length of the weak link chains dictates the angle of attack to the seafloor. There are four break away points in the bridle that sequentially activate with increasing load on the bridle. The first two are the weak-link chains and, depending on which side is caught on the seafloor, one or both will break (we usually replace between 2 and 8 during a voyage depending on terrain and number of tows). If both weak-link chains break then the towing force transfers to the rear lugs and the sled will try to flip over (this has happened twice in twelve years of use). If the sled does not break free then the 10 mm lifting chain bridle is the next to go (this has happened once). Both lifting chains have never broken.

Figure 2: Sherman tow bridles arrangement; a) schematic and b) on rear deck of the RV Southern Surveyor.

a)



b)

Chaffing protection

To protect the catch within the cod end and the cod end itself there are two layers of chaffing protection. The first is a piece of heavy duty mesh, usually and old trawl cod end, with a mesh size of 60mm or less and a twine size of 5mm or more that surrounds the normal cod end. This protective cod end is secured in six places (corners and one in the centre of the top and bottom edge) using a chain loop that is secured to the sled rails using hammerlocks to reduce the risk of loss due to chaffing. The protective cod end is shown in Figure 3. On some seafloors the hard substrate caught and tore the protective cod end so a section of old conveyor belt was installed under the cod end to protect both nets. The conveyor belt is approximately one metre wide and and three and a half metres long. It is chained to the lower attachment bar. The chains are run up the conveyor belt for some distance and then bolted to the belt in four places. This is to help spread the load along the belt as previous ones have torn away when just attached by the leading edge. Figure 4 shows the attachments for the conveyor belt. When both the outer protective mesh and the chaffing mat are attached the internal cod end suffers much less damage and can last over 40 deployments.

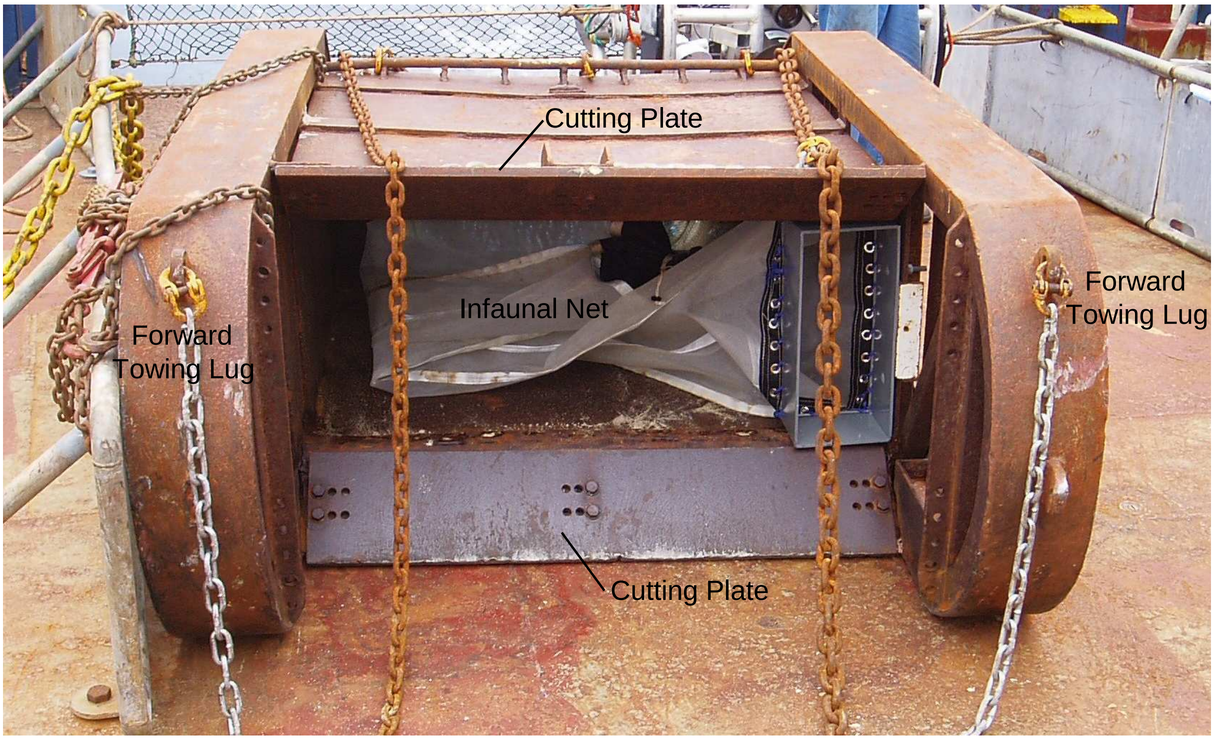
Figure 3: The protective cod end attached to Sherman (note the hammerlock attaching the chain to the bar in the centre of the lower edge of the picture).

