Non-lethal options for mitigating catch depredation by toothed whales from pelagic longlines

Update #7 – December 2010: PDMD Tank trials

- Find this and other related documents at: http://www.marinemammals.gov.au/regional-initiatives/depredation-project
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7.1 Controlled experimentation in the Australian Maritime College flume tank

The development of the *Tuna Guard – Streamer Pod* (Figure 15) and the *Whale Shield – Jellyfish* (Figure 16) has progressed sufficiently for initial proof-of-concept trials to be undertaken. Before embarking on operational scale sea trials, the two devices were tested under experimental conditions to determine if they would behave 'normally' when deployed (i.e. when released or set away from the stern of the vessel). The logical place to undertake such a trial is at the Australian Maritime College Beauty Point flume tank facility, which boasts world class capability, being 2.5 meters deep and approximately 20 m long.

Specifically, experiments were conducted to determine the sink rate of the two 'treatment' snoods (*with* the *Streamer Pod* and *Jellyfish* attached) and then compare them with the sink rate of a 'control' snood (*without* a device attached). Sink rate is thought to be the best method of measuring the overall behaviour of the devices as they descend to fishing depth upon deployment. It was thought that the weight (*Streamer Pod*: 154 g; *Jellyfish*: 103 g) and shape of the two devices could affect the behaviour, and thus sink rate, of the devices.

The three snoods (two treatments and one control) were constructed of 6 metres of 1.8 mm monofilament nylon line, with a 30 g weight on the end to replace the hook and bait (these could not be included when conducting the experiments in the flume tank). A 60 g weighted swivel was incorporated in the snood line approximately 1 m above the 30 g end weight and the 'treatment' devices were attached immediately below it. Time depth recorders (TDRs; G5, CEFAS Technology Limited, Lowestoft, UK) were attached to the 60 g swivel (Figure 17).

The experiment was conducted from a platform located approximately 1.5 m above the surface of the flume tank water. Each snood was secured to the gantry by the end furthest from the end weight to facilitate retrieval post-release. Each snood was suspended immediately above the water surface and then released and allowed to settle to the bottom of the tank. The devices were then returned to the surface manually and the cycle repeated 100 times.

Although the ground speed of the longline gear during deployment at sea is effectively zero, 'spring back' (caused by the elasticity of the mainline) and sinking (as the line descends to fishing depth) may result in some degree of relative horizontal ground speed being applied to the fishing gear. As such, sink rate experiments were also undertaken (using the same methodology described above) at water speeds of 0.5 m/s (0.9719 knots) and 1 m/s (1.9438 knots).

7.2 Results

The data was retrieved from the three G5 TDRs, processed and analysed. It was found that, with no horizontal speed involved, the control snood sank faster than the two treatment snoods (1 m/s) and that the *Streamer Pod* (0.72 m/s) sank faster than the *Jellyfish* (0.39 m/s; Table 3; Figure 18). It was also found that the sink rate decreased as horizontal water speed increased (e.g. control: 1 m/s @ o m/s horiz.; 0.93 m/s @ 0.5 m/s horiz.; 0.9 m/s @ 1 m/s horiz.). Interestingly, the sink rates of both treatments and the control were slightly slower initially, suggesting a degree of unspecified surface interference.

Although these results are not surprising, it demonstrates that the drag and weight of the two devices cause sink rate to decline by a factor of 0.3 to 3. Nonetheless, both devices sank in a seemingly 'orderly' manner, without oscillation or rotation, suggesting that while they may take longer to sink to fishing depth, they are unlikely to increase the incidence of gear fouling or damage.

A few aspects of the study should be taken into consideration. Both devices reduce the sink rate by a marked degree. This change should be taken into account where fisheries are subject to bird by-catch mitigation regulations, which typically focus on increased sink rates to be effective. Although not adjusted for in this experiment, this potential problem could be addressed with the addition of weight to the devices, thus resulting in comparable sink rates between the treatments and the control. In addition, there were limitations in using the flume tank to produce meaningful and transposable results. Firstly, the flume tank is only 2.5 m deep and thus can only provide information relating to the very beginning of the descent from the surface. Secondly, under operational conditions there would be considerable turbulence at the stern of a longline vessel caused by the prop, which cannot be simulated in the flume tank. Turbulence would most likely inhibit descent of the *Jellyfish* in particular, due to larger size and more complex shape.

