Sea Mammal Research Unit

CORNISH FISH PRODUCERS ORGANISATION LTD.

# Extension trial of an acoustic deterrent system to minimise dolphin and porpoise bycatch in gill and tangle net fisheries

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# 1. Project background

This extension trial was established in March 2010 as a collaborative venture between the Sea Mammal Research Unit (SMRU) at the University of St Andrews and the Cornish Fish Producers Organisation (CFPO) under the Fisheries Challenge Fund (FCF). The project aimed to help implement the use of acoustic deterrent devices in the Cornish over-12m static net sector to minimise the bycatch of porpoises and dolphins in several static net fisheries, as required by EC Council Regulation 812/2004 and in accordance with UK domestic policy and the desire of the fishery to minimise unnecessary bycatch.

This project builds upon other bycatch mitigation trials that began in 2008, also managed by the SMRU, under contract to Defra (Project MF1003), in which a commercially available acoustic deterrent device (the ‘Dolphin Dissuasive Device’ or DDD manufactured by STM Products) was being tested to determine whether or not it was a suitable tool for reducing bycatch rates of porpoises and dolphins in the offshore set net fisheries in the Southwest of England. The FCF funds meant this work could be extended to a larger group of relevant vessels which allowed a fuller assessment of the practical aspects of using the device to be made and to obtain more comprehensive feedback from industry on any potential problems. The aims of this extension trial, therefore, were not only to test the effectiveness of the DDDs as a bycatch mitigation device more thoroughly than would have been feasible under the Defra funded project alone, but also to ensure that the majority of UK vessels covered by 812/2004 would have an opportunity to become involved in the development of an appropriate operational approach for pinger use within this fleet.

To fulfil the project aims, the SMRU placed observers on board relevant vessels to assist in the deployment of DDDs, to monitor their effectiveness as a bycatch mitigation tool (by recording bycatch events and testing pinger functioning) and to obtain feedback from skippers and crews on the practical aspects of pinger use. Additional DDDs were purchased with funds from Defra under MF1003 and project management and data analysis costs were also covered by the MF1003 project. The funds available through the FCF were used primarily to provide an additional 255 days of observer coverage on >12m vessels trialling pingers between March 2010 and April 2011.

## 1.1 The need for a workable acoustic deterrent device

EU Council Regulation 812/2004 requires certain vessels over 12m in length to use acoustic deterrent devices (pingers) to minimise the risk of accidental capture of dolphins and porpoises in static nets. There are several such devices currently on the market, and the regulation specifies the characteristics of those that must be used. Although these devices are known to be effective at minimising porpoise bycatch they are not always practical to use (SMRU, UCC et al. 2001). Trials by Seafish (Anonymous 2003; Anonymous 2005) in the UK and similar trials conducted by the relevant authorities in Ireland and France (Cosgrove, Browne et al. 2005, Le Berre, 2005) concluded that the devices described by the regulation were unsuitable for offshore fisheries that use long fleets of gill or tangle nets. High levels of damage to and loss of pingers was reported from all trials, as were potential dangers to crew members when devices broke.

It should be noted that when Council Regulation 812/2004 was drafted it was not clear that common dolphins were also bycaught in gillnets to the extent to which we now know they are and it is not known whether the pingers described in the regulation are effective in minimising dolphin bycatch. One study in California showed a reduction in common dolphin bycatch in a drift net fishery when such pingers were used (Barlow and Cameron 2003), but this has not to our knowledge been repeated elsewhere for common dolphins in set nets and neither is it clear that the bycatch reduction was more than temporary.

A problem with the devices currently specified in Regulation 812/2004 is that pingers are required every 100m or 200m of netting. Where fleet lengths of many kilometres are used, pingers cannot realistically be attached and removed from each net panel as and when required – that would take too long and expose crew members to too much risk. Instead pingers need to be attached and left on the nets for the duration of their battery life. This tactic of semi-permanent attachment means they often get broken or come away from the gear as the nets are shot or pass through the deck machinery, and often become entangled among the meshes of the nets when stored on board. The industry therefore suggested using louder pingers with a greater range (see Figure 1, following page), so that fewer would be needed per fleet of nets. It might then be practical to attach pingers only to the end ropes of each fleet of nets during shooting operations and remove them as the gear is hauled, thereby minimising the likelihood of damage to the pingers or harm to crew members. A suitable pinger, the DDD, was identified by the SMRU as being theoretically loud enough to enable inter-pinger spacing to be increased up to 2km, but this device does not conform to the specifications listed in Council Regulation 812/2004.

Therefore under this extension trial and project MF1003 the applicability of DDDs for use in the over 12m fleet of set gillnet and entangling net vessels operating in ICES Division VII was tested as permitted under Article 2 Paragraph 3 of Council Regulation 812/2004, which allows member states to develop new technical measures to reduce the incidental capture or killing of cetaceans.

