

Seafish Research & development

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Channel Beam Trawl Roller Ball Foot Rope FEF 0738

Summary:

The aim of the project was to provide beam trawl fishermen with a practical and efficient means of reducing impact on the seabed, reducing discards, improving selectivity and reducing fuel consumption figures through the use of an innovative 'Rollerball' ground gear design. The project was co-funded through the European Fisheries Fund (EFF), the Seafish Industry Project fund (IPF) and Langdon and Philip (Brixham Trawler Owners).

The concept roller ball ground gear will replace the heavier standard hopper rig as currently used by beam trawlers. The roller ball beam trawl is designed to reduce the impact of the trawls on the seabed, allowing the trawls to be towed more easily, improving selectivity and assisting in avoiding catches of benthic material, non-target species and juvenile fish. Reducing the ground contact of the gear will also reduce fuel usage improving the environmental credentials of the gear.

From work carried out in the Hirtshalls Flume tank, Denmark, during a Seafish technology workshop. Model beam trawls were tested and showed a 10-15% reduction in drag when comparing the concept roller ball system with standard ground gear and demonstrated how the roller system would assist in reducing seabed impact.

The trials involved fitting two new trawls to the 'Barentssee' a 30m Beam trawler from Brixham. One of the trawls was rigged with the standard hopper ground gear with the other trawl rigged with the concept roller gear. Using load tension equipment the relative weights of the gear and the towing loads involved when fishing were established. The performance of rollerballs fitted to the trawl was also assessed using an underwater camera. Results from the sea trials showed a reduction in drag of 12-16% during fishing when compared with a standard trawl.

Catches were sampled to quantify any difference in retained and discarded fish between the two nets and the volumes of benthos was recorded to assess any difference in the benthic impact of the gear. Results showed a reduction in catches of some commercial species, Dover sole, Lemon sole & Plaice though an increase in Monkfish caught. A reduction in the discards of fish by 15% and benthos reduced by 4.7% was also observed.

Post trial modifications by Shaun (Barentssee skipper) and Edd (gear designer) have improved the performance of the rollerball trawl, with catch now on a par with the standard trawl. Further work is required to perfect the attachment of the balls to the fishing line and fully replace the standard hoppers in the bosom of the trawl. Work is due to recommence in the Spring of 2013.

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1. Introduction

This project will look at reducing the seabed impact of a beam trawl, improving the discard rate through selectivity and reducing the drag thereby reducing fuel consumption and emissions. This project will also improve the environmental credentials and public perception of beam trawling. The successful 50% project has shown that through using industry initiatives to drive innovation can result in targets being met. By utilising the same proven team of gear makers and fishermen as carried out the 50% project we are maximizing our chances of success. Results from an industry visit to the Flume tank in Hirtshalls Denmark have already highlighted possible costs savings and specific elements of the trawl that could be improved upon.

Project 50% has gone a long way to improving the selectivity of the SW beam trawl fleet with proven results in the reduction of discards by 57% overall. The project demonstrated to the industry that using their own experience they could make alterations to their gear to successfully reduce discards while maintaining profitability and viability of their vessels. As a follow on to the 50% project some of the skippers and gear makers that were involved wanted to take the gear alterations a step further and make radical changes to the standard beam trawl design and rigging. Model beam trawls, including the new alterations, have been tested in the tank at Hirtshalls, Denmark by the project team and gear technologists from Seafish. Tank results looked very promising showing a decrease in drag on the gear of between 10-15% and by altering the ground gear the possibility of further reducing the discards of bottom living species and benthic material.

The main concept of the alterations is to replace the traditional rubber disc footrope that drags along the seabed with one made up of large diameter roller balls to enable the gear to run smoothly over the seabed. Included in this concept is the removal of the heavy frame chain to be replaced by a much lighter chain. The net making team of Darren Edwards and Alan Porter designed and construct a full scale trawl based on the results of the models they built and tested in the Danish Flume tank. The gear was tested at sea during trials conducted onboard a Brixham beam trawler. The Beamer chosen for the work was the 30m Barentzee skippered by Shaun Gibbs and owned by Langdon and Philip who run a fleet of beam trawlers from Brixham. As one of the skippers that took part in the '50% project' Shaun has experience in carrying out gear trials and was part of the group that visited the Hirtshalls Flume tank.

The new design of Roller-design was fitted as an addition to the large mesh 50% net and compared with a standard 50% net fitted to the opposite beam. Total drag on each net was measured using Seafish load cells and data logging gear, providing a comparison between the drag of a standard beam trawl versus the rollerball trawl. Using the load data an estimate of possible fuel savings were calculated. The catch compositions of both gears were measured to assess selectivity and discard rates of the experimental gear to the vessels standard gear.

The main aims of the project were:

To reduce the seabed impact of a beam trawl

To reduce the discard rate and improve the selectivity of a beam trawl

To reduce the drag thereby reducing the fuel consumption in beam trawling

To improve the environmental credentials and public perception of beam trawling

1.1. Background

Fishermen are under increasing pressures to reduce discards and unless they show that reductions in discards are being made their future fishing opportunities will be effected. Currently in certain EU fisheries quotas and 'days at sea' are being cut if discard reductions are not made.

Beam trawling has been highlighted by environmental groups as needing to address issues with discards and gear impact. This project looked at ways of reducing both of these components through modification to the design of the gear. The steady increase in fuel prices was another driver for the fleet to look at means of reducing their overall fuel consumption. By adopting the innovative rollerball trawl vessels can reduce their fuel consumption enabling increased profitability at the same time reducing their environmental impact.

1.2. Benefits for Industry

Reducing discards is now a priority issue for both UK and EU fisheries managers. This project will look to provide an innovative, but relatively simple solution to a specific discards issue highlighted by fishermen and gear makers. It is recognised that solutions to fisheries issues that come about through engagement with industry have enhanced levels of adoption in the long term.

The main benefit of this project is to provide fishermen with a practical but very efficient means of reducing impact on the seabed, reducing discards, improving selectivity and improving fuel consumption figures. Faced with diminishing quota and increasing pressures to reduce the levels of discards, fishermen are being tasked with providing solutions to ensure a sustainable future for fisheries. Innovative measures need to be developed to provide fishermen with the tools and knowledge to assist in the reduction of discards to safeguard the local fishing industry.

The project will also lead to a reduced environmental impact, improved fish stocks through increasing the survivability of juvenile fish, improved quality of catches and an opportunity of premium prices being achieved through supplying high quality sustainably caught fish whilst reducing the environment footprint and a reduction in emissions.

