MINOUW

Case study results

1.8 – Bottom trawl in Tuscany, Italy

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SUMMARY

The limited species selectivity of trawls is a continuing concern for fisheries scientists and managers in the Western Mediterranean and beyond. Developing new technology to reduce bycatch and discards in trawl fisheries is especially important. A total of 52 hauls (26 with lights, 26 without lights) was performed using a professional bottom trawler in the Tuscany sea. The hauls were carried out alternating the control bottom trawl net with the one equipped with artificial lights on the headline. The field trials were conducted on consecutive days in three different seasons (summer 2016, autumn 2016, and spring 2017).Sorting of the catch was performed by fishermen to avoid any bias in discarding practices. Number of individuals and total weight for the commercial and discarded fractions were recorded for each haul and for each species. Then, biomass and density indices (kg/km2 and N/km2) were calculated. The use of artificial lights on the headline of the trawl net has resulted in a significant reduction (-57%) in the capture of European hake under the MCRS in the fishery targeting deep water pink shrimp. The use of artificial lights placed on the trawl net is a simple and economical solution to significantly reduce unwanted catches of European hake without loss of the commercial fraction.

CASE STUDY RESULTS

Type of intervention

Artificial lights on the headline of trawl net.

Aim of the experiment

The objective of this intervention is to evaluate the effects of artificial lights attached to the headline of the trawl net to 1) reducing fish bycatch (and discards), and 2) increasing catches of targeted crustaceans.

Main activities carried out

Trawl fishermen in Tuscany are using lights on nets in shrimp fisheries. Those lights seem to be efficient in increasing the catch of shrimps; currently, there is no scientific evidence in support of this anecdotal believe. The aim of the study is to evaluate whether those lights are efficient in increasing the catch of target species, and, at the same time, in decreasing by-catch and discards.

The study area comprises the commercial fishing grounds of the continental shelf and slope in the northern Tyrrhenian Sea (NW Italy). Those fishing grounds are routinely exploited by the trawl fleets of Porto Ercole and Porto Santo Stefano, practicing mixed bottom trawl fisheries targeting European hake, Merluccius merluccius, red mullet, Mullus barbatus, horned octopus, Eledone cirrhosa, deep-water pink shrimp, Parapenaeus longirostris, as well as Norway lobster, Nephrops norvegicus, in deeper waters.

The sampling design consisted in paired hauls using a local commercial fishing vessel (FV Angela Madre, 22.7 m LOA and 210 kW), that was the same over the duration of the experiment, alternating the control bottom trawl net with the one equipped with lights on the headline. The field trials were conducted on consecutive days in three different seasons (summer 2016, autumn 2016, and spring 2017), for a total of 52 hauls (26 with lights, 26 without lights). Trawling was performed at 3.1-3.4 knots. In each haul, the trawl net was equipped with SIMRAD sensors to monitor the geometry of the net during the towing. In addition, a TD probe (DST centi Star:Oddi) was placed on the net to record bottom temperature.
Sorting was performed by fishermen to avoid any bias in discarding practices. Commercial fraction was divided by species, and total weight by species and commercial category recorded. Individual size (total length for fish, mantle length for cephalopods and carapace length for crustaceans) was measured from sub-samples by species and commercial category. Total weight of discards was recorded, and sub-samples brought to the lab for sorting and identification at the lowest taxonomic level possible (i.e., species). For each taxon, number of individuals and total weight were recorded. For each haul and for each taxon identified (both in the commercial and discarded fraction), biomass and density indices (kg/km2 and N/km2) were calculated (swept area method, Sparre and Venema, 1992).
The data were analysed by means of generalised additive mixed modelling (GAMM). GAMM models with Poisson distribution were used to fit the response variable biomass (kg) (Miller, 2013). Bottom temperature and depth are significantly correlated (-0.7), therefore only depth was used in the models. The swept area was used as an offset, and each pair of tows used as a random effect.
Miller T.J. (2013) - A comparison of hierarchical models for relative catch efficiency based on paired-gear data for US Northwest Atlantic fish stocks. Can. J. Fish. Aquat. Sci., 70: 1306-1316.
Sparre P., Venema S.C. (1992) - Introduction to tropical fish stock assessment. FAO Fish. Tech. Pap. 306. FAO, Rome.

Main result

The use of lights allowed a general decrease of discards of species with MCRS;
In particular, the use of lights allowed a decrease of European hake discards. Average discard rate of European hake was 11.6 kg/km2 with lights, while it was 27.4 kg/km2 without lights (-56.6%);
The use of lights did not affect the catch rates of commercial catches. No significant effect was detected by GAMM analysis;
The use of lights did not affect the catch of the main target species, deep-water pink shrimp, Parapenaeus longirostris. No significant effect was detected by GAMM analysis.