We had two main objectives with respect to porpoise bycatch – firstly to confirm that these devices were as effective in reducing porpoise bycatch (80-90%) as other devices and secondly to determine the likely optimal spacing of DDDs on nets. Putting DDDs too close together is wasteful both economically and in terms of acoustic ‘pollution’, whereas having them spaced too far apart will almost certainly reduce any mitigation effect.

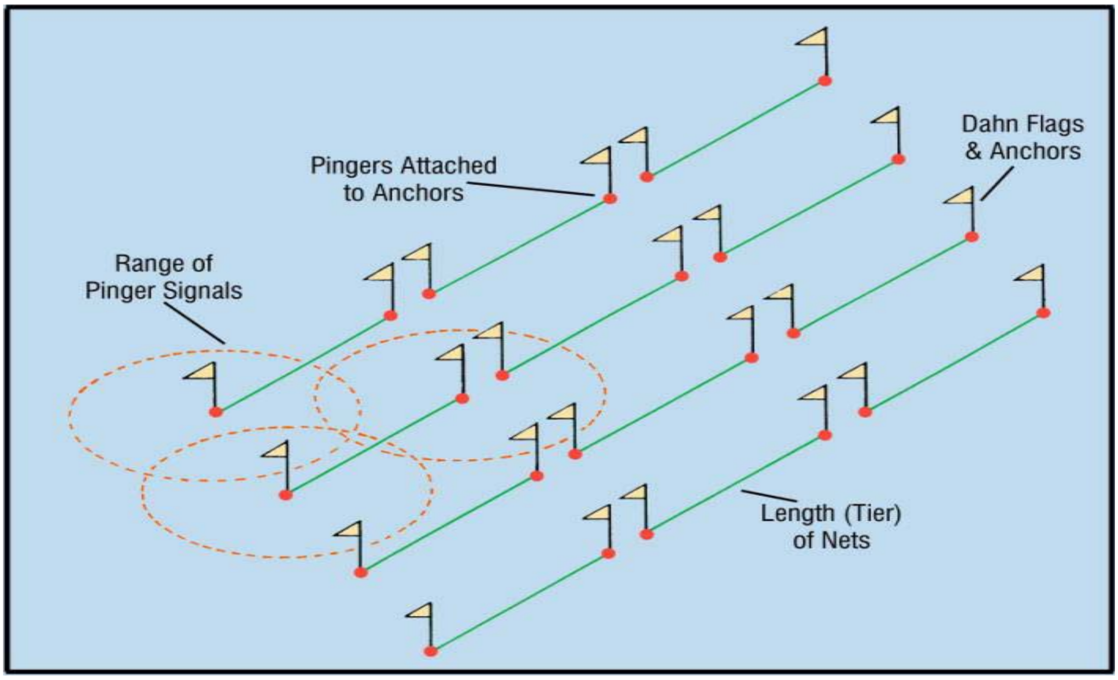


**Figure 1: Schematic showing the industry suggestion for pinger deployment on static nets (courtesy of G.Caslake, Seafish)**

## 1.2 The fishing vessels involved

The UK fleet that is required to use acoustic deterrent devices is specified in Annex I of Council Regulation 812/2004. This refers to all vessels of over 12m using any bottom-set gillnet or entangling net in ICES divisions VIId,e,f,g,h and j (English Channel and Celtic Sea) and some more specific static net fisheries in ICES subarea IV (North Sea). Reference to the UK IFISH database, the official repository of EU fisheries logbook information, suggests that there are normally around 20 such vessels operating in subarea VII, though the number fluctuates from year to year as vessels are sold on, sink, are scrapped or switch gears or areas. In 2010 there were 21 boats that were UK flagged and reported having fished using set nets in the relevant divisions of subarea VII. Four of these were boats that are owned by Spanish companies and that are based in Spanish ports and of these two were only present in the relevant area for 6 days in total. Of the remaining 17 vessels, three reported less than 20 days fishing with gillnets in 2010 (1, 14, 18 days respectively) and do not appear to be regular netters. Of the remaining 14, two are day boats that fished with nets for 139 and 31 days respectively in 2010, while the remaining core of 12 vessels made an average of 44 trips with 177 days at sea during 2010. Net fishing in this area is constrained by tides and usually only neap tides are fished, with trip lengths of around 4-7 days on average.

There are therefore three groups of UK vessels working in subarea VII that are required to use acoustic deterrent devices – 1) day boats (n=2), 2) boats based in Spain (n=2 or 4) and 3) regular offshore netters (n=12) primarily targeting hake, pollack, and monkfish/turbot seasonally in three distinct fisheries. Of the latter group 8 are based in Newlyn, with 2 based in Grimsby and 2 in Padstow. We have tried to work with all three of these groups of boats.

## 1.3 Industry concerns regarding the currently prescribed devices

Industry concerns about the use of pingers have focused on the fact that when pingers are required on more or less every net, they are liable to malfunction or frequently break. This means that they are ineffective in reducing bycatch and it increases the cost of maintenance dramatically, while also posing a safety risk to crew members. When pingers are permanently attached to the head rope of a gill net or tangle net they can become enmeshed in the netting when the net is stowed in pounds or net bins. When the net is shot away again, the pingers may pull bunches of netting out with them, which reduces the net's effectiveness and can be an additional safety issue for the crew member overseeing net deployment. Attaching pingers part-way along a fleet as it is being shot is also dangerous and practically speaking very difficult when long fleets of nets are being shot away at relatively high speeds (often 6-7 knots).