1.3. Communications

As one of the key outputs for the project the UK fishing industry and relevant authorities were informed of the outcome of this project by:

1. Press releases to all relevant media (eg Fishing News, local and national newspapers)
2. Results distributed to Inshore fisheries groups such as IFCA,s FLAG's, regional fishermen's associations
2. Industry, Seafish and Government Dept and Agency websites
3. Word of mouth within the industry - not to be underestimated particularly with respect to the catching sector

1.4. Media articles

Alongside articles produced for appropriate media outlets a blog was written by Gus Caslake, a Seafish gear technologist, on the work carried out during the sea trials. A video was also produced by Seafish, outlining the work carried out during construction and trialling of the rollerballs combining photographs with underwater video footage of the trawls in action. Some of the articles and links are shown below:

Latest Seafish blog posts:

[Roll up, Roll up! South West gear trial reports success](#)

My latest trip was to be onboard the Barentssee a 30 metre beam trawler from Brixham. I was joining Shaun Gibbs and crew to carry out sea trials looking at a replacing a standard rubber hopped ground gear with a concept rollerball system.

Seafish announces success of revolutionary ground impact trial

[Seafish](#) has today announced that industry trials of revolutionary fishing gear have been successful in reducing ground impact caused by beam trawlers and further reducing fish discards.

- **Seafish** Monday 23 July 2012 <http://www.seafish.org/about-seafish/news/seafish-announces-success-of-revolutionary-ground-impact-trial>
- **Fish News EU** Monday 23 July 2012 http://www.fishnewseu.com/index.php?option=com_content&view=article&id=8632:top-gear-found-to-reduce-discards&catid=44:uk&Itemid=55
- **The Fish Site** Tuesday 24 July 2012 <http://www.thefishsite.com/fishnews/17754/seafish-announces-success-of-revolutionary-ground-impact-trial>
- **FIS** Tuesday 24 July 2012 <http://fis.com/fis/worldnews/worldnews.asp?l=e&ndb=1&id=54058>
- **World Fish** Tuesday 24 July 2012 <http://www.worldfishing.net/news101/revolutionary-ground-impact-trial-success>

Fish Update Tuesday 24 July 2012

http://www.fishupdate.com/news/fullstory.php/aid/17934/Seafish_announces_success_of_revolutionary_ground_impact_trial.html

The screenshot shows a press release from Seafish dated 8 August 2012. The headline is 'Seafish announces success of ground impact trials'. The text describes the success of a revolutionary fishing gear trial on the Barentssee beam trawler, highlighting a 17% reduction in ground impact and a 17% reduction in fish discards. It mentions the involvement of Seafish, the Seafish Innovation Fund, and various industry partners like the Seafish Innovation Fund, Seafish Industry Project, and Seafish Gear Technologists.

The screenshot shows the Seafish website's news section. The main headline is 'Seafish announces success of revolutionary ground impact trial'. Below the headline, there is a short summary of the trial's success. The page also features a 'What's new?' section with a link to 'Aquaculture news alert' and a 'RSS Feed' button.

The screenshot shows a news article on the Worldfishing website. The headline is 'Revolutionary ground impact trial success'. The article, dated 24 July 2012, reports that Seafish has announced the success of a revolutionary fishing gear trial on the Barentssee beam trawler. It notes that the trial resulted in a 17% reduction in ground impact and a 17% reduction in fish discards. The article also mentions the involvement of Seafish and the Seafish Innovation Fund.

2. Methodology

The main concept of the alterations is to replace the traditional rubber disc footrope that drags along the seabed with one made up of large diameter roller balls to enable the gear to run smoothly over the seabed. Included in this concept is the removal of the heavy frame chain to be replaced by a much lighter chain. The net making team of Darren Edwards and Alan Porter have designed and constructed a full scale trawl based on the results of the models they built and tested in the Danish Flume tank. The constructed gear will be tested at sea during trials conducted onboard a Brixham beam trawler. The Beamer chosen for the work is the Barentzee skippered by Shaun Gibbs and owned by Langdon and Philip who run a fleet of beam trawlers. As one of the skippers that took part in the '50% project' Shaun has experience in carrying out gear trials and was part of the group that visited the Flume tank.

The new design of Roller-design will be fitted as an addition to the large mesh 50% net and compared with a standard 50% fitted to the opposite beam. Total drag on each net will be measured using Seafish load cells and data logging gear. This will give a comparison between the drag of a standard beam trawl with that of the design from the original 50% project. This will give an indication of fuel savings that could be made with the roller ball gear. The catch compositions of both gears will be measured to assess selectivity and discard rates of the experimental gear to the vessels standard gear.



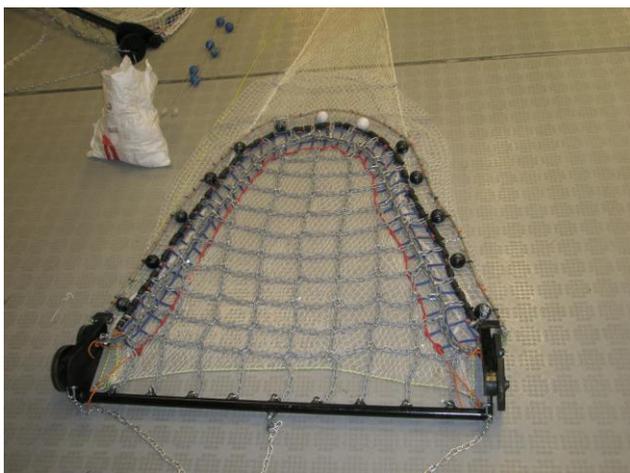
The 30m Barentssee BM 361

2.1. Technical scoping – Hirtshalls, Denmark Flume tank trials

During September 2011 a group of Brixham Beamer skippers, owners and net makers travelled to Denmark to attend a Seafish gear technology held at the Flume tank in Hirtshalls. The group included Darren 'Edd' Edwards and Alan Porter net makers/designers, Dave Langdon beam trawl owner and Shaun Gibbs and Richard Chamberlain beam trawl skippers.

Prior to embarking on the trip Edd and Alan had designed and made three model beam trawls. The first trawl was a copy of the standard beam trawl as used by the majority of SW beamers. The other two trawls included the concept rollerball system. All three trawls were tested in the tank during the visit, alterations were made to the trawls as required and an assessment of the drag of each trawl was made using the tanks load cells. The results of this assessment

showed a reduction in drag of between 10-15% of the modified trawls depending on design and the speed of the trawl through the water.