Discussion of the results

The limited species selectivity of trawls is a continuing concern for fisheries scientists and managers. Developing new technology to reduce bycatch and discards in trawl fisheries is especially important (Hannah et al., 2011, 2015). Sartor et al. (2003) showed that the by catch of trawl fisheries in the Ligurian and northern Tyrrhenian Seas accounts for about 80% of the total annual average catch, while the remaining fraction was constituted by target species. The fisheries targeting crustaceans produce

a significant amount of discards, representing about 20% of the total catch (Sartor et al., 2003).
Discards of commercial species are mostly constituted by individuals under the minimum conservation reference size (MCRS). In addition, discards of low commercial value species, such as blackmouth catshark, Galeus melastomus, and greater forkbeard, Phycis blennoides, can be particularly abundant. The low selectivity of the trawl nets as well as the species diversity of the exploited demersal assemblages are the main reason for the high species richness observed in the catches, especially as regards the discarded fraction. This may produce an ecosystem impact on a complex of species belonging to the demersal communities.
The introduction of new trawl net mesh size obligation by the Reg. CE 1967/2006 was particularly opposed by the fishermen and their representatives. They are afraid that further increasing the trawl net mesh size might result in loss of target species (shrimps) and other important retained by catch species (such as horned octopus, Eledone cirrhosa, and squids); therefore, such a management measure is particularly unwanted by fishermen, who are looking for technical devices that may reduce the by catch, while not affecting the catch of target species.
In the last few years, some fishermen adopted the use of artificial lights attached to the trawl net in order to increase the catches of targeted crustaceans, while reducing the by catch. According to their knowledge, the use of such a device resulted particularly effective in the hauls performed during the night and targeting P. longirostris.
The objective of this intervention was to evaluate the effects of artificial lights attached to the headline of the trawl net to 1) reducing fish bycatch (and discards), and 2) increasing catches of targeted crustaceans.
The results show that the use of lights affect the discards of species with MCRS (mostly fish), and in particular European hake. The analysis performed by means of GAMM shows that discards of European hake are significantly higher in the hauls performed without lights attached to the headline of the trawl net.
Hannah R.W., Jones S.A., Lomeli M.J.M, Wakefield W.W. (2011) - Trawl net modifications to reduce the bycatch of eulachon (Thaleichthys pacificus) in the ocean shrimp (Pandalus jordani) fishery. Fish. Res., 110: 277-282.
Hannah R.W., Lomeli M.J.M, Jones S.A. (2015) - Tests of artificial light for bycatch reduction in an ocean shrimp (Pandalus jordani) trawl: strong but opposite effects at the footrope and near the bycatch reduction device. Fish. Res., 170: 60-67.
Sartor P., Sbrana M., Reale B., Belcari P. (2003) - Impact of the Deep Sea Trawl Fishery on Demersal Communities of the Northern Tyrrhenian Sea (Western Mediterranean). J. Northw. Atl. Fish. Sci., 31: 275-284

How practical is it for a fisherman to implement this improvement, technically and financially?

The use of artificial lights on trawling is technically very simple and consists only of tying these devices on the headline of the net.
The cost of the lights is very low and it is possible to replace the batteries when exhausted.

Is there sufficient evidence to support wider adoption of the method/technology?

The experiment carried out on the effect of lights on the trawl net showed that their use has a positive impact on the reduction of the catches of M. merluccius specimens under the MCRS.
The use of these devices can be recommended for other similar fisheries in the Mediterranean, especially those operating on the nursery areas of European hake.

CONCLUSION

We investigated how the addition of artificial lights to a trawl net alters fish bycatch and target crustaceans shrimp catch. In parallel trials (one trial incorporating artificial lights on the headline of the net and the other serving as a control), we attached 60 lights (20 green, 20 blue, and 20 white lights) along the trawl headline. In 52 paired hauls, the addition of artificial lights along the fishing line reduced the discards of fish (in particular European hake) with no effect on crustacean target species.
Our study, originated through the multi-actor approach and tested under commercial fishing conditions, revealed that the use of artificial lights attached to the fishing line of trawl nets may be a useful alternative design, which could potentially satisfy the fisheries management objective under the Landing Obligation of improving selectivity and reducing bycatch and discards in trawling fisheries.
ADDITIONAL RELEVANT RESOURCES OR LINKS
EU Common Fisheries Policy (CFP) Reform: https://ec.europa.eu/fisheries/cfp_en
International Guidelines on Bycatch Management and Reduction of Discards: http://www.fao.org/fishery/nems/40157/en

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