**Answer to Special request on pulse trawl electrical fishing gear**

The European Commission (EC) has requested ICES to evaluate the possible effect of the use of pulse-trawl electrical fishing gear to target plaice and sole in beam-trawl fisheries:

a) *What change in fishing mortality could be expected following the adoption of such gear in the commercial fishery, assuming unchanged effort measured in KW-days at sea?*
b) *What effect would such a widespread introduction have in terms of (i) the mixture of species caught; (ii) the size of fish caught?*
c) *What, if any, effects would such introduction have on non-target species in the marine ecosystems where this gear was deployed?*

This second response to the EC's request deals with the outstanding question a) ICES' earlier response dealt with questions b) and c) and that advice was released in May 2006 where further background details to the request can be found.

**Background**

Council Regulation (EC) No 850/98 (article 31, paragraph 1) states that '… *The catching of marine organisms using methods incorporating … electric current shall be prohibited*'. Nonetheless, electrical systems have been used as a survey tool in freshwater environments for many decades and in some non-commercial marine fisheries since the 1960's. The environmental concerns relating to the physical impact on the sea floor caused by beam trawling and the recent economic reality of increased fuel prices, have led to renewed interest in this technology for use in commercial fisheries.

**ICES Advice**

*a) What change in fishing mortality could be expected following the adoption of such gear in the commercial fishery, assuming unchanged effort measured in KW-days at sea?*

ICES is unable to accurately predict the change in fishing mortality from the introduction of the pulse trawl in the North Sea flatfish fishery. The two sets of data that are available to assess the effects of the pulse trawl give contradictory information for sole. The potential uptake of the pulse trawl by the commercial fleets in the North Sea if the current legal status of the system was changed is unknown. There is also a lack of information on the proportion of vessels currently using tickler chain beam trawls which would be the candidates to change to pulse trawl.

Based on the comparative trials with the pulse trawl onboard a commercial vessel, ICES has been able to approximate the potential losses and gains in fishing mortality, yield and spawning stock biomass (SSB) for plaice and sole assuming 100% uptake The results are summarized in the text table below. The commercial trials indicate lower fishing mortalities for both plaice and sole with yields in 2010 which would be slightly below current yields and SSB which would be expected to be substantially higher than at present.

| Species | Plaice | Sole |
|---|---|---|
| F2-6 | -27% | -22% |
| Initial Yield | -14% | -19% |
| Yield by 2010 | -3% | -5% |
| SSB by 2010 | +34% | +21% |
| Cumulative Yield | -9% | -10% |

**ICES comments**

There were two main sources of sea trial data:

1) Comparative fishing trials were conducted on the research vessel FRV *Tridens* with a conventional and a pulse beam trawl fished simultaneously at the relatively low speed of 5.5 knots, which provides the optimum catching efficiency.

2) A year-long feasibility study onboard a commercial beam trawler (MFV) fitted with a complete system of cable winches and two pulse beam trawls. In this case, catch data were compared with similar commercial vessels fishing with two conventional beam trawls. These vessels fished at their normal commercial operating speed (~6-7 knots) in the same weeks and at comparable fishing locations.

Data from the two sources produced different results for each species – plaice and sole. The RV trials showed a 16% reduction in plaice catches across all length classes; whilst the MFV trials showed no significant reduction in catches of plaice below the minimum landing size (MLS) but a 35% reduction in catches above the MLS. By contrast, the RV data collected using the electrical pulse trawl showed that for sole the probability of capture increased with length and that higher catch rates were obtained for fish larger than ~25cm in length. Conversely, the MFV trials failed to show any significant length dependency for sole with a ~25% reduction in catches across all length classes.

To determine the possible stock effects, it is necessary to estimate the level of commercial uptake if the current legal status of the system was changed. It should be noted that the pulse trawl system can only be used as an alternative to tickler chain beam trawls and not for the chain mat type because the gear cannot operate on rough fishing grounds. To accurately predict the stock effects it is necessary to obtain information on the partial fishing mortalities or the relative effort associated with the two gear types. However, current data collection programmes do not distinguish between the two gear types. Gear technologists (pers. comm.) note that there are national differences between the beam trawl fleets of the Netherlands, Belgium and the UK in terms of relative usage of the two gears. In the Netherlands, approximately 95% of the vessels use tickler chain beam trawls, whereas the converse is true in Belgium and the UK (non-flag vessels). The recent commercial evaluation trials indicated that the electrical pulse system did not provide an economically viable alternative due to the losses of target species associated with the electrical pulse system (van Marlen et al., 2006).