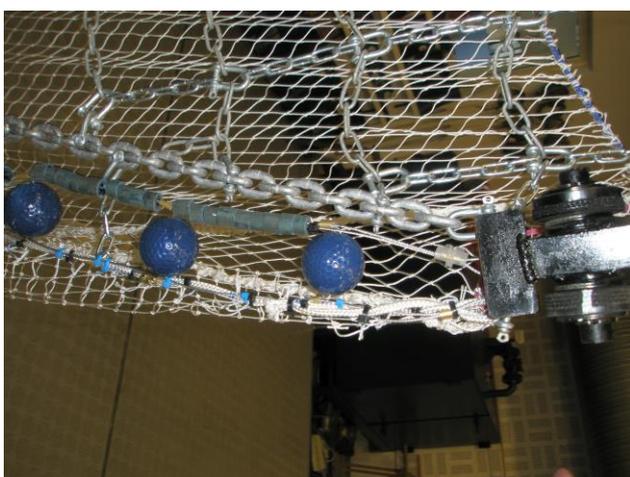
The model beam trawl



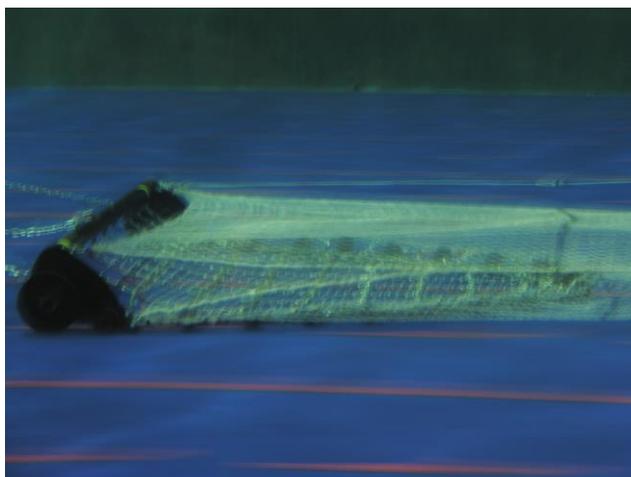
Edd & Alan work with Seafish technologist Mike

Results from the flume tank showed the potential of the rollerball not just in terms of reducing drag but also in terms of reducing impact on the seabed which in turn could have a positive effect on reducing discards.

Both Edd and Alan were keen to develop a full scale version of the models tested and both Dave Langdon and Shaun Gibbs committed to testing the concept gear when completed. In order to assist in covering the cost of purchase, construction and testing of the trawls it was decided that an application would be submitted to the European fisheries fund (EFF). With the assistance of Seafish the application was submitted by the South West Fish Producers Organisation (SWFPO). On confirmation from the Marine Management Organisation (MMO) that the application had been successful Edd and Alan sourced and began construction of the rollerball trawl.



Concept Rollerball ground gear (model)



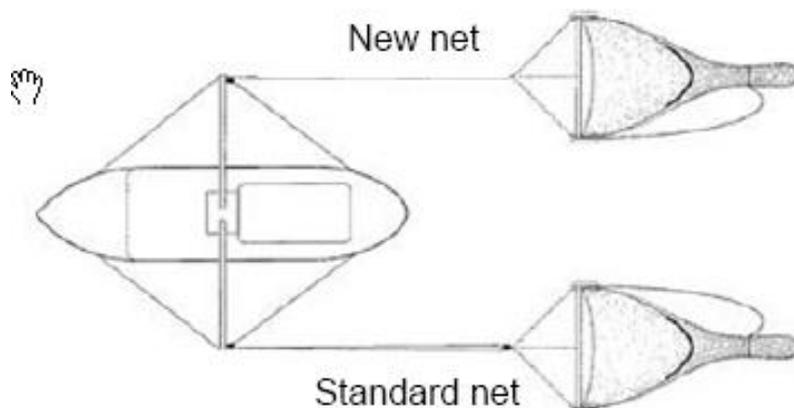
Model trawl being tested in the Flume tank

2.2. Fishing Gear

Beam trawls are the original form of towed gear and have been used in European waters for over 700 years. The beam trawl is a simple conical net construction from two sheets of netting. The length of the beam to which the upper part of the trawl is attached defines the horizontal

opening of the net. The ground rope is rigged to curve back into the lower net sheet with the area between the beam and the round rope being taken up by 'tickler' chains attached to the aft side of the shoes/wheels attached to each end of the beam. Beam trawls used in the Southwest are nearly always fitted with chain mats rather than traditional 'tickler' chains due to the generally harder ground in the region. The chain mat is attached to the beam, allowing it to ride over the larger boulders and preventing them from entering the gear.

For the purposes of the trial one of the trawls will be rigged as standard and the other one will be rigged with the concept rollerball system.



In order to ensure a fair comparison during the trials two brand new identical trawls were constructed from the chain mat up. The only difference between the two trawls was one was rigged to the standard specification and the other had the concept rollerball ground gear.

2.3. Gear construction

Gear was constructed by Edd and Alan in the weeks running up to the sea trials. The nets were then transported to the harbour side for fitting onto the Barentszee. The Barentszee arrived back into Brixham on Thursday the 27th June, once the fish had been landed; Edd and the crew began the job of stripping the old nets from beams ready to take the new trawls. Friday involved attaching and setting up the starboard side (standard) trawl with Saturday spent fitting the Port (Rollerball) trawl. Extra lugs needed to be welded to the beam shoes to give as wider spread as possible on the ground gear to attach the rollerballs.

Fitting of the new gear to the rollerball ground gear did not pose a problem and all went well. Sunday saw the final fitting of the trawls and the smaller wheels on the beam shoes were changes on each of the beams. Once the gear on both sides was complete the gear was weighed using the Seafish load cells. The standard gear weighed in at 3,700Kg's and the rollerball gear 3,400Kg's a saving of 300Kg's.



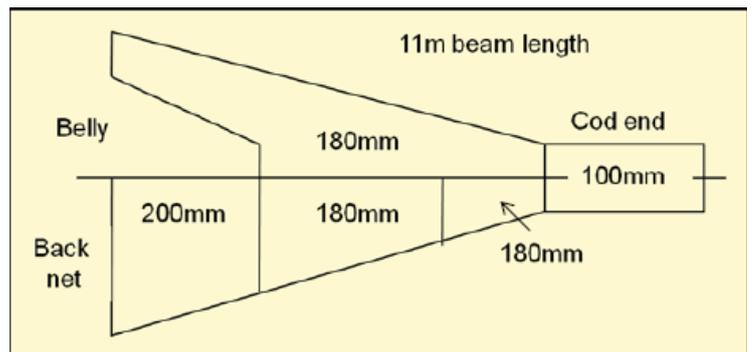
Ground gear being constructed



Nets being rigged on the Barentssee

2.4. Trawl plans and designs

The trawls on the Barentssee are attached to an 11m beam with a standard 5 link square chain mat. The net has increased on the top sheet, as part of the 50% project initiative, from 200mm to 300mm in the cover reducing to 180mm net in the taper and 180mm netting throughout in the bottom panel. The codend is made from two panels, constructed from 100mm netting. Both standard net and trial net were built brand new and were identical.



2.5. Concept roller ball ground gear

The concept gear involved replacing the standard rubber hoppers that make up the ground gear of the trawl with rubber rollers that enabled the gear to roll over the seabed rather than being dragged through it. The rollerballs were of solid rubber construction weighing 8.6Kg's each. In order to attach the rollerballs to the fishing line and ground rope, Edd and Alan designed and made an axle that ran through the centre of the ball with a plate welded on each end holding a lug with which to attach the balls. The completed ball and axle weight was 11Kg's.