Industry is therefore looking for a solution that would involve deploying far fewer pingers, and preferably only on the end or anchor ropes of each fleet of nets. A simplistic consideration of the spherical spreading loss of the sound propagated by a variety of commercial pingers can be used to examine how an increase in acoustic output might be expected to affect the effective distance of an acoustic deterrent device, assuming that source level and not any other signal characteristic is the sole factor influencing cetacean response.

In Figure 2 we have plotted the predicted received level of three signals with source levels of 130, 145 and 165dB respectively, crudely mimicking the expected source levels of three different acoustic deterrent devices. Under the assumption of spherical spreading the three devices have an equal received level of about 98dB at distances of very roughly 100m, 200m and 2000m respectively. This simple analysis suggests that a DDD may be as effective at 2000m as other pingers may be at 100 or 200m. This led us to propose that DDDs should be trialled on offshore netters to determine their efficacy and handling characteristics.

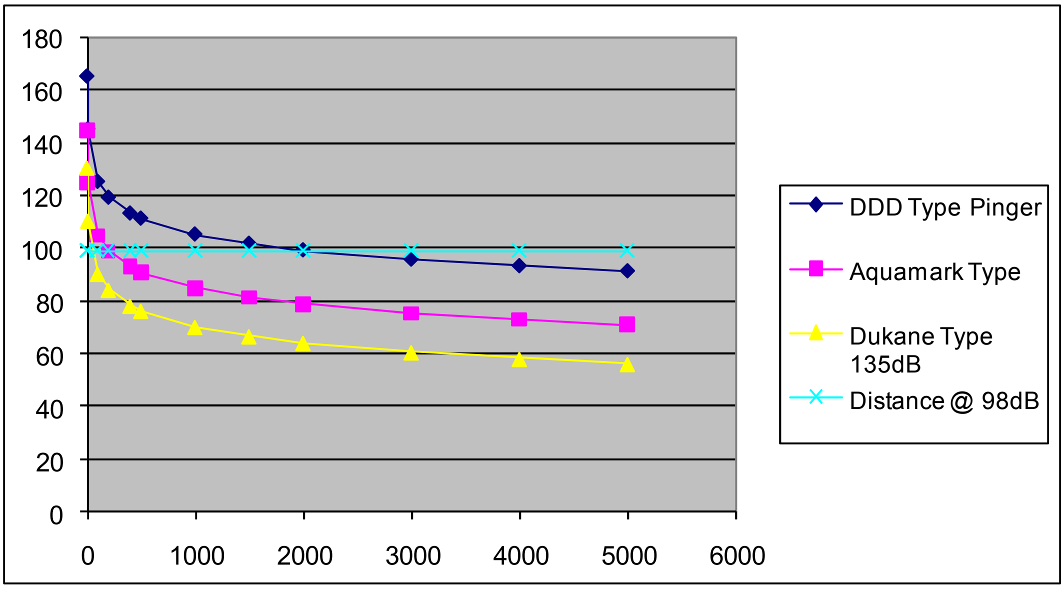


**Figure 2: Spherical spreading loss of acoustic signal with distance from source for three pinger types**

## 2. Methods

At the start of the MF1003 trial in 2008 we began by placing DDDs in the middle of every section of 20 nets, so that for a 40 net fleet pingers were placed part-way along the fleet on net numbers 10 and 30. We also began with a mix of fully observed trips and trips where skippers were asked to keep a simple log of deployments and bycatches. On some trips all fleets were equipped with DDDs and on other trips with the same boats in the same area no fleets were equipped with DDDs so we could make comparisons between test and control fleets.

As the MF1003 trial progressed it became apparent that this method of working was impractical. Logistically the collection of skippers' logs became too difficult, and skippers and crews were generally unhappy with the placement of DDDs part-way along fleets. We therefore moved to a system whereby DDDs were only deployed on trips with observers who could then keep a more detailed record of where and how DDDs were deployed, while the positioning of the devices was also changed so that all devices were now attached to both end ropes of each fleet (approximately 10m above the anchor). This change took place during the summer of 2009 and we have employed the same system since then. A perceived advantage of this second attachment system is that it would also provide a better opportunity to determine the effective spacing of DDDs by calculating the distance from bycatch events to the nearest pinger. We had previously conducted experiments to ascertain the likely effective exclusion distance of DDDs, which ranged from 1.2 to 3 kms, however this would not necessarily translate into an effective bycatch reduction range. By positioning pingers on the end ropes of fleets that can be up to 8km in length we would expect to see some bycatches in the middle of the fleet which is outside of the pingers effective range. Clearly to be an effective bycatch mitigation tool DDDs need to be spaced closely enough to ensure bycatch rates are significantly reduced, but far enough apart to minimise the cost implications to the industry and if possible eliminate the operational problems associated with attaching devices part-way along the fleet. Minimising the number of DDDs used per fleet will also reduce any possible wider effects such as potential habitat exclusion.