7.3 Next steps

Although some further refinements of the two devices are still necessary, this experiment has demonstrated that both are nearing readiness for more extensive sea trials under operational conditions. The sea trials are viewed as the essential step for proving the concept of physical deterrence as an effective tool in mitigating whale depredation and by-catch from pelagic longline gear. When this step has been realised, it is hoped that the designs of both devices will be made publically available, thus providing a unique opportunity to those seeking commercial opportunities in this field.

Table 3 Summary table of mean sink rates of pelagic longline fishing gear in a 2.5 m deep flume tank, based on (i) the absence/type/presence of devices designed to mitigate toothed whale depredation and by-catch (columns) and (ii) horizontal water speed (rows).

Sink rate				
		Horiz. water Speed (m/s)		
		0	0.5	1
	Control	1.00	0.93	0.90
Device	Pod	0.72	0.69	0.56
	Clip	0.39	0.38	0.37

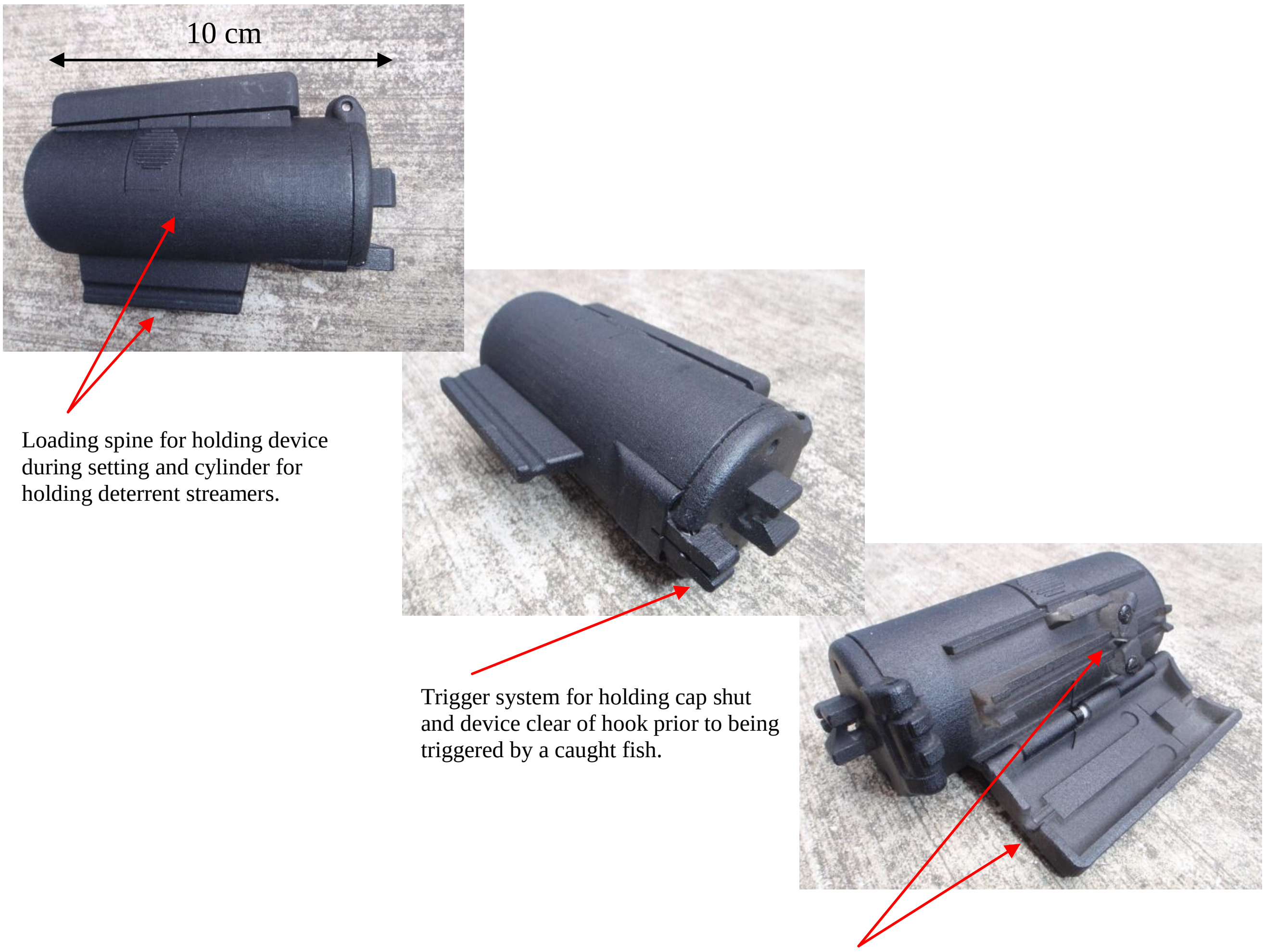

Figure 15 Production ready version of the *Tuna Guard – Streamer Pod*, shown in three views to expose detail.