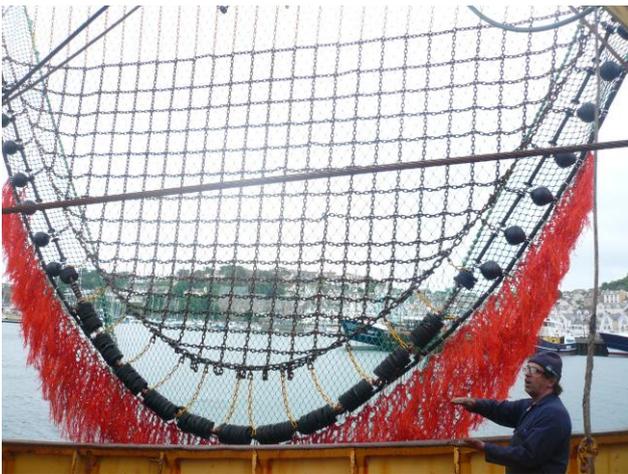


Concept Rollerball & axle



Rollerball & standard hopper ground gear

The initial setup of the concept trawl had nine roller balls fitted to the 'wings' on each side of the trawl, with a standard hopper rig retained in the 'bosom' of the trawl. A rollerball 'bosom' section was constructed and taken to sea; the intention was to completely replace the standard hopper rig with rollerballs throughout the 'bosom' section once initial tests had been completed.



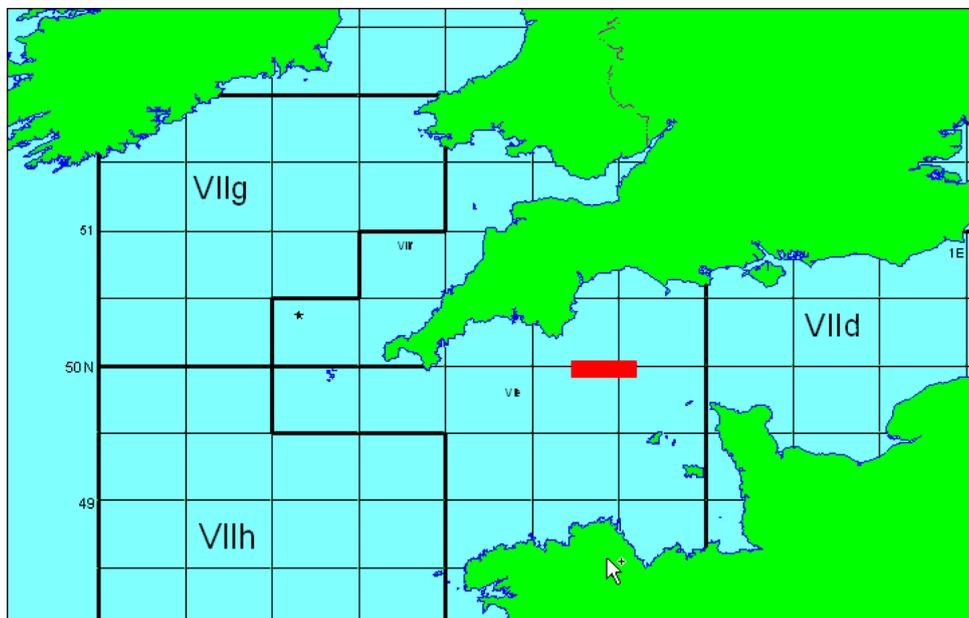
Complete concept ground gear and chain mat



Standard 'bosom' section

3. Sea Trials

Shaun Gibbs and the crew of the Barentssee accompanied by Gus Caslake (Seafish), Simon Armstrong (Cefas) and Edd set sail from Brixham on Monday 2nd July. In discussions with Edd and Shaun the plan for the trial was to test the gear over a range of grounds and substrates, an area to the South of Brixham was chosen to conduct the trial.



Area fished during the July Sea trial

As this was a commercial trial we would be working to Shaun's standard practice of 90 minute tows. The catch from the standard gear and the rollerball gear would be kept separate for each tow and sampled at regular intervals throughout the trip.

Monday -the Barentssee reached the fishing grounds around 1pm and the gear was shot away for the first haul. Working the gear during the afternoon and night initial results indicated that the starboard side (standard gear) was fishing slightly better catching on average 2 Dover soles more and 7 plaice, the other species catches were similar on both sides. In response, a slight alteration was made to the rollerball side with the frame chain weight reduced, replacing 5m of 26mm chain with 19mm chain. The gear was shot away again and fishing continued. During the day the rollerball side continued to be slightly down on the number of soles caught but appeared also to be catching less benthos and stones. During tow 14 the load sensors were fitted to the gear on both sides. The results showed that the portside roller gear when towing at 3.5 knots had a load of 2.8 tonnes compared with the standard gear load of 3.2 tonnes. At 4 knots the load was 3.2 tonnes compared with 3.8 tonnes for the standard gear, a saving of 600 Kg's per side.



Load cells being fitted to the warps

Tuesday - Haul 17 the rollerball gear was brought alongside and the footrope was taken in two links and the fishing line taken in a link as Edd thought the fishing line may have stretched. This gave the balls a better angle as the frame chain was not so tight allowing the rollerballs more movement. On the subsequent tow after these adjustments the rollerball side was up on fish caught and again appeared to be fishing slightly cleaner. During the night these adjustments improved the rollerball catch rates so in the first morning haul the same adjustments were made to the starboard side. On the next haul the adjustments made to the starboard side had not worked so the fishing line was let out one link.

Wednesday night - after readjusting the starboard side the rollerball side was now down on plaice and sole as seen before. First thing Thursday morning (haul 36) the rollerball gear was brought aboard and the top section 5.5m of rubbered wire footrope was taken out and replaced with chain. It was thought that this would allow more 'play' for the balls improving their angle on the gear.



Replacing the rubbered wire footrope

Thursday afternoon -the underwater camera was deployed to have a look at the alterations. The balls were marked with tape and they could be clearly seen spinning and making good

ground contact on the footage. The footage also showed that the throme ropes fitted in the sides of the trawl were well clear of the seabed and could possibly be removed further reducing drag.



Red throme rope on the wings

The weather begins to pick up during Thursday afternoon and the underwater footage clearly shows the gear lifting off the seabed. Fishing is poor both sides due to the weather with the rollerball side still slightly down on fish. Edd's thoughts are that exchanging the rubbered wire has not had any effect.

Catch sampling calculations from the first 50 hauls show that on average the rollerball gear has been down 1 sole, 7 plaice and up 1 monk per haul. Bait fish (gurnards, dogs), pouts, brill, turbot and lemon catches had been similar for both sides.

On Friday morning rubber straps (rubber strap +2 linker shackled to the chain arm) were put between the rollerballs as it was possible that fish were finding their way out between the gaps. The rollerball side still appears to be catching less benthos and stones. Catch samples to date show that the rollerball side is down 23% on sole, 64% on plaice but up on monk and gurnards by 10% and 17% respectively.



