

# Research into chances of survival of flatfish and rays: what are the chances of survival in pulse fishing?

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**How many undersized fish actually survive the process of being discarded? This question is relevant because of the European landing obligation, which obliges fishers to land undersized fish that are subject to a quota. Wageningen Marine Research, together with the fishing industry, has investigated the chances of survival of flatfish and rays in pulse fishing. Which conclusions about the chances of survival can be drawn from the research?**

## Why research into changes of survival of undersized fish?

As of 2019, the Common Fisheries Policy will oblige the fishing industry to land all undersized specimens of fish that are subject to a quota. Under the previous policy, fishers had to discard these fish. Some of the undersized fish survive the process of discarding and can contribute to the fish stock. This is not the case if the fish has to be brought to shore; in that case, all fish are certain to perish. The discards policy therefore includes a provision that states that an exception may be made on the landing obligation for fish species with a high chance of survival. For this reason, knowledge is needed on the chances of survival of discarded fish.

## Research method

The research into the chances of survival of plaice, common sole, turbot, brill, thornback ray and spotted ray in the North Sea was carried out on board of three trawlers, which each fish using a pulse trawl with 80 mm meshes and 12m wide gears. Scientists of Wageningen Marine Research (WMR) collected the undersized fish during regular fishing. A total of nine fishing trips were made, spread over the entire year and the Southern North Sea. This produces final results that are representative for the constantly changing conditions in which the fishing takes place, such as fluctuating water temperature, the type of fishing ground, and wind strength and direction. After examining the reflexes and external characteristics

of the fish, these were put in tanks in special survival units and monitored daily. At the end of the fishing trip, the fish were brought to the laboratory for further monitoring until mortality ceased. Healthy control fish were taken on board. They were given the same treatment. This allows for a differentiation between mortality caused by fishing and mortality caused by research activities. The method used follows the guidelines for survival research developed by the International Council for the Exploration of the Sea (ICES).

## Number of undersized fish studied

In total, 558 undersized plaice, 274 common soles, 111 turbot, 90 brill, 99 thornback rays and 23 spotted rays were studied. The chances of survival were calculated based on the numbers of fish that were alive at the end of the observation period (15 to 18 days after catch). What were the results? First some explanations about the way the estimation of chances of survival is done.

## Estimation of changes of survival: how it is done

Variations in chances of survival between the fishing trips were found in all species. The actual chance of survival can only be determined if the scientists were to measure the survival of all discards (the population). This is not possible, obviously. The chance of survival can only be measured for a small part of the discards (the sample). For each species, the chance of survival of discards is calculated based on the results of the nine fishing trips. The survival measured in the sample (nine trips) is an estimate of the true survival for all discards in a one-year round of pulse fishing. For plaice, this estimate is 14%. This figure means that, based on the nine trips with three trawlers, WMR estimates that 14% of the total undersized plaice catch discarded by the entire pulse fleet fishing with 80 mm meshes and 12m gears in an

entire year survives. The next question is, of course, how close this estimate is to the true (and unknown) survival chance, in other words: how reliable is this estimate? This question could only be answered if the scientists would know the true survival. But that is not known, as it would require WMR to measure the survival of all undersized plaice, a feat that is practically impossible. What the scientists can do, however, is estimate an interval (or range) of the survival chance. To this end, they used a 95% confidence interval (95%CI). This means that the probability of the interval containing the true chance of survival is 95%. To make it more concrete: for plaice, this 95%CI was estimated to be between 11 and 18%. This means that the scientists are 95% confident that the interval of 11 to 18% contains the true chance of survival of plaice. The easiest way to interpret this, although it is technically not entirely correct, is to say that there is a 95% probability of the true chance of survival being between 11 and 18%.

### Chance of survival of plaice in 80mm pulse fishery: 14%

The study reveals that the chance of survival of undersized plaice in pulse fishing is 14% (95%CI 11-18%). A comparable study performed in 2015-2016 on-board pulse fishing vessels produced an initial indication of a 15% chance of survival of plaice of (95%CI 11-19%) (Van der Reijden et al., 2017). The 95% confidence intervals of both studies almost fully coincide. This means that the estimates for chances of survival of all plaice discards based on both studies do not differ. As the results for plaice from both studies agree and a large amount of undersized fish from catches spread over the year was monitored, it is concluded that the results found for plaice (14%, 95%CI 11-18%) are representative for the chance of survival in 80mm pulse fishing with 12m wide gears.