Figure 4: The conveyor belt and its attaching chains. Note the bolts in the chains and how far up the mat the chains run to spread the load. The mat is lashed up over the sled to give a better idea of how the chains are attached.

Cutting Plates

To enable Sherman to sample the upper sediment layer more effectively a pair of cutting plates have been mounted on the upper and lower edges of the mouth area. These plates are shown in Figure 5 and visable in Figures 1 and 2(b). They are constructed out of 12 mm steel plate and mounted using three pairs of bolts. The plates can be adjusted to cut deeper than the runner but are usually set to the lower edge of the runner as shown below.

Figure 5: The mouth area of Sherman showing the cutting plates in position and the infaunal net.



Infaunal Net.

An additional infaunal net was bolted into the mouth area of Sherman in 2005 to sample the infauna on sandy substrates. The main target groups were polychaetes and small crustaceans. The position of the infaunal net is shown in Figure 5. The design of the infaunal box is shown below in Figure 6 and the net in Figure 7. The net was tied off using 2 mm twine wrapped at least three times around the lower cordura collar about half way along its length (200 mm in). The net retained vast quantities of sand and mud which showed just how much substrate was being filtered by the main net during a tow.

Figure 6: The infaunal box that is bolted into the mouth area of Sherman.

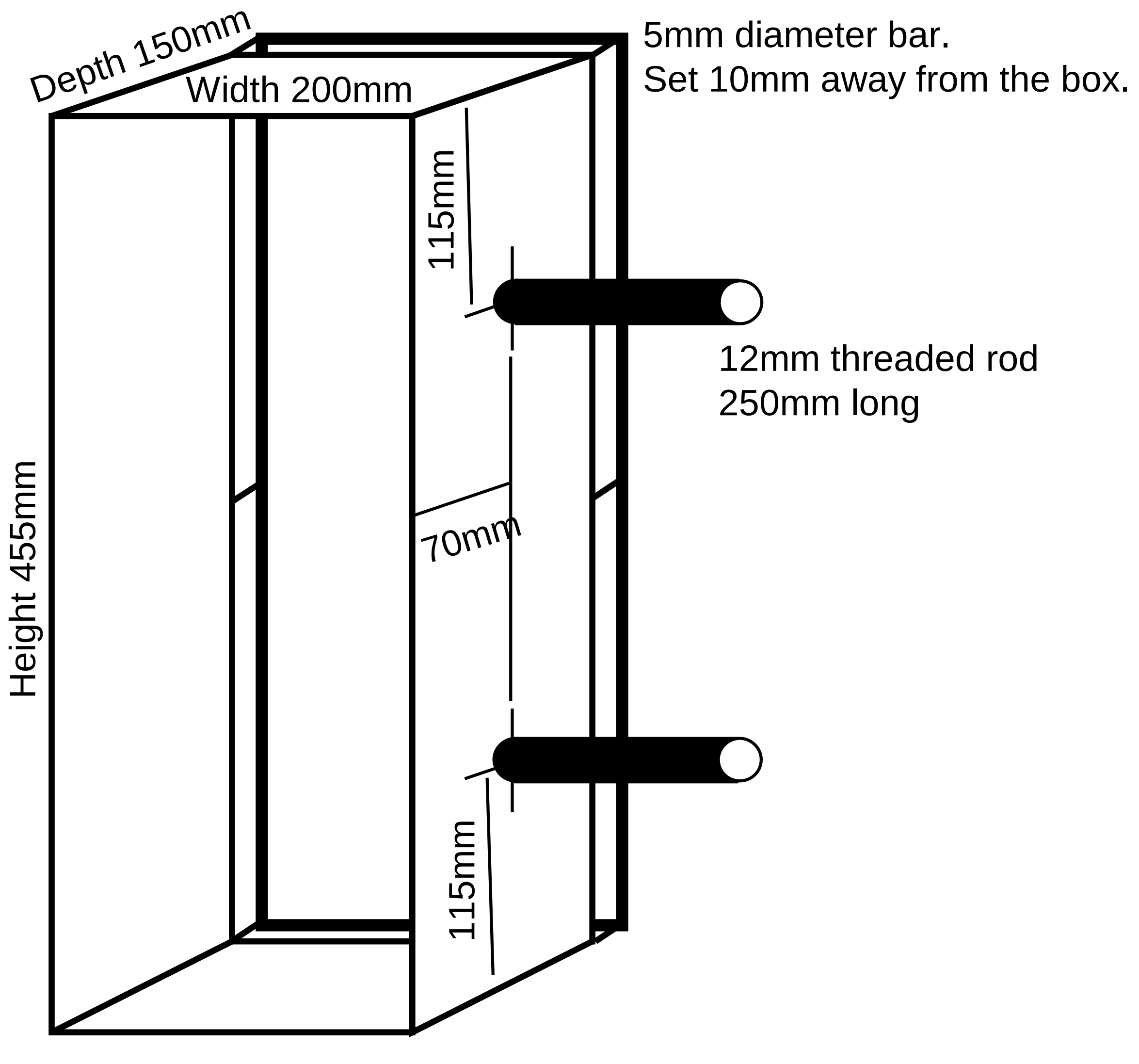
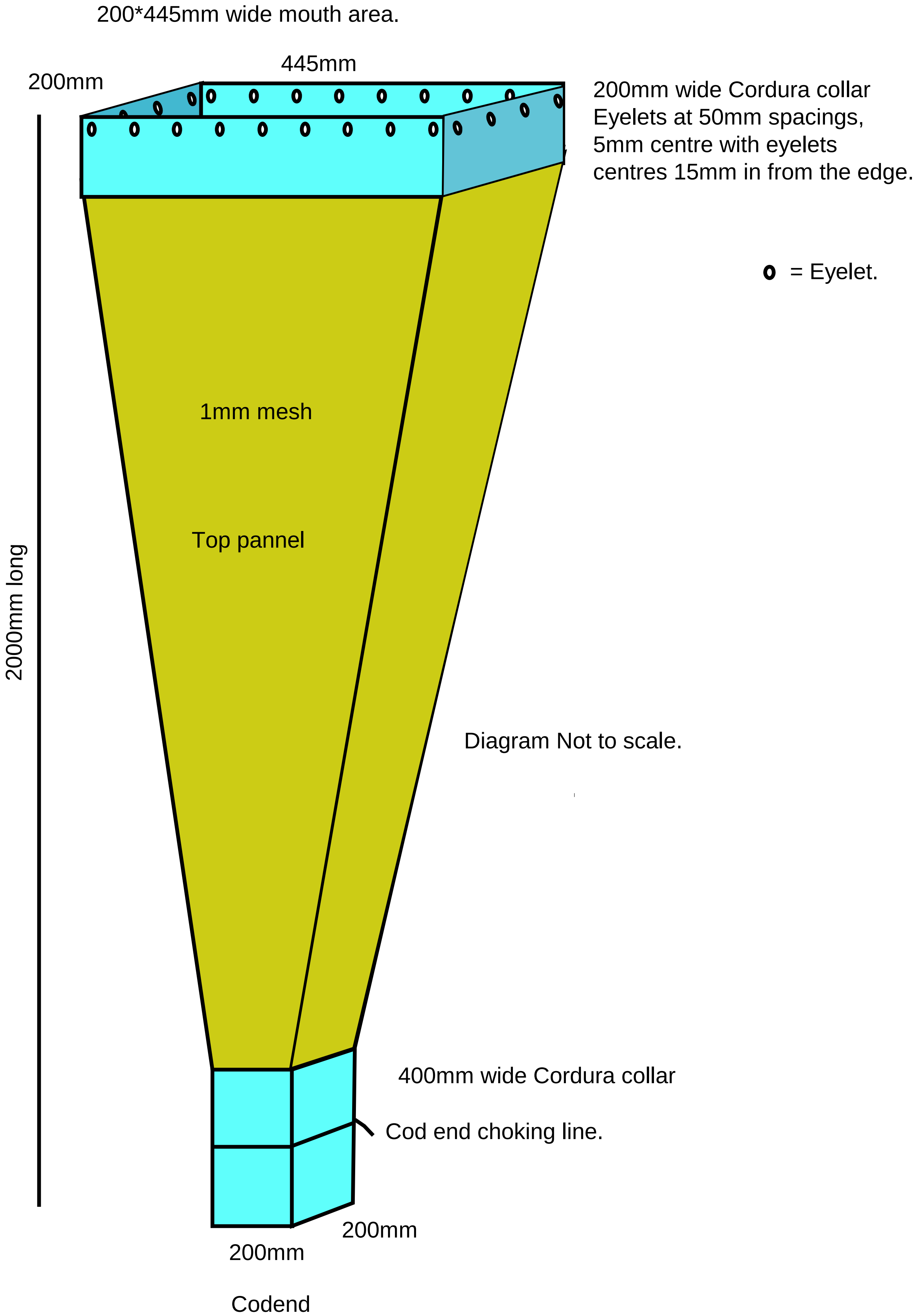