Rubber spans being fitted between the balls

Friday afternoon – codend out on the standard side, no rocks on the rollerball side, this is the second time this has occurred during the trip. The rollerball gear appears to catch a lot less debris and rocks. Now that the straps have been fitted between the balls the portside is catch the same amount of sole. During the night on 75% of the hauls the rollerball side was up on sole though still down on plaice.

Saturday morning - the weather has changed and is now blowing a southerly gale 8. Putting the balls into the bosom has had to be cancelled. Worries that the rollerballs would not fish so well in poor weather have not materialised. Rollerball side is now up slightly on sole and similar for the other species. Haul 66, rollerball side up on sole 31 to 21 on the standard side and also up on plaice 50-42.

Saturday afternoon – rollerball side down all of a sudden, net is brought alongside and stopped to check for holes, no holes found. Edd decided to let the footrope out one link each side in the hope this would help. The subsequent hauls the fishing improved on the rollerball side though still down slightly on the standard gear. This continued on all hauls till the end of the trip the following day.

Sunday – Arrived back in Brixham and started to strip down the rollerball section. When the gear was lifted to the block, revealing the bosom it was noticeable that the fishing line had come up over the top of the footrope which would have badly affected the fishing and probably the reason why the rollerball side was down on fish from Saturday afternoon onwards. The fishing line was reset so there was a fist sized gap between the footrope and fishing line. The larger 26mm frame chain replaced the 19mm chain fitted during the trial to bring the gear back to the original specification.

Shaun retained the rollerball gear on the port side during full commercial trips for the next four months. Edd was in regular contact with Shaun during this period making alterations to the gear as Shaun requested. The performance of the gear improved from the initial trial to a point where Shaun commented that “on certain grounds, particularly stony ground, the rollerball trawl would out fish the standard gear”. In November an issue arose with the attachment of the balls. Shaun found it difficult to keep the balls attached in poor weather. The rollerball trawl was taken off the Barentssee at this point, the intention being for Edd to source a new means of attachment for the balls and recommence the trial in the spring.



Rollerball gear in its current form

4. Catch Sampling

The sampling method largely followed the same methodology as used in the 50% project to compare the catches between the standard and modified gear. Simon Armstrong from Cefas has previously sampled the Barentssee on a number of occasions during the 50% project and was very familiar with the working practices of the vessel. Gus Caslake from Seafish assisted Simon in collecting samples from 35 of the 75 hauls completed during the trip. Those hauls where there was damage to either trawl or hauls were cut short were not sampled. To allow comparison between the two trawls samples were taken from each side as each side was processed separately by the crew. Shaun also filled out a wheelhouse log for each haul.

The following information was recorded for each haul:

- Wheelhouse log – Shooting and Hauling date, time and lot/log, depth along with a haul number and the wind strength and direction
- On sampled hauls - A species by species catch composition of the haul per side to be landed and an evaluation on the bulk (in baskets) of the discarded fish. Length frequencies were also recorded for the retained fish and from a sample of the discarded species.

At sea during sampled hauls, all retained fish were measured from both sides along with a sample of the discarded catch. Initial results show a reduction of 17% in the volume of fish discarded.

Overall the catch rates from the trip Shaun felt were satisfactory for the number of hauls completed.



Simon Armstrong sampling the catch and measuring length frequencies

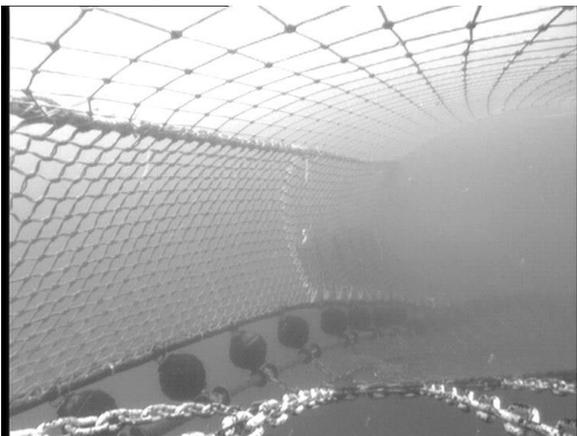
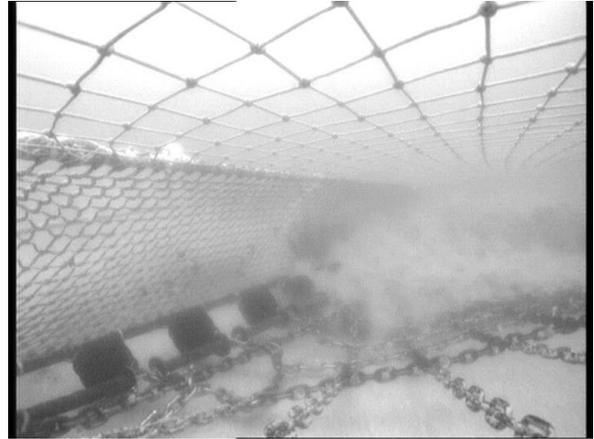
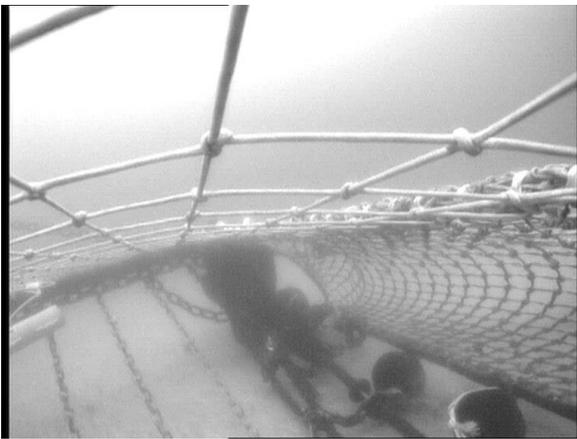
4.1. Underwater Filming

To assess how the rollerballs were performing when the gear was fishing on the seabed an underwater camera supplied by Seafish was used to capture footage of the balls in action. The camera lens linked to a digital hard drive was fixed to the beam trawl in a number of locations to give various aspects of the trawl during fishing operations. The camera recorded footage whilst the gear was deployed and once hauled the footage could be retrospectively viewed on computer.



Camera and hard drive fitted to the down chains

In order to see whether the balls were rolling effectively they were marked with tape prior to deployment. Analysis of the footage showed that the balls were rolling along the seabed as they had been designed to do. The footage also enabled minor changes to be made to the gear thus improving performance. Below are a number of still shots taken from the video footage collected during the trials. An edited copy of the underwater footage captured has been produced alongside a digital media account of the work carried out during the trial to supplement the information included in this report.



Stills taken from the underwater video footage

An edited video of the underwater footage taken during the trial will be available to accompany this report.

5. Results

During the trial catches were sampled from 35 of the 75 completed hauls during the trip. On each haul the catch from each trawl was kept separate and an assessment was made of the 4 key species Dover sole, Monk, Plaice and Lemon sole. During the 35 sampled hauls all retained fish from both trawls was measured, total discards (fish and benthos) were recorded and a sample of the length frequency of the discarded fish was also measured.