During MF1003 and the FCF project we have used two different versions of the DDD static net pinger. The first, the DDD-02, was first acquired and used in 2008, while an updated version, the DDD-03L, was also used during 2010 and 2011 when the field trials were extended to include more vessels.

Observers recorded the end positions (where the pingers were located) of each fleet of nets as they were hauled and also recorded the exact positions of any bycatch that occurred so that we could calculate the distance to the nearest DDD. Equivalent data were also recorded from fleets deployed without DDDs.

We also obtained voltage testing devices from STM (standard multi-meters do not work with these devices) and from early 2010 our observers also routinely recorded the charge of each DDD at the start and end of each deployment. This enabled us to determine the battery depletion rates during deployments over a trip and to compare the DDD-02s with the newer DDD-03L devices to see if there were any major differences in this aspect of performance between models.

Observers also regularly reported on skipper and crew feedback concerning the DDD pinger and its use, and this has been followed up recently with a more structured phone survey to gauge skippers' reactions regarding the use of the device over a protracted period and to obtain further comments and suggestions.

# 3. Results

Overall, observations were made on 15 vessels each of which made between 1 and 18 observed trips using DDDs between August 2008 and April 2011. In addition a number of trips were observed among these same 15 vessels when DDDs were not used. In total 1906 fishing observations were reported on between August 2008 and April 2011, 1709 of which were reported by SMRU observers and a further 197 that were recorded by skippers.

Between April 2010 and May 2011 SMRU observers accompanied 46 vessel trips totalling 266 days at sea under the FCF funded project. However, for statistical reasons we have not treated these data separately from data collected previously under project MF1003 so the results presented in this report are based on all data collected between September 2008 and May 2011.

## 3.1 Marine mammal bycatch rates

Over the course of the two projects 26 harbour porpoises, 5 common dolphins and 37 seals (species not always determined but presumed to be mainly grey seals) were recorded as bycaught. The numbers of hauls observed with and without DDDs and the numbers of marine mammal bycatches by species are provided below in Table 1.

**Table 1: Observations of numbers of mammals in fleets of nets with and without DDDs: all fleet lengths and all DDD deployment types 2008-2011**

| No of Hauls | DDDs Used? | Porpoises | Dolphins | Seals |
|---|---|---|---|---|
| **Observations by SMRU observers alone** | | | | |
| 780 | No | 16 | 3 | 8 |
| 929 | Yes | 7 | 2 | 29 |
| 1709 | | 23 | 5 | 37 |
| **All Observations – SMRU and Skippers** | | | | |
| 907 | No | 19 | 3 | 8 |
| 999 | Yes | 7 | 2 | 29 |
| 1906 | | 26 | 5 | 37 |

Nets with DDDs caught statistically significantly fewer porpoises for the whole dataset whether including skippers' observations (p=0.01: $\chi^2$ Test), or only SMRU observations (p=0.02). The overall bycatch rate with DDDs is 66% or 63% lower for each dataset respectively when DDDs are used. None of the bycaught animals were associated with any abnormally low voltage readings for the DDDs on retrieval.

There is no significant difference in the observed bycatch rate of dolphins when DDDs are used or not, however the small sample sizes are too small to be certain that this reflects no actual difference.

There is an apparently significantly higher bycatch rate of seals in nets equipped with DDDs, but this misleading. Significance tests assume that bycatch events are independent. Usually dolphin and porpoise bycatch events exhibit a binomial distribution with respect to net hauls, where more than one porpoise/dolphin per trip is a rare event. The data on seals are highly affected by a single extraordinary trip in which 19 seals were caught during a trip where DDDs were deployed on 26 of 28 fleets. If this trip is excluded from the analysis there is no difference in seal bycatch rates between hauls with and without DDDs.

The reduction in porpoise bycatch rate by 63-66% is substantially less than has been reported in previous pinger studies for this species, where bycatch rate reductions are typically in the 80%-95% range. This can be explained by the fact that many of the fleets we observed had widely spaced DDDs that were often further than 4km apart, for example many observed fleets were 4 - 8km in length, most of which only had DDDs positioned at the fleet ends, so some acoustic deterrent 'dead space' would be expected in the middle of these long fleets. None of the dolphins or porpoises caught in nets with DDDs was closer than 1.2 km from the nearest DDD. Table 2 shows the distances to the closest DDD on the same fleet, for nets for each of the two dolphins and 7 porpoises listed above.