After the five weeks of comparative trials on the commercial vessel there were technical modifications to the pulse systems and cable winches, with the objective to improve the catching performance of the gear, which was reported by the crew as being lower than in initial weeks of fishing with the gear. Apparently the system has not fully outgrown the experimental development phase at the time of trials. This makes final conclusions about the relative efficiency of the fishing gear premature and more comparative data would need to be collected to get a better estimate of the relative efficiency during commercial fishing operations.

Given the differences in results highlighted above, together with the unknown level of potential uptake by the commercial fleet and the relative importance of each gear type, a number of options have been simulated in order to give an indication of the likely range of effects that the introduction of the electric technology might have on the North Sea stocks of plaice and sole.

**Plaice**

*Research vessel trial data:* A 16% reduction in fishing mortality would be expected. In the case of full commercial uptake, the yield from the fishery would fall by 13% initially but would reach current levels by 2010, with an overall cumulative gain of 3%. SSB should be above $B_{lim}$ within 2 years and have increased by 27% by 2010 (Figure 1[upper panels]).

*Commercial vessel trial data:* The data from the commercial trial have only been analysed in terms of catches above and below MLS. For the purposes of stock modelling, this has been represented as a step function at MLS and that fish below MLS are either 1- or 2-group where fish above MLS are 3-group and over. The trials show no difference in plaice catches below MLS and a reduction of 35% in catches of plaice above. The modelling suggests that the yield from the fishery will diminish by approximately 14% in the first year but lead to a cumulative loss (2005 – 2010) of 10%; by 2010 yield will be 3% lower with full commercial uptake. SSB will increase by 34% approaching $B_{pa}$ (Figure 1 [lower panels])

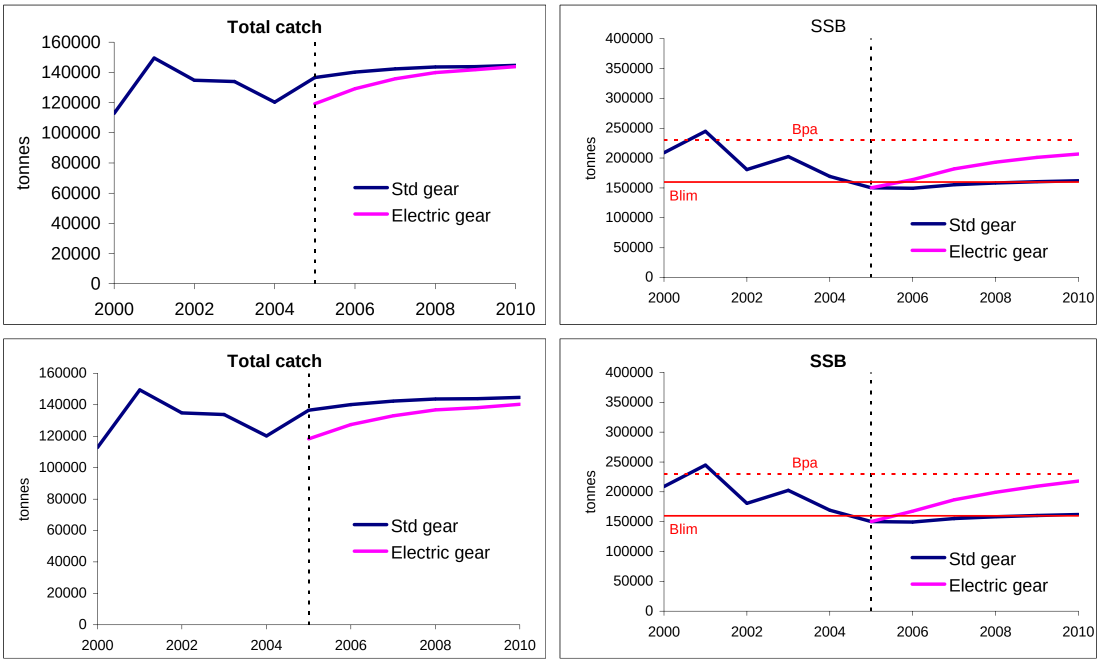


*Figure 1. Scenario results for North Sea plaice. Top panels: based on research vessel data, bottom panels: using commercial trial data. Left panels: total catches, right panels: SSB. The blue line indicates the no-change scenario and the pink line the full implementation of the new trawl.*

For a range of commercial uptake scenarios, the cumulative effect on plaice catches, discards and SSB are given in table 1based on the commercial vessel trials. In those scenarios the implementation of the pulse trawl is expected to increase landings and SSB in the longer term.

