

- Informal information by the divers, that these systems use so much energy, that it is possible to see a “dead”/ “yellow” mark where the gear went over.
- 5 kW (kVA) welding generators are being used per side (little detailed information is available)

5.3 Electric fishery on brown shrimp (presentation by Bart Verschueren)

5.3.1 HOVERCRAN testing on commercial shrimp trawler TX 25

The HOVERCRAN, a modified shrimp beam trawl, aims at stricter selectivity and reduced seabed contact. The fundamental idea is to replace the heavy bobbin rope with lightweight electrodes, in order to use electrical pulsation as a stimulation alternative. Prior research by ILVO showed that the use of a specific electric field close to the seabed induces a startle response in shrimp, meanwhile not affecting most of the other benthic species. The elevated footrope lets non-target species escape underneath the trawl and collects the shrimp that jump up into the water column. Herein lays the selective fishing potential of this alternative technique.

Preservation of the commercial catches and the reduction of discards and seabed contact are the decisive criteria in the evaluation of the HOVERCRAN. Extensive testing of the prototype on a Belgian shrimp cutter, by direct catch comparison with a standard shrimp trawl, revealed important and hopeful results. First and foremost could be shown that at least as much shrimp can be caught with the new technique compared with the traditional gear. An important remark hereby is that the catch efficiency of the HOVERCRAN seems less influenced by the fishing conditions. Different hauls during daytime, night-time, in clear or turbid water, in good and bad weather conditions produced relatively constant catches, while the traditional gear showed rather diverse catch results. On top of that, an average bycatch reduction of 35% in volume is a major step forward in the discard issue of the brown shrimp fishery. These results showed that the raised groundrope plays an essential role in separating shrimp from unwanted bycatch. The higher the footrope is placed, the more bycatch is reduced. As a consequence also more shrimp tend to escape beneath the groundrope. Therefore the ideal footrope height should be a trade-off between acceptable shrimp catches and sufficient bycatch reduction. Reduction of bottom contact by 75% is a radical change in the environmental impact issue. Opinions on the effects of the bottom contact on the seabed and its associated organisms differ a lot. Avoiding bottom contact in the brown shrimp fishery makes the discussion redundant.

It should, however, be borne in mind that the sea trials only covered a relatively short time range of 6 months in summer and autumn and only took place in Belgian waters. For this reason, it was recommended to elaborate the research. An extensive range of sea trials on commercial vessels in different conditions and fishing grounds should precede commercial application.

In the mean time ILVO and IMARES have begun new testing in collaboration with the Dutch shrimp fishery. In spring 2011 a Dutch commercial shrimp cutter (TX 25) was equipped with an improved version of the system. In summer 2011 a second vessel (HA 31) will follow. These vessels will perform year-round testing, operating in the Wadden Sea. This will hopefully reveal the feasibility of the technique under variable commercial circumstances.

5.3.2 Effects of the HOVERCRAN pulse (low-frequency pulsed direct current) on captive-housed sea fish

To reduce the unwanted bycatch in shrimp trawling, alternative stimulation techniques such as electricity which selectively invokes a reaction in shrimp might be used. The effects of the specific HOVERCRAN electric pulse on a selection of sea fish were investigated by ILVO.

Sea fish

Seven different species were selected i.e. (Pleuronectes platessa, n=41, length: 9.5–41.0cm), sole (*Solea solea*, n=44, length: 13.0–36.0cm), dragonet (*Callyonimus* spp., n=40, length: 8.0–21.0cm), pogge (*Agonus cataphractus*, n=40, length: 6.0–14.0cm), armed bullhead (*Myoxocephalus scorpius*, n=29, length: 14.0–27.0cm), fivebeard rockling (*Ciliata mustela*, n=14, length: 12.0–19.5cm) and Atlantic codfish (*Gadus morhua*, n=30, length: 17.5–40.0cm). Fish were captured on the Belgian coast with an 8m twin flatfish beam trawl or an 8m shrimp beam trawl during 3 different sea trips. Once ashore, all fish were visually inspected for liveliness and injuries, only animals in good condition were transferred to the aquarium facilities. All fish were given an adaptation period between 14 and 45 days, during which general condition and feeding was constantly observed.

Experimental setup

After the adaptation period each fish was alternately transferred to a glass exposure aquarium containing approximately 240 litres of seawater (120cm L x 50cm W x 40cm H) and was allowed to swim free. Seawater quality and temperature in the exposure tank was the same as the housing aquariums. The bottom of the aquaria was covered with rinsed sand. The tank was equipped with two threadlike electrodes, placed on the bottom plate of the tank. Each 50cm long electrode was composed of seven solid copper strands and had a circular section of 16 mm². These conductors were placed parallel at a distance of 60cm from each other, 30 cm from the adjacent aquarium wall. Both electrodes were electrically connected with a custom built adjustable impulse generator. After a fish was transferred to the exposure tank, the behaviour of the animal was observed during 10–20 minutes. As soon as the animal was at rest, the generator was manually switched on by means of an interrupter. During a period of approximately ten seconds a pulsed direct current electric field was generated in the tank between the two conductors. After ten seconds the interrupter was manually switched off again. During the experiment pulse characteristics were closely monitored. The amplitude between the electrodes was fixed at 60 volt. Pulses were generated at a frequency of 5Hz. The low frequency direct current pulses had an almost square pulse shape and a duration of 0.5 milliseconds. A total of 21 plaices, 22 soles, 21 dragonets, 21 poggies, 14 armed bullheads, 8 fivebeard rocklings and 20 Atlantic codfish were exposed to electric pulses according to the procedure mentioned above. In each species control animals were included. In total, they consisted of 20 plaices, 22 soles, 19 dragonets, 19 poggies, 15 armed bullheads, 6 fivebeard rocklings and 20 Atlantic codfish. All control animals were treated similarly, except for the exposure to the electric field.