5.1. Catch results

The results of the 35 sampled hauls show a 1% reduction in the total volume of retained fish caught in the rollerball trawl compared with the standard trawl. Total volume of discarded fish and benthos in the rollerball trawl was reduced by 15.2% and 4.7% respectively.

	Standard Trawl	Rollerball Trawl
Total retained Catch (bskts)	37.7	37.3
Total Fish Discarded (bskts)	46.0	39.0
Total Benthos Discarded (bskts)	127.0	121.0

Standard 5 stone baskets used

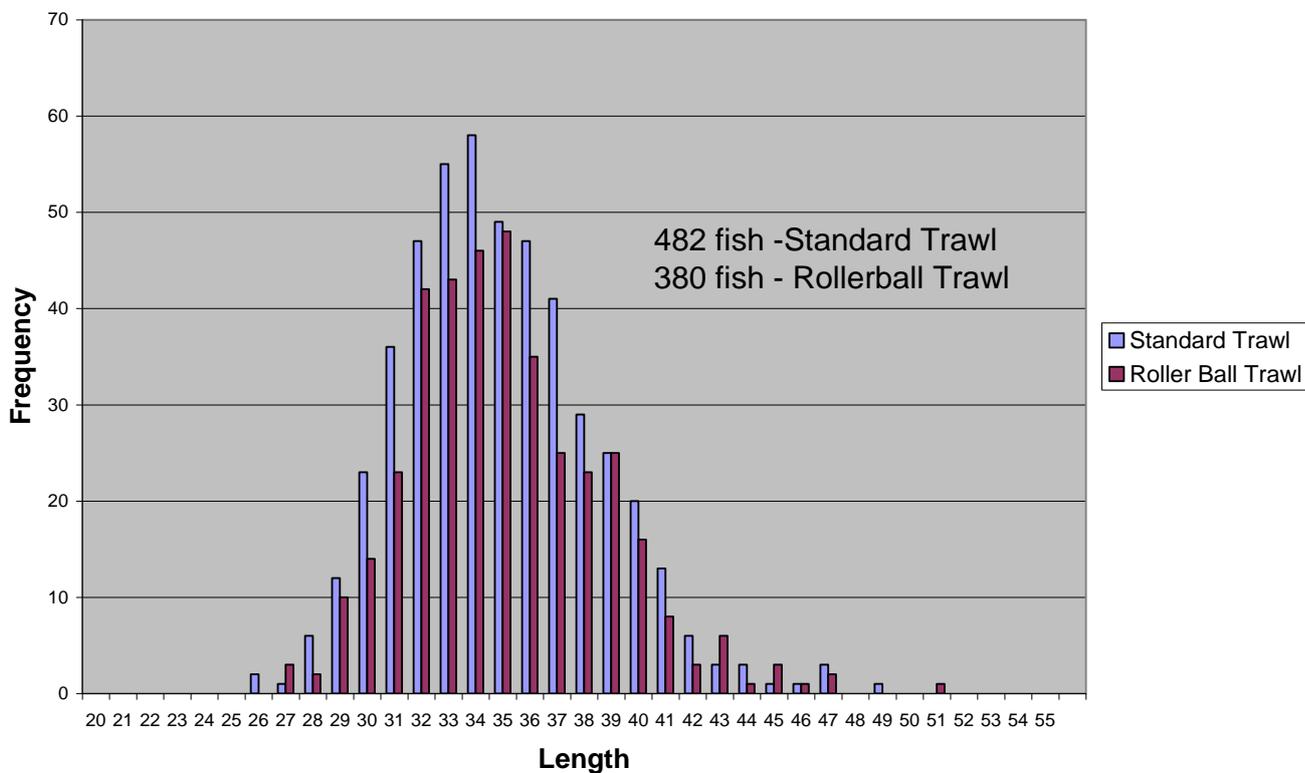
In terms of numbers of fish caught per trawl from the 35 sampled hauls, the rollerball trawl catches were down for Dover sole 21.2%, Plaice 27% and Lemon sole 20.8% though up for monk by 23%.

	Standard Trawl	Rollerball Trawl
Dover sole	482	380
Monkfish	199	245
Lemon sole	168	133
Plaice	752	547

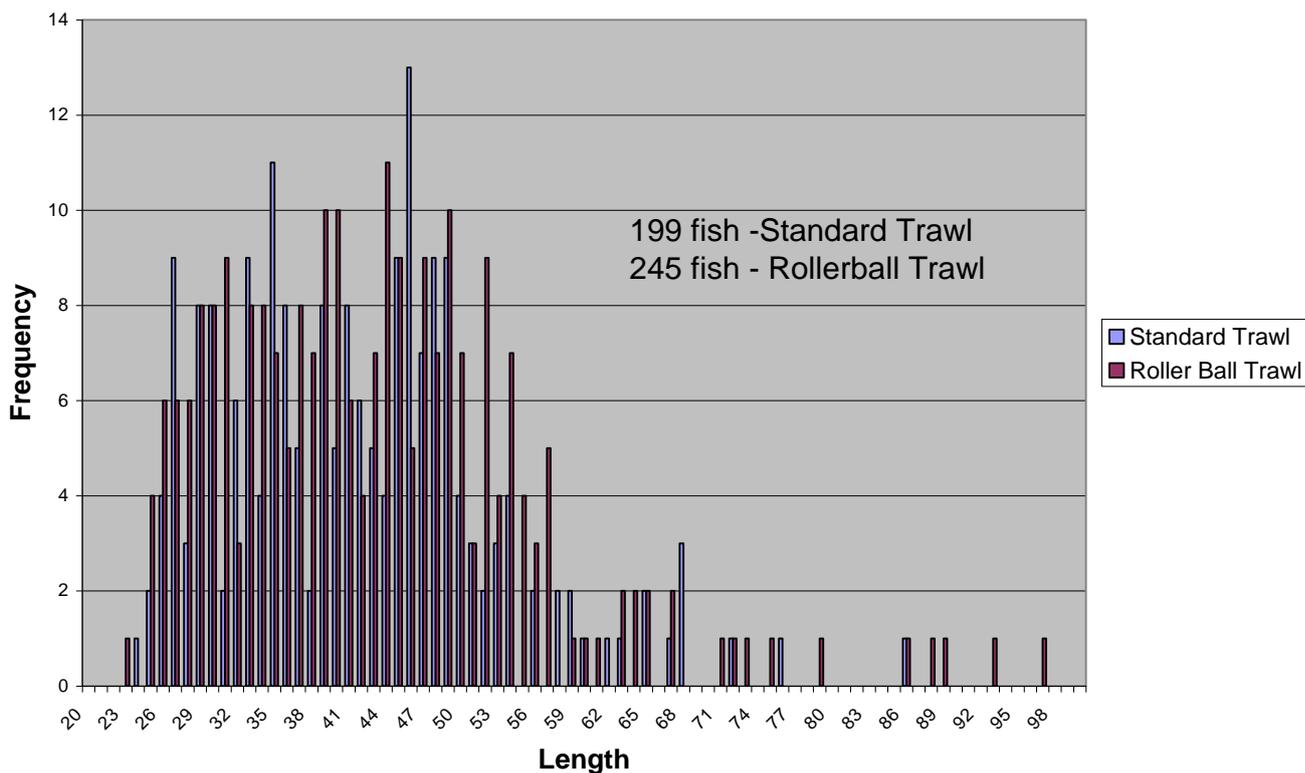
Numbers of fish caught and measured from the 35 sampled hauls

Below are the length frequencies for the 4 main commercial species. The length frequency for Dover sole shows that the numbers caught in the rollerball trawl are less throughout the whole length range and it is not just the smaller run of fish being lost.