**Table 2: Distances to closest DDD on the same fleet of nets**

| Species | Distance to closest DDD Km |
|---|---|
| Common dolphin | 1.3 |
| Common dolphin | 2.5 |
| Harbour porpoise | 1.2 |
| Harbour porpoise | 1.3 |
| Harbour porpoise | 1.6 |
| Harbour porpoise | 1.9 |
| Harbour porpoise | 2.1 |
| Harbour porpoise | 2.2 |

These distance data are difficult to interpret. Figure 3 shows that the observed fleets of nets fell into three board categories – short, medium and long (broadly representing wreck nets, tangle nets and gill nets) with modal values of about 100m, 4km and >6km respectively. The numbers of porpoises taken in each length category of net is also plotted in Figure 4. It can be seen that on all fleets where DDDs are present porpoise bycatches are most likely to occur if the total fleet length is longer than 4km (6 of 7 instances). This supports the notion that the weakly ensonified mid sections of long fleets are more likely to take porpoises than sections that are more fully ensonified.

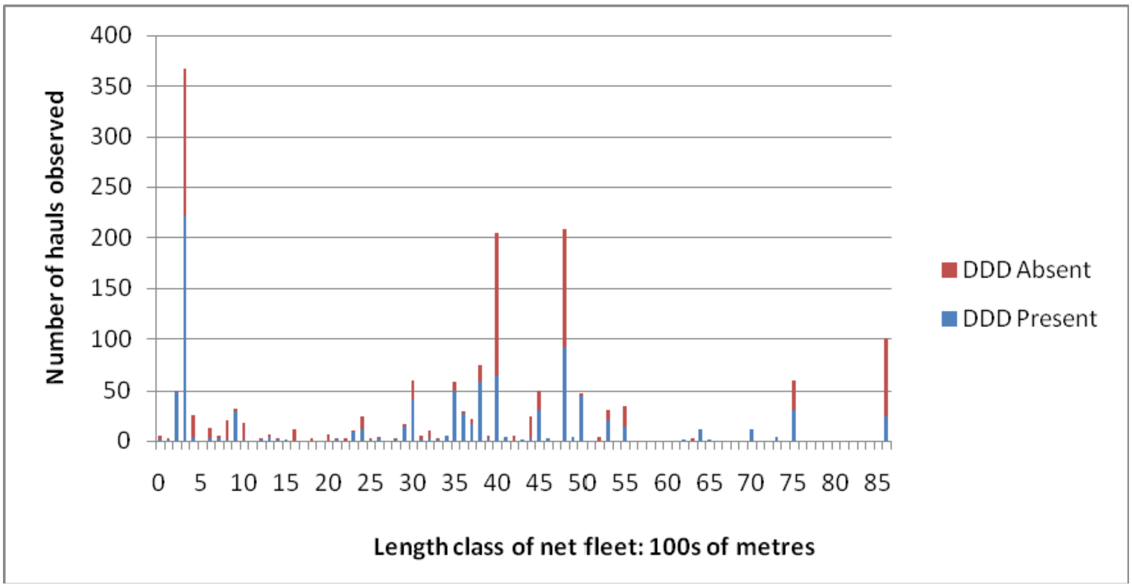


**Figure 3: Length frequency distribution of observed fleets of nets with and without DDDs**

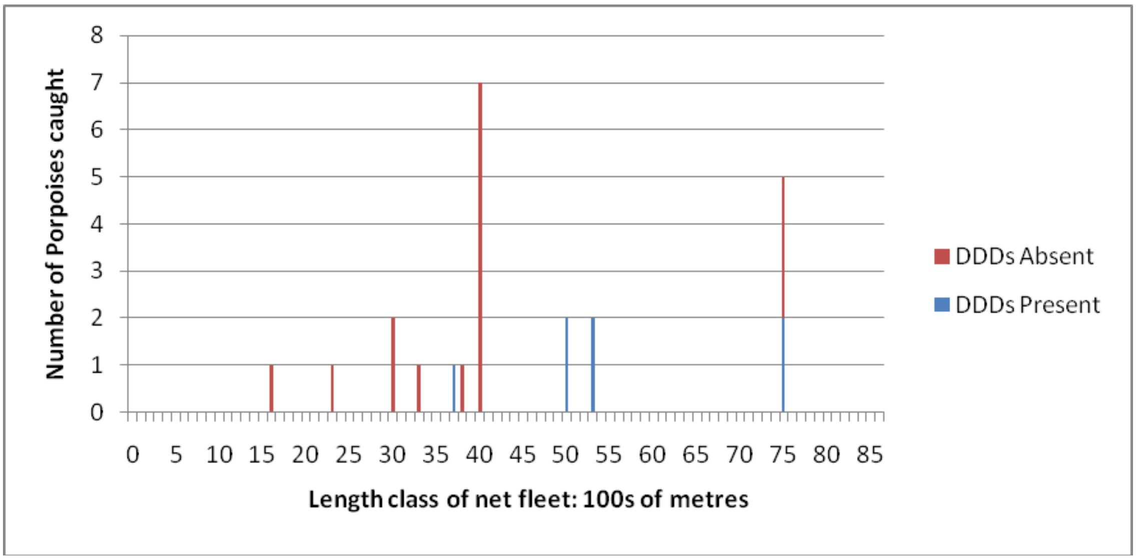


**Figure 4: Net lengths in which porpoises were reported caught in 100m bin lengths: note that porpoises caught in nets with DDDs (blue) are predominantly (6/7) in longer nets (>4km)**

A priori evidence (see Figure 2) suggests that porpoises should be less affected by DDDs beyond 2km. An analysis of the observed net lengths shows us that only 22% of all observed net is further than 2km from the nearest DDD, yet 3 of 7 porpoises were taken in such areas. The probability of this having happened by chance was determined by bootstrap simulation to be less than 0.04, indicating that significantly fewer than expected animals are indeed taken within 2km of a deployed DDD.