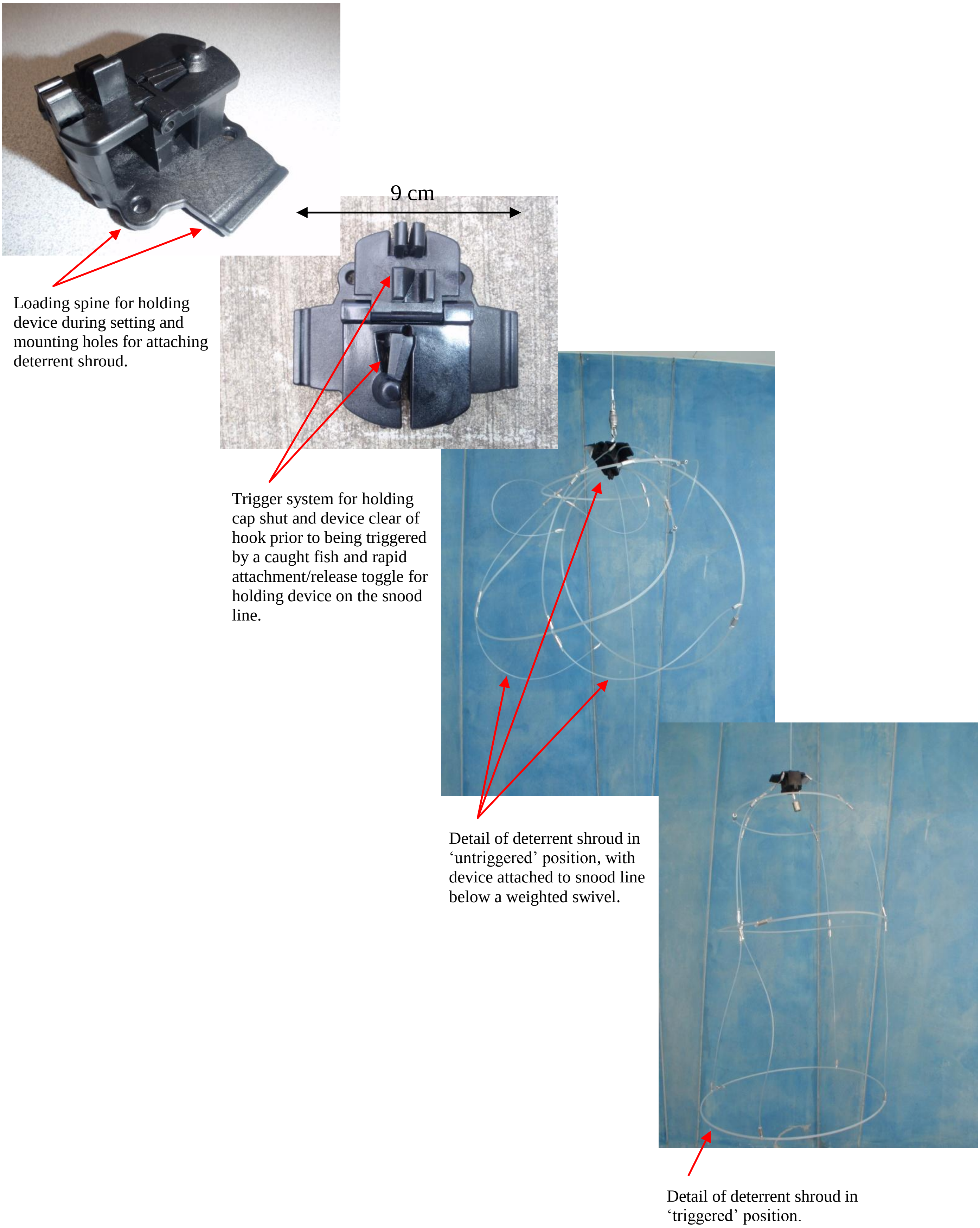

Figure 16 Production ready version of the *Whale shield – Jellyfish*, shown in four views to expose detail.