Observation

During and 30 minutes after the exposure to the electric field, reactions such as movement, flight response, deviant behaviour and mortality were reported. In almost all fish, minor reactions were observed during the 10 seconds of exposure to electric

pulses. Immediately thereafter, they returned to their normal position. Abnormal behaviour was not observed in control animals.

Plaice

During the settling period, plaice dug into the sand until only the head was partly visible. As soon as the animal was exposed to the pulses, the fish body gently vibrated to the frequency of the pulses without leaving its buried position. This lasted for full 10s, and after the generator was switched off, the animal remained where it was

Sole

Sole showed comparable reactions to plaice. In about one quarter of the cases, however, the fish rose from its buried position and started swimming actively in random directions. After the generator was switched off, the animals returned to the bottom were dug into the sand.

Dragonet

While resting, dragonets were partly dug into the sand. After the pulses started, they showed strong irregular muscular contractions and moved over very short distances. They stayed, however, close to the bottom.

Pogge

Most poggies lay on the bottom before the pulses started. Some of the fish, however, kept on swimming around in the tank. When the pulses started, the fish lying on the bottom started moving around slowly with their bodies vibrating at the frequency of the pulses. The fish higher in the water column immediately returned to the bottom.

Armed bullhead

At rest, the armed bullheads lay on top of the sandy bottom. Under the influence of the pulses, the fish showed slight vibrations, but did not move their position.

Fivebeard rockling

Before the pulses started, the fivebeard rocklings rested on the bottom or swam slowly over the sand. During the electric stimulation, they agitatedly swam close to the bottom. After the pulses were switched off, these fish soon resumed the behaviour they showed before stimulation.

Atlantic codfish

During the settling period, Atlantic codfish stayed relatively motionless in the middle of the exposure tank. As soon as the electric field was switched on, they started swimming agitatedly in random directions, hereby regularly bumping against the walls of the tank. During the full 10s of exposure, the fish body showed small jerks to the frequency of the pulses. After the pulses were switched off, these fish soon resumed the behaviour they showed before stimulation.

Necropsy and histology

Immediately after euthanasia, all animals were examined for gross lesions. Special attention was given to haemorrhages, discolouration and injury of skin, abdominal organs, muscles and vertebrae. Samples from gills, liver, spleen, kidney and dorsal muscle were immediately immersed in phosphate buffered formalin (10%) and processed for paraffin sectioning according to standard techniques. For histological examination, 5 µm sections were stained with haematoxylin and eosin.

In general gross and histological abnormalities were rarely present in both the group of exposed fish and the control group. In one control and two electrical exposed plaices, small multifocal cutaneous haemorrhages were observed. In the remaining animals, macroscopic and histological abnormalities suggestive for electrocution were not found, except for one small focal interstitial haemorrhage in the muscle tissue of a sole.

Conclusion

At least under experimental conditions, the HOVERCRAN electric pulse for catching brown shrimp could be promising since this has low impact on fish. The presentation featured:

5.3.3 Discussion on HOVERCRAN presentation

Bycatch of sole and others species is important. Do we then need different rules for shrimp or distinguish species groups in the regulation? This seems to be the case.

Verschueren emphasized that in the shrimp trawling system the only variable is pulse amplitude, all the others are fixed, such as pulse frequency at 4.5 Hz. Also it was found that there is no point in aiming for higher output, as the best catch results were found at 80% output (30 V/m), and beyond that the catch efficiency drops.

Bycatch was not yet studied in the TX-25 trials. The footrope has been raised by 15 cm off ground. This would result in lower bycatch but also fewer shrimps. It was not yet tried out to raise the anodes and leave the cathodes on the bottom to enhance the jumping effect. In addition this would lead to higher corrosion if the polarity is not alternated.

The output of a 2-D model of field strength was shown, programmed by Lieven Geeraert of Marelec.

The HOVERCRAN might be a good alternative for the bobbin groundrope. The square net has been tried for two weeks now, with a length of electrodes of 3 m to the footrope. It appeared that more rubbish is caught in this net, possible stirred up in the wake of the trawl shoes.

The electrodes are made of stainless steel wire with one strand replaced by copper.

There is communication between DELMECO and Marelec about a combined flatfish shrimp pulse trawl (Verschueren). This may affect the ideas of creating species-specific regulations (van Marlen).