

Competitive interactions between pulse and beam trawlers in the North Sea

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Since 2009 every European member state is allowed to replace 5% of its beam trawl fleet by trawlers equipped with electric fishing gear (pulse trawlers) to target demersal fish species in the Southern part of the North Sea (EU, 2009). Compared to beam trawling, pulse trawling is more efficient in terms of fuel use, reduces by-catches and has less disturbance of the seafloor (van Marlen *et al.*, 2014). The Dutch beam trawl fleet switched gradually to pulse trawling and since 2012, 42 vessels are equipped with pulse fishing gear to target sole (*Solea solea*). Simultaneous changes occurred in the fishing effort distribution of Belgian beam trawlers. Effort is reduced on fishing grounds which they exploit together with pulse trawlers and reallocated to areas where pulse trawlers do not fish. This study investigates the relationship between the introduction of pulse trawlers and the changed effort patterns of Belgian vessels based on the concepts of behavioural ecology.

Following the theory of the Ideal Free Distribution (IFD) (Fretwell and Lucas, 1970), foragers are distributed over a patchy environment proportional to the density of the resource. When competitive interactions occur, better competitors are more present on better patches while weaker competitors are driven away to poorer patches. Despite violation of some assumptions, the IFD is successfully applied in other fields such as fisheries (Gillis, 2003). Following this concept, a change in fishing effort allocation is caused by changes in resource density or competitive interactions. The focus of this study is on the mechanism of interference competition which is reversible and occurs in direct presence of other competitors (Gillis and Peterman, 1998; Poos and Rijnsdorp, 2007; Poos *et al.*, 2010). If beam trawlers encounter higher interference competition interactions, catches of beam trawlers would be affected in presence of pulse trawlers.

To examine this hypothesis, catch rates were analysed based on the difference in weekly exploitation patterns of Belgian and Dutch fishing vessels. Dutch fishermen typically make fishing trips from Monday until Thursday, while Belgian fishermen continue fishing during weekends. Thus daily catch rates during weekends should be higher than during weekdays. Logbook data of commercial Belgian beam trawlers were used to fit a linear regression model with daily catches of sole as dependent variable and a dummy variable accounting for the weekend effect. Other relevant covariates accounting for skipper effect and seasonal variation are included as well.

Results show differences in catch rates for sole between weekdays and weekends. In 2012 and 2013, daily sole catches are significantly higher during weekends than during weekdays. Differences are highest on fishing grounds where activity of Belgian beam trawlers is highest. Before 2012, in absence of pulse trawling no difference was measured. This difference was only found for sole which is the main target species for both pulse and beam trawlers in the Southern part of the North Sea. Our results show that interference competition for sole increased and might be a reason that Belgian beam trawlers fish less in the Southern part of the North Sea.

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