Dover Sole Length Frequency

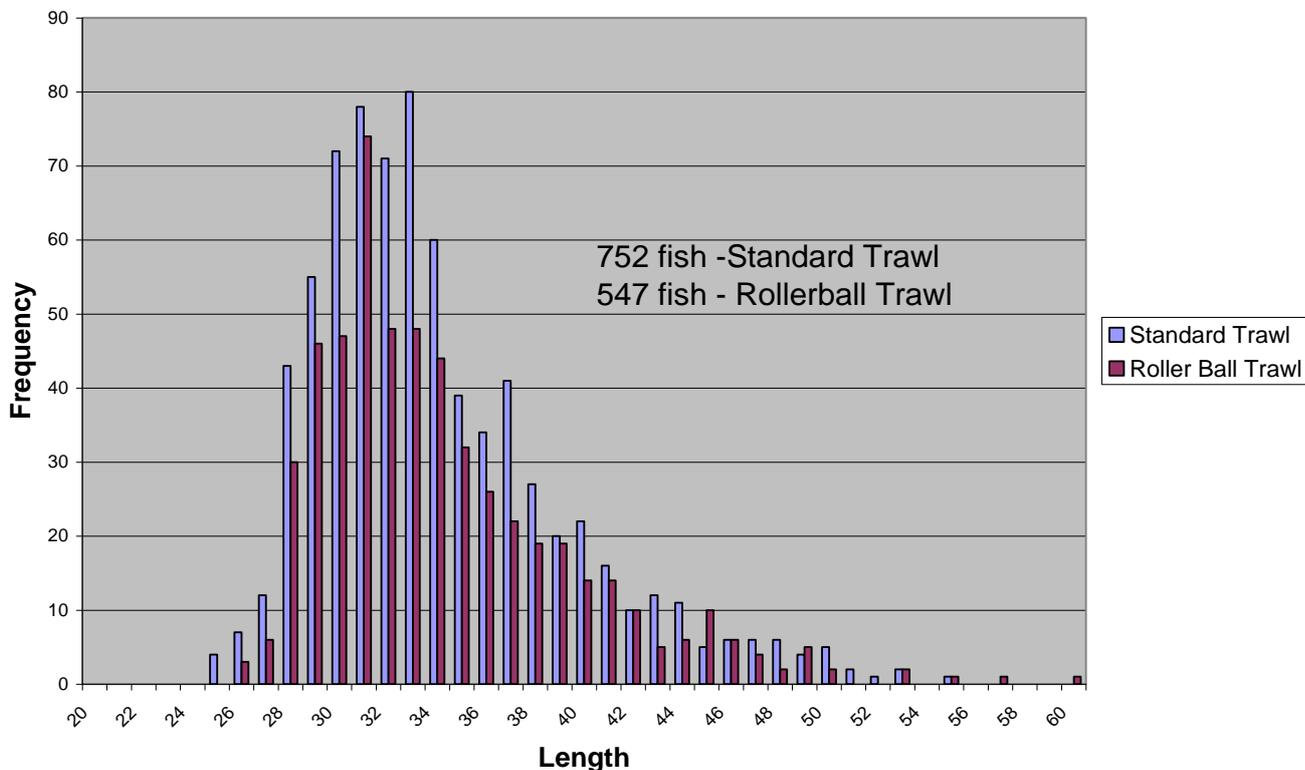


Monkfish Length Frequency



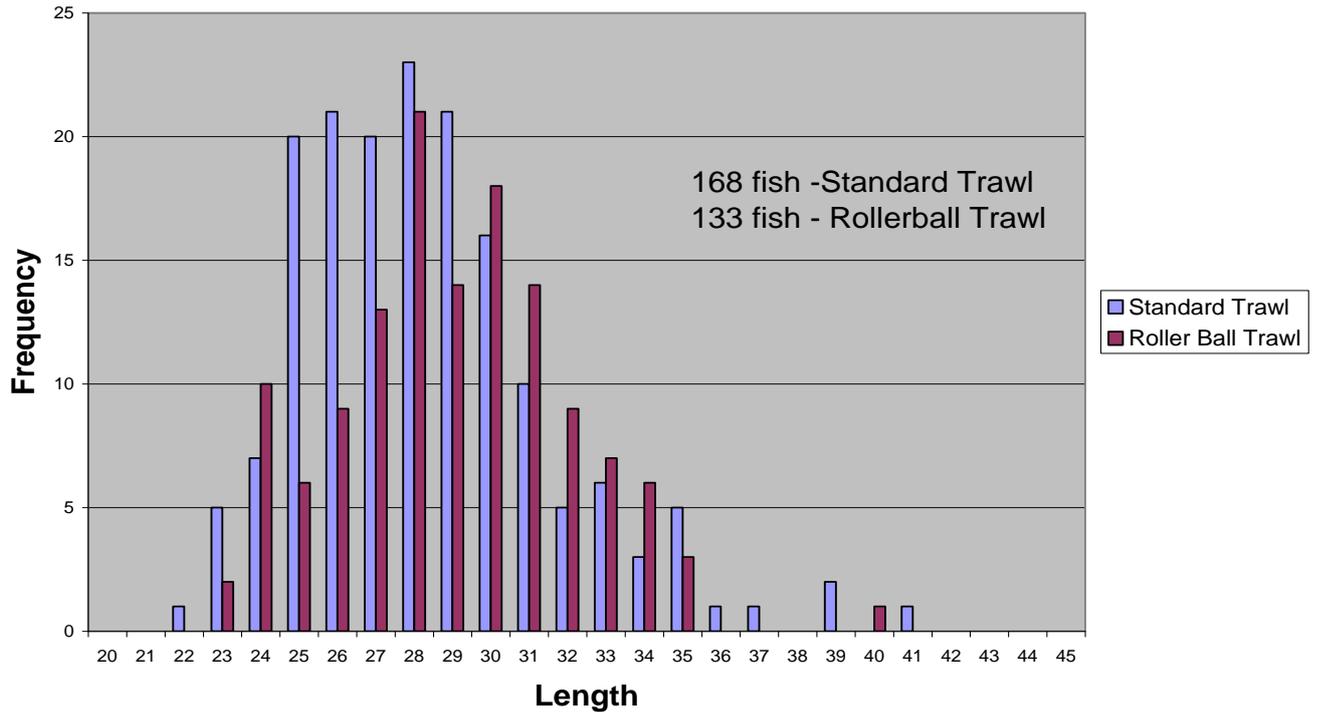
The monkfish length frequency shows the additional fish being caught by the rollerball throughout the length ranges. This additional catch of Monkfish may in part be due to the additional lug welded on the outside of the beam shoe to accommodate the rollerballs. Shaun noted that when the rollerball trawl was removed and the standard trawl replaced and rigged to the outer lug on the portside. Catches of Monkfish were consistently up when compared with the same trawl on the starboard side.