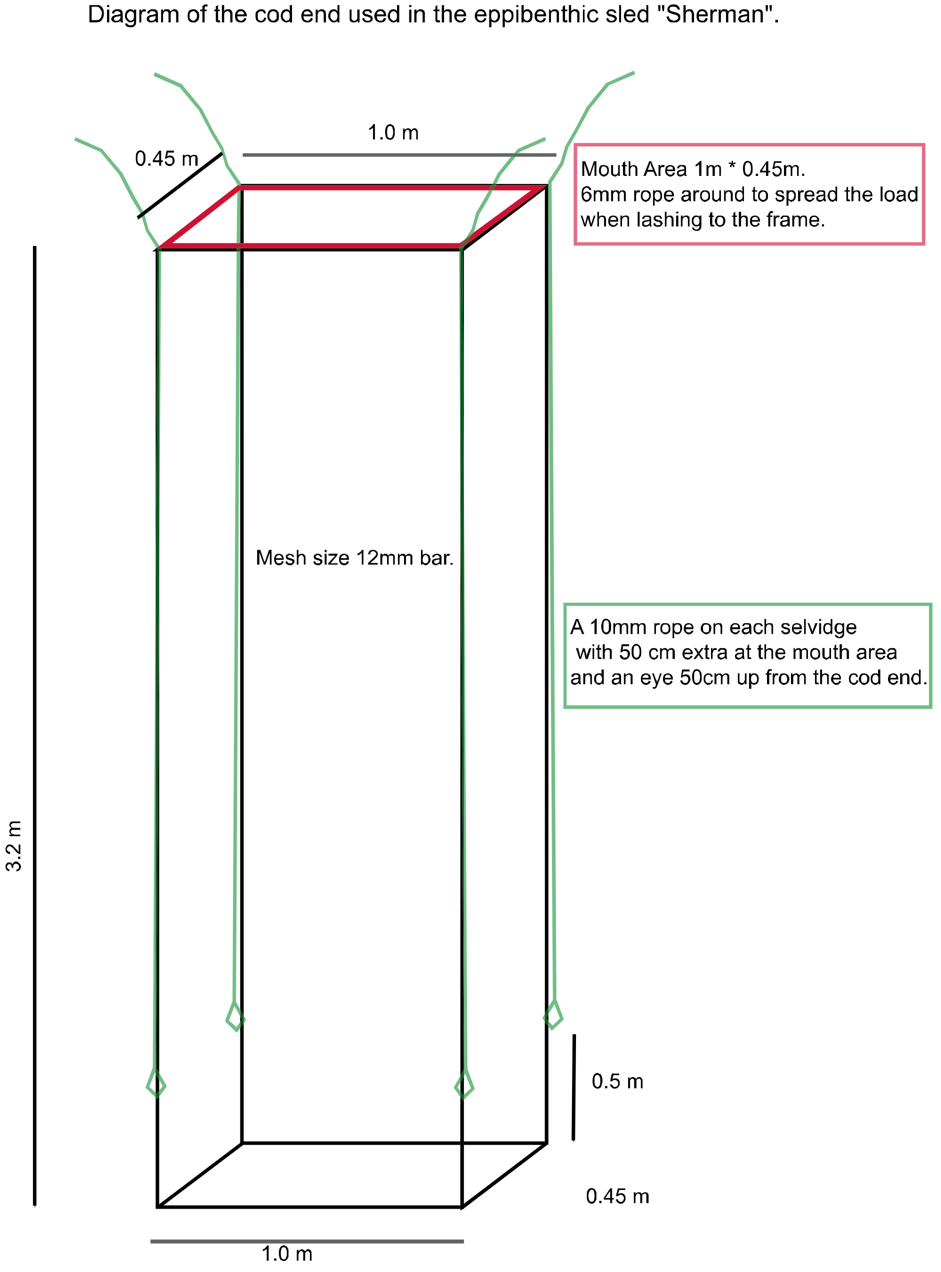
Figure 7: Sherman's infaunal net.