Another way to examine the difference in bycatch rates between short and long fleets is to consider fleets that are up to 4km in length and those that are longer than 4km in length separately, and to compare bycatch rates between these two gear categories. In this case we find that 3 porpoises were caught in 305 long fleet hauls without DDDs while 6 were taken in 973 long fleet hauls with DDDs. The rate with DDDs is 37% lower than without DDDs but the difference is not significant. In contrast, among fleets of less than 4km, 13 porpoises were reported caught in 475 fleets without DDDs while just 1 was taken in 665 fleets with DDDs.

When DDDs were used on both end ropes of fleets of 4km or less the bycatch rate of porpoises is considerably lower ($p=0.0001$: $\chi^2$ Test), with 94.5% fewer porpoises per haul. This finding is in line with previous studies on the effectiveness of other pinger types.

## 3.2 Battery performance

It was not practical to check the actual acoustic output of individual pingers regularly during the course of the project as this would have required the use of specialist and expensive acoustic equipment. However, the DDD manufacturer states that pinger performance is compromised when battery voltages drop below 6.0V. Therefore our observers routinely recorded the battery voltages before and after each deployment. This system, essentially a proxy for pinger functioning, allowed us to say with some degree of confidence whether any observed bycatch events were associated with sub-optimal pinger performance which could potentially affect our results. Results of the voltage readings indicated that all pingers on fleets where bycatch occurred were fully functional so our estimates of the DDDs effective range are valid.

The voltage data also allowed us to calculate battery depletion rates, an important consideration, as this will impact on how frequently vessels will be required to charge the devices to ensure they remain operational. The manufacturer states that under normal operating conditions the batteries of both models (DDD 02 and DDD 03L) should last for approximately 300 hours after a full charge. Figures 4 and 5 (page 12) show plots of the battery depletion rates based on our data for each of the two models used.