Figure 17 CEFAS G5 time depth recorder (TDR), used during the flume tank trials.

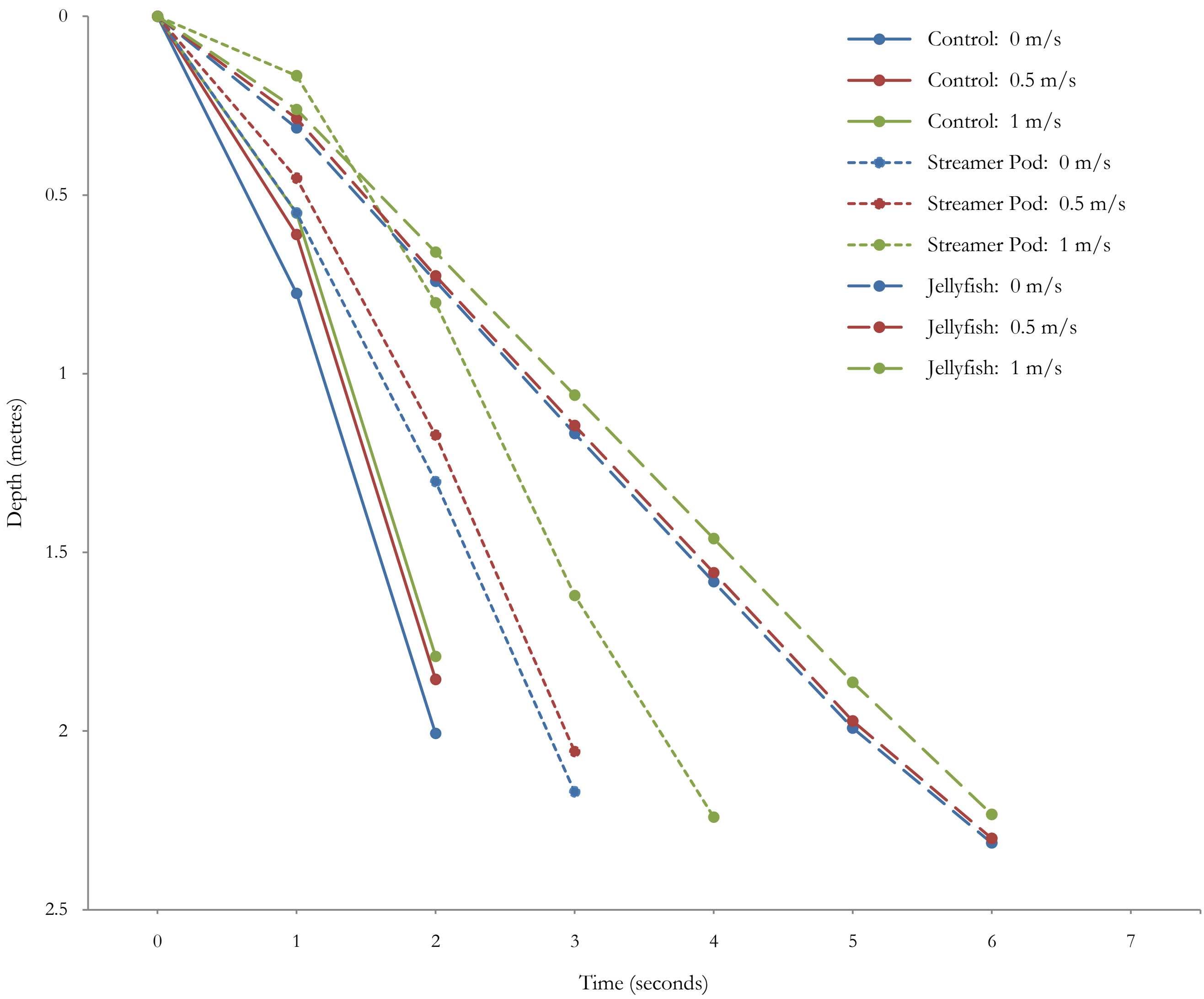

Figure 18 Plot of sink rate of pelagic longline fishing gear in 2.5 m deep flume tank, based on (i) the absence/type/presence of devices designed to mitigate toothed whale depredation and by-catch and (ii) horizontal water speed. End points are truncated due to 1 second sampling rate of G5 TDR.