Sherman’s cod end net plans.

The cod ends for Sherman have to cope with a variety of materials, from rocks to sand and mud. The preferred material is knotless nylon for its durability and reduced abrasion on the samples. Figure 8 shows the approximate net plans. The ropes down the selvidges transfer the load of any heavy catch back to the cod end frame and sled. The cod end mesh has a 12 mm bar and 2 mm twine. It is tied off using a 10 mm double braid rope threaded through the pre-spliced eyes which is then wound tightly around the cod end at least three times, and tied with the appropriate cod end knot. The rope is usually wound around above the eye splices to help stop the rope slipping down and it has to be tight to avoid loosing specimens.

Figure 8: The net plan for Sherman's cod end.



Sonardyne Beacon.

A sonardyne transponder beacon is attached to Sherman to accurately geolocate Sherman on the seafloor and therefore to target areas of interest. The Sonardyne USBL (Ultra Short Baseline) system is an underwater acoustic positioning system.
The vessel transceiver sends coded interrogations as acoustic pulses from a hull mounted transducer. A Sonardyne transponder beacon attached to the Sherman listens for these interrogations and replys to the vessel. By measuring the return pulse "time of flight" and the arrival angle on the ships transducer the ship's system can determine the position of the platform relative to the ship. Subsequently using a GPS input signal the ship's system is able to record the true latitude, longitude and depth of the platform.
The beacon is mounted inside a stainless steel tube (6 mm wall thickness) to give the transponder some protection. The tube is mounted within the mouth area of the sled as shown in Figure 9.
Another benefit of the system is that it helps determine when the sled is on the seafloor as you can match the expected depth to the sled depth.

Towing speeds and wire ratios.

Sherman is towed at 2 to 2.5 knots for 10 to 20 minutes depending on the terrain. A wire out ratio of 2:1 is recommended in shallow water (to 200 m) and 1.8 to 1.5:1 in deeper water (to 700 m and > 700 m respectively). As a sonadryne positioning system is used the depth and position of the unit in the water column is known. If Sherman is used without a positioning system a wire out ratio of 2:1 should be used for all depths to ensure good bottom contact.
Sherman samples have been criticised on two points; too much material of low quality. The degredation of the material is usually a factor of the terrain the sled is dragged over and how long you drag the sled over the seafloor. It has been our experience that reducing the tow time to 10 minutes or less in productive areas gives a smaller number of better quality samples.

Future modifications.

Sherman is an evolving sampling tool that has changed over time to suite different needs. In the future we intend to mount a video or stills system to give us more information on the towing characteristics of the sled and the catchability of target organisms. This would also improve our understanding of the distribution of organisms in the deep sea as several recent voyages have shown that the coral reefs on seamounts are not wide spread but restricted to certain locations and missing from other, undisturbed areas, for as yet unknown reasons.

Acknowledgements

I am very gratefull for the assistance given by Dave Kube and his staff in our workshop here in Hobart for advising about material dimensions and bracing for Sherman as well as the professional manner in which the many repairs were carried out before and after voyages. I would also like to thank Dr Rudy Kloser for his helpful comments on this report.

References

Lewis, M. 1999. CSIRO-SEBS (Seamount, Epibenthic Sampler), a new epibenthic sled for sampling seamounts and other rough terrain. Deep-Sea Research 1, **46.** pp. 1101 – 1107.

Contact Us

Phone: 1300 363 400
+61 3 9545 2176
Email: enquiries@csiro.au
Web: www.csiro.au

Your CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.