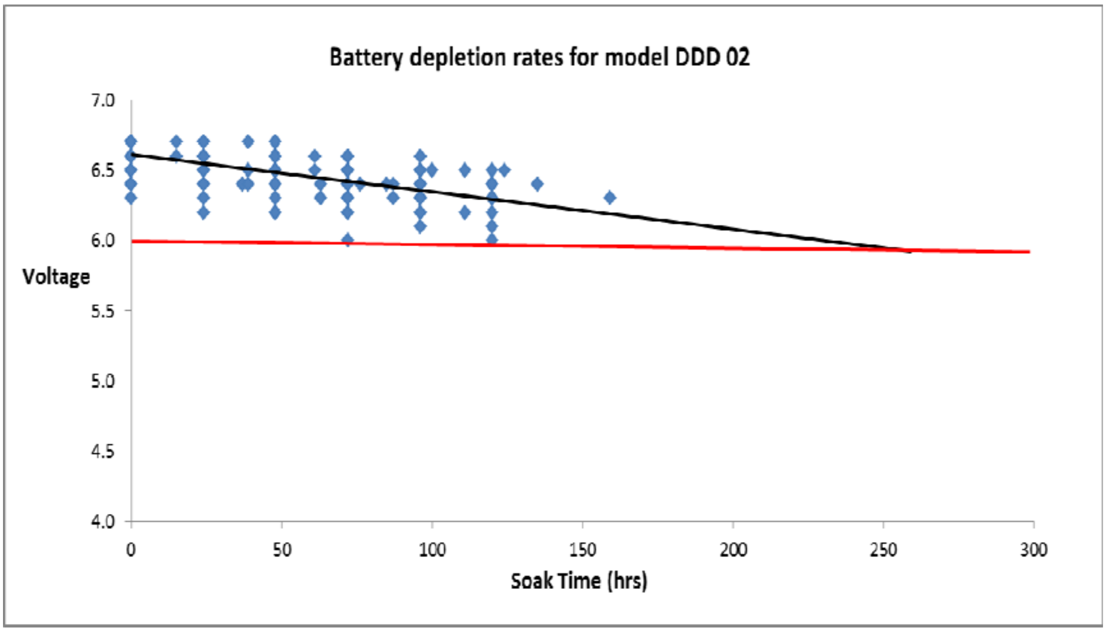

**Figure 5: Battery depletion rate for model DDD 02**

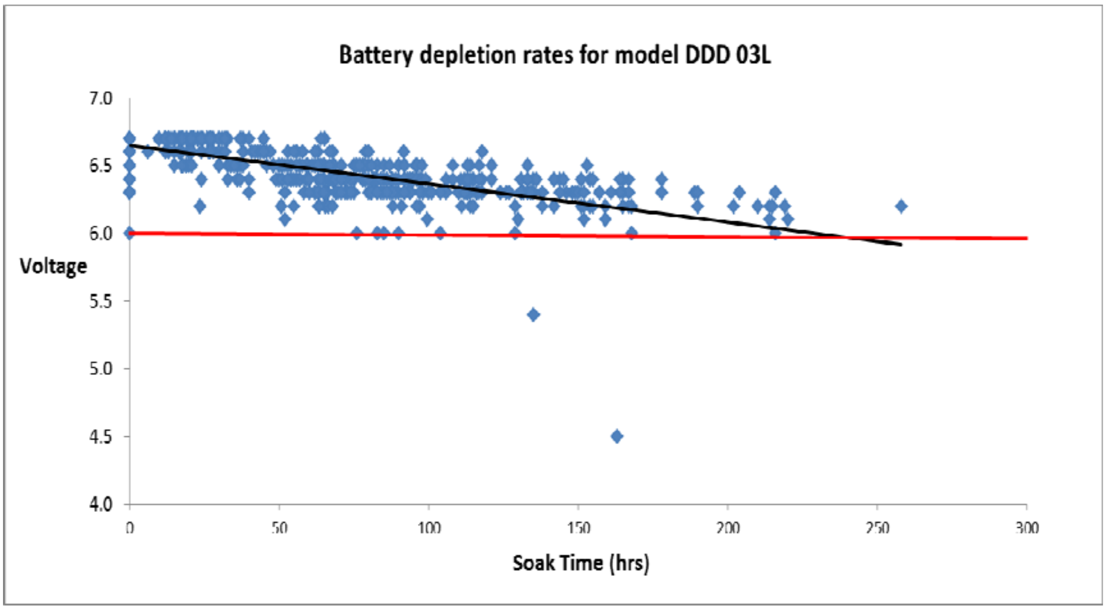

**Figure 6: Battery depletion rate for model DDD 03L**

The slopes and intercepts of both trend lines are very similar which suggests that there are no major differences in battery depletion rates between the two models. However in both cases the trend line intercepts the 6.0 volt level (below which pinger functioning is compromised) at approximately 250 hours, somewhat less than the manufacturers stated battery duration of 300hrs. One possible explanation for this may be as follows: the DDD battery is fully charged at 6.7 volts (although slightly elevated readings (up to 7.1V) can be obtained for a short period after charging) but from the data in Figures 5 and 6 it appears that a number of initial readings (after charging) for both models are below 6.7. This suggests that on some trips pingers were not fully charged prior to their first deployment, which would reduce our estimates of battery duration. Therefore the manufacturer's estimate of 300 hours seems a reasonable guide for battery duration from a full charge.

## 3.3 Industry feedback

Feedback from industry about using DDDs has generally been positive. Our communications with skippers, via observers and through a telephone survey, suggest that they will be prepared to use mitigation devices routinely, provided the system is safe, practical, financially viable and effective at reducing cetacean bycatches. The following paragraphs highlight some of the main concerns expressed by skippers over the course of the trials.

1. Initial concerns were mainly associated with the attachment of pingers in the middle of long fleets of nets which could potentially pose a significant hazard to crew members during shooting. As mentioned previously, because of these concerns, we decided after about 9 months of project MF1003, to alter the attachment method and simply deploy pingers above the anchors on the end ropes of each fleet. This method means that pingers are deployed at more or less the same time as the anchors, which reduces potential risks and minimises interference with the crews' normal duties. Consequently this approach is favoured by all skippers, and will probably continue to be so unless a suitable automatic deployment method for attaching and deploying pingers in the middle of long fleets can be devised. Most skippers have indicated that they would be prepared to shorten the lengths of the fleets they work to a maximum of 4km to ensure that the optimum acoustic protection is attained without having to attach pingers part-way along the fleet.

2. Regulation 812/2004 currently requires all >12m netters working in ICES divisions VIIdefghj to use pingers regardless of the specific net type in use. However a couple of skippers have questioned the need to use pingers when they are working short fleets of wreck nets which they claim have very low incidences of bycatch in the Celtic Sea and Channel. This claim is supported by observed bycatch rates from wreck netters albeit from fairly limited sampling levels.

3. Over the course of the trials, and more recently as well, some of the skippers have suggested a possible link between DDD use and reduced fish catches and/or possible increased seal depredation from nets. Our data to date show no difference in the proportion of fleets depredated by seals (based on 1 or more seal damaged fish) either with DDDs (25%) or without DDDs (22.5%), but this and the possible fish catch effect remain two issues to watch closely as they are the major concerns for skippers.