### Chance of survival of common sole in 80mm pulse fishery: 19%

For undersized common sole, the chance of survival in pulse fishing is calculated to be 19% (95%CI 13-28%). This result is also representative for the chance of survival in 80mm pulse fishing. It cannot be excluded that the chance of survival of sole might be higher than 19%. The study that was performed in 2015-2016 produced an initial indication for the chance of survival of common sole of 29% (95%CI 24-35%) (Van der Reijden et al., 2017). However, this study had no measurements in winter. In the current study, measurements were performed in winter, and survival was very low in that period. This has consequences for the calculation of the for the entire year, which therefore becomes lower. The 19% in the current study is probably a better estimate. In order

to get a more precise estimate, WMR advises to combine the datasets of both studies.

### Indicative results turbot, brill, thornback ray and spotted ray

For turbot, brill, thornback ray and spotted ray, the calculated chances of survival are an initial indication. This is because the sample (the number of collected and monitored undersized specimens) was small. For turbot, WMR found a chance of survival of 30% (95%CI 20-43%). For brill 13% (95%CI 7-23%) and for thornback ray 53% (95%CI 40-65%). Spotted rays were only sampled on two trips, with the chances of survival on one trip being 21% and 67% on the other. Collecting additional data for these species will bring the extreme values of the confidence intervals closer together. This will allow for more precise estimates of the chances of survival. The expectation is that these more precise estimates will be within the range of the current 95%CI estimates; this means that future studies into the chances of survival of turbot in 80mm pulse fishing will, with 95% certainty, not lead to a lower estimate than 20% nor a higher estimate than 43%.

*Table 1 Chances of survival and 95% confidence intervals (95%CI) for six fish species (undersized) in 80mm pulse fishing in the North Sea*

Species	Survival rate	95% CI
Plaice	14% <sup>1</sup>	11-18%
Common sole	19% <sup>1</sup>	13-28%
Turbot	30% <sup>2</sup>	20-43%
Brill	13% <sup>2</sup>	7-23%
Thornback ray	53% <sup>2</sup>	40-65%
Spotted ray	21 and 67% <sup>2</sup>	N.A. due to small sample

Status calculated survival rate: <sup>1</sup> determined, <sup>2</sup> indicative

Source: Schram & Molenaar (2018)

## Condition of the fish influences survival

The condition in which the fish is brought on board turns out to be of significant influence on the survival of undersized fish for all species studied. In that aspect, there are significant differences between the chances of survival of the fish in the best and worst conditions. However, the share of fish in the best condition was small in the total catch of undersized fish. This is the reason why the high survival in the best group only contributes a little to the chance of survival that was calculated across all undersized specimens caught. Measures to improve the chance of survival should therefore focus on improving the condition of undersized fish during capture. The research also shows that the processing time after catching has no effect on the condition of the fish nor on the survival. WMR therefore recommends that the measures aimed at improving the condition of the undersized fish should focus on the catching process itself, instead of focusing on the processing of the catch.



Undersized plaice at the end of the sorting belt, ready to be discarded into sea.

## Series of factsheets into fish survival research

This factsheet is part of a series of factsheets in which research into the chances of survival of flatfish and rays in pulse fishing are discussed. Other factsheets discuss the question why a choice was made for research with survival tanks instead of markings; the results of the research into the chances of survival of flatfish and rays; the effects of changes in processing on chances of survival; and the effects of the conditions under which fishing takes place on the chances of survival of flatfish and rays.

## Animal Experimentation Act

The treatment of the fish in this research project was in accordance with the Dutch Animal Experimentation Act, as approved by ethical committees (Experiment 2017 D0012.002).

## References

- Van der Reijden, K. J., Molenaar, P., Chen, C., Uhlmann, S.S., Goudswaard, P.C. Van Marlen, B. 2017. Survival of undersized plaice (*Pleuronectes platessa*), sole (*Solea solea*), and dab (*Limanda limanda*) in North Sea pulse-trawl fisheries. *ICES Journal of Marine Science* 74(6), 1672–1680.
- Schram, E. & P. Molenaar. 2018. Discards survival probabilities of flatfish and rays in North Sea pulse-trawl fisheries. Wageningen Marine Research report number C37/18. Wageningen, Wageningen University and Research Centre, 41p.

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More info: [www.wur.eu/fishsurvival](http://www.wur.eu/fishsurvival)