Plaice Length Frequency



The length frequency for plaice appears to show a similar trend to that of Dover sole in that catches are down across the whole length range. Plaice are caught in the highest numbers of any of the key species therefore are a good indicator of how one trawl is fishing compared with another.

Lemon Sole Length Frequency



The length frequency table for Lemon sole appears to show that although the rollerball trawl catches 20% less fish in total the reduction in catches tends to be the smaller fish under 29cm. With the roller trawl catching more of the 30cm + fish.

5.2. Gear weight and Vessel Fuel Comparison

Once the two new sets of gear (Standard & Rollerball) had been attached to the beams on the Barentssee and prior to sailing, the weights of the gear were measured using the Strainstall load cells whilst still in harbour.



Gear being weighed in harbour

The rollerball gear was 300 Kg's lighter when weighed than the standard trawl. The weights of the trawls are shown below.

Gear weight/load (in air)	
Standard Trawl - weight in tonnes	3.7t
Rollerball Trawl - weights in tonnes	3.4t

In order to assess the reduction in drag of the rollerball trawl whilst fishing, the load cells were attached to each warp during one of the 90 minute tows. The relative weights of each of the trawls at two different towing speeds are shown in the table. **Note – depending on the tide the standard towing speed is between 3.5-3.8 knots.**

Gear load whilst towing		
Vessel Towing Speed	3.5 Knts	4.0 Knts
Standard Trawl - load in tonnes	3.2t	3.6t
Rollerball Trawl - load in tonnes	2.8t	3.0t

Results from the tension meters showed that the load with the rollerball trawl was reduced by 400Kg's at 3.5 knots and 600Kg's at 4.0 knots when compared with the standard trawl, a saving in drag of between 12-16%. During fishing operations the reduction in drag has a direct correlation to the amount of fuel used. From figures supplied by the Shaun the skipper and Diamond Diesels, the suppliers and fitters of the Mitsubishi S12R marine diesel engine fitted in the Barentssee, the average fuel used per day whilst fishing is 2,700 litres. The current price being paid for diesel is 55.4 pence per litre (Jan 13).

On average the 14% saving in drag relates to a fuel saving of 378 litres per day (2,700 litres x 14%). During 2011 the Barentssee completed 191 fishing days, a fuel saving of 378 litres per day at 55.4 pence per litre, would result in a saving of **£209.41 per day** (378lts x 0.554) and an anticipated saving of **£40,000 per year**.

6. Discussion

6.1. Trial Success/Failure

The trial was a success in that it proved that the use of the rollerballs did reduce the drag of the trawl leading to a reduction in fuel usage and significant cost saving. Adoption of the gear at the end of the trial by Shaun and use on full commercial trips for a further 3 months after the trial had ended is a significant success. Although there was a loss of commercial species during the initial sea trial Shaun and Edd's commitment in carrying out further development brought the rollerball trawl to a point where catches were on a par with the standard trawl. This is a testament to their belief that the concept can work as a replacement for standard ground gear.

The reduction in fish discards and benthos is also a successful outcome from the trial. Further work is required to perfect the attachment of the balls to the fishing line and fully replace the standard hoppers in the bosom of the trawl.

6.2. Cost Benefit

The cost of the rollerball ground gear is on a par with the cost of a standard hopper rig. The potential fuel savings, around £40,000 per annum, which could be made as a result of the reduction in drag, could be further improved by replacing the standard hopper section in the bosom of the trawl with rollerballs. The added benefit of reducing discards of small and juvenile fish and minimising the benthic impact of the trawl improves the environmental credentials of the beam trawl fishery, demonstrating best practice.

6.3. Viability

The use of the rollerball ground gear is a positive step forward in beam trawl design addressing a number of issues including fuel usage, gear impact and discards. The trawl was proven to work in a commercial environment in the 3 months post the initial trial matching the catch rates of a standard trawl. The use of the rollerballs needs further trials over a wider range of substrates and differing times of the year to reassure the industry that it provides a viable alternative which can lead to substantial cost savings. The price of fuel has been steadily rising over recent years and as the highest single cost associated with demersal trawl fisheries, skippers are looking to technology to help reduce operating cost, this technology will certainly help them to do so.

6.4. Future Developments

It is the intention of both Edd and Shaun to continue development work with the trawl in the spring of 2013 when the weather improves. Solutions to the attachment issue are already being worked on and a return trip to the Hirtshalls flume tank have been pencilled in for 2013. Both Edd and Shaun are very positive that the rollerball gear will work as a viable alternative to the current gear with the potential to reduce both fuel costs and discards.

6.5. Conclusions

Initial results from the first trial were mixed, although demonstrating a marked reduction in drag resulting in a substantial fuel saving there was also a significant loss of three of the main commercial species Dover sole, Plaice and Lemon sole. This was slightly offset by the increase in monkfish caught by the rollerball trawl. Subsequent alterations to the trawl nullified the loss of commercial species to a point where, on certain grounds the rollerball ground gear was out fishing the standard ground gear. The one issue that did arise after the trials were complete was the attachment of the rollerballs to the fishing line. In poor weather encountered towards the end of the year the balls were becoming detached resulting in the gear being having to be bought alongside and loss of fishing time. A new method of attachment needs to be sourced to ensure the balls remain attached to the fishing line.

Another positive outcome from the trials was that the rollerball gear appears to catch a lot less rocks and stones, reducing the amount of damage to the nets and improving the quality of fish caught in the codednd.

The reason for choosing the larger class of beamer on which to trial this technology was if the rollerball ground gear was proven to work it would be a relatively simple, and somewhat easier task to design and build a roller footrope for the 'Euro' beamer class of vessels working a 4m beam.

Increases in the cost of fuel will continue to drive owners and skippers to look for ways to reduce their diesel bills. Rollerball ground gear proves a cost effective and relatively simple means of achieving fuel savings and with only minor alterations can replace the standard beam trawl ground gear.

7. Acknowledgements

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8. References

Lart, W.et al (2002). Monitoring of discarding and retention by trawl fisheries in Western waters and the Irish Sea in relation to stock assessment and technical measures. Contract Ref 98/095

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