4. Voltage data indicate that a single full charge should allow DDDs to be used over the duration of a typical neap tide (roughly 7 days) so in theory pingers could be charged ashore between tides. However, skippers have informed us that there are certain times of year when vessels may work through smaller spring tides (typically in May and June) and in these instances ideally vessels would have a suitable pinger charging system on board which is currently not available.

Some further comments and suggestions from skippers and crew members are as follows:

1. The overall impression of the DDD as a device ranges from Ok – Excellent.
2. They would like to see a device that would also deter seals from their nets.
3. Ideally the device would be lighter and have inbuilt buoyancy so there is no requirement to deploy it with a float.
4. A combined multi-charger unit and voltage testing device would be favoured over the existing individual chargers and separate voltage testers.
5. In addition to some concerns about possible effects on fish catches and seal depredation associated with pinger use, most skippers also have limited concerns about the financial implications and one skipper was worried about the possible extra workload for his crew.

6. Most skippers will be prepared to use DDDs as things stand, though one skipper would like to see further trials as he is not convinced they are fully effective as a bycatch mitigation device.
7. Some skippers have shown an interest in attending a workshop to address any outstanding issues prior to enforcement of the regulation should that happen.
8. Some skippers would like to see a code of practise developed which would provide operational guidelines for the relevant fisheries and which might help in marketing their product.

## 4. Discussion

The results presented here show that DDDs are effective in reducing porpoise bycatch. Bycatch was reduced by about 95% in fleets of less than 4km in length but by only about 66% when all fleet lengths are included, as DDDs were mainly attached to the ends of the fleets we observed. The overall bycatch reduction rate (66%) could clearly be improved either by shortening longer fleets or by placing DDDs part-way along longer fleets. This would require some changes to the existing fishing practices of some vessels but it seems that at least some of the skippers involved would be prepared to shorten fleets to 4km where necessary. There is clearly a trade-off to be made between optimising uptake within the industry, and minimising bycatch rates, while also minimising the unnecessary use of acoustic deterrents, which are expensive and will also affect animals beyond the range that is required to prevent them from becoming entangled.

The effects of DDDs on dolphin bycatch rates cannot yet be determined because we only observed 5 common dolphin bycatches over the three years of the trials. Continued monitoring will eventually clarify this point, but it is worth noting that: 1) the closest dolphin bycatch event observed to date was 1.3km from a DDD, which is similar to that seen for porpoises and 2) a different model of the DDD pinger, the DDD 03H, has been shown to reduce dolphin bycatch in the bass pair trawl fishery in the English Channel. This limited evidence certainly suggests that the DDD gillnet model may have some mitigation effect which has not yet been quantified.

Despite one anomalous trip we do not believe there is any underlying difference in the bycatch rate of seals when DDDs are used. This might provide further empirical support to our existing, albeit fairly limited, data which suggests that there is no increase in seal depredation when DDDs are used.

From an operational perspective, the DDD pinger, despite not meeting the current specifications required by Regulation 812/2004, would appear to provide the most suitable existing solution to pinger implementation in the UK based >12m netting fleet operating in ICES subarea VII. One vessel has recently been supplied with a full complement of DDDs and as far as we are aware is now using them routinely. We intend to provide the rest of this fleet with DDDs in the coming months after further discussions with industry, Defra and the MMO on aspects of implementation, enforcement and best practice.

As part of this extension trial we carried out one 45 day trip on an Anglo/Spanish netter which trialled the DDDs, albeit mainly in ICES subarea VI (an area not covered by the 812/2004 regulation). Feedback from the owner and skipper was relatively positive. However this vessel, like others in this fleet, tends to work mainly in deep water on the continental slope, outside the normal foraging depth range of most small cetaceans. The skipper thinks that when bycatches occur in these fisheries the animals are caught as the gear is being shot, rather than when it is lying on the seabed, and suggested that a more sensible approach for this fleet might involve having a powerful pinger attached to the boat to deter animals from the area during shooting operations. This vessel is open to further collaboration to test such a device.

## 5. Conclusions

1. The effective range of the DDD pinger is at least 2km or 1.1nm.
2. The DDD pinger can achieve bycatch reduction rates in existing offshore static net fisheries ranging from 65% to over 95% depending on the fleet lengths used.
3. Bycatch reduction rates for dolphin species have still not been quantified.
4. The system of attaching pingers only to the end ropes of fleets is favoured by all skippers involved in the trial.
5. Some technical issues with the DDD charging system remain.

## 6. Acknowledgements

The project management team from SMRU and the CFPO would like to thank the following people:

- The skippers and crews of all the vessels that participated in the trial, whose vast experience, insight, suggestions and good nature ensured the trial was conducted in a safe, informative, productive and enjoyable way.
- The SMRU observer team, but in particular Jimmy Hicks and Phil Spencer, all of whom approached the task at hand diligently and enthusiastically.
- Martin Ipuche at STM products, who arranged prompt delivery of the DDD pingers and answered all our technical and operational queries.
- Mike Lonergan at the Sea Mammal Research Unit for discussion and advice on the statistical aspects of data analysis.
- Defra and the Fisheries Challenge Fund for making it possible.

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