| Uptake | F2-6 | Cum disc | Cum landing | SSB 2010 | Catch 2010 | Discards 2010 | Landings 2010 |
|---|---|---|---|---|---|---|---|
| 1 | 0.42 | 347420 | 294060 | 217873 | 140272 | 59279 | 55453 |
| 0.8 | 0.45 | 353196 | 302840 | 203817 | 141716 | 60312 | 55814 |
| 0.6 | 0.48 | 358723 | 309917 | 191411 | 142801 | 61298 | 55863 |
| 0.4 | 0.51 | 364014 | 315575 | 180432 | 143603 | 62240 | 55677 |
| 0.2 | 0.54 | 369079 | 320053 | 170689 | 144187 | 63140 | 55315 |
| 0 | 0.58 | 373930 | 323548 | 162019 | 144601 | 64001 | 54826 |

*Table 1. Predictive effects on plaice based on a range of uptake scenarios and based on the commercial vessel trial data.*

## <u>Sole</u>

*Research vessel trial data:* The effect on catches was weakly length dependent. The model suggests no initial or cumulative (2005-2010) loss in yield and a slight increase by 2010 (1%) and a slight reduction in SSB (2%), but remains above $B_{pa}$ (Figure 2[upper panels]).

*Commercial vessel trial data:* The model predicts a significant initial loss in catches (19%) and an 11% reduction in cumulative yield (2005-2010). With full commercial uptake, yield could still be 5% lower in 2010 but could result in a 21% increase in SSB (Figure 2[lower panels])

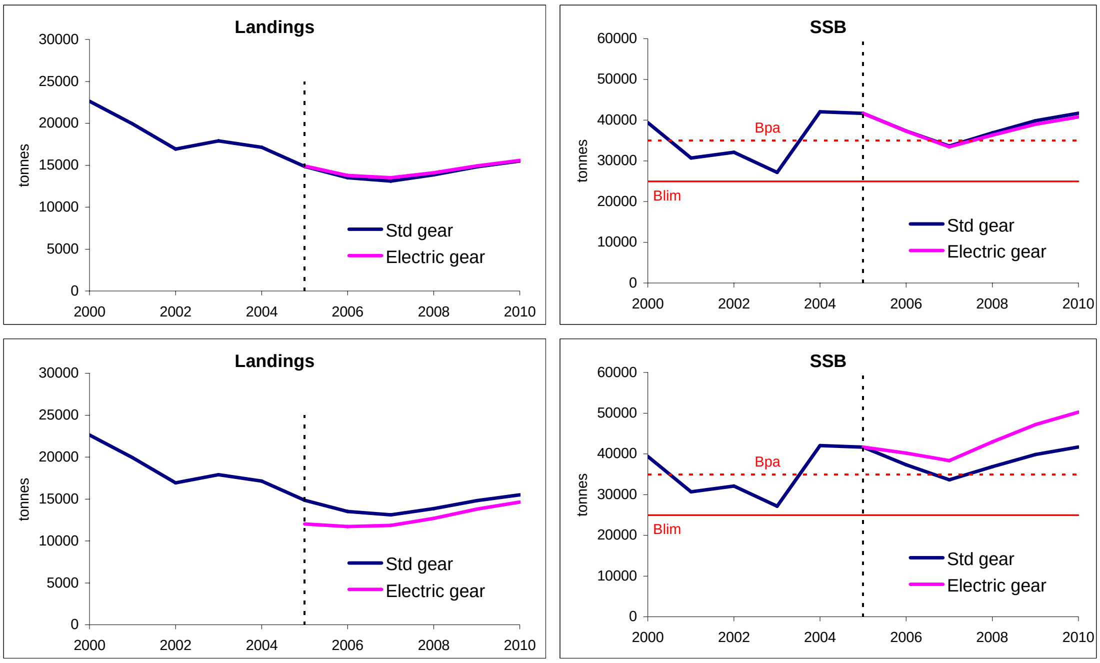


*Figure 2. Scenario results for North Sea sole. Top panels: based on research vessel data, bottom panels: using commercial trial data. Left panels: total catches, right panels: SSB. The blue line indicates the no-change scenario and the pink line the full implementation of the new trawl.*

For a range of commercial uptake scenarios, the cumulative effect on sole catches, discards and SSB are given in table 2 based on the commercial vessel trials. In the scenarios the implementation of the pulse trawl is expected to result in slightly lower landings and a higher SSB in the longer term.

| Uptake | F2-6 | Cum disc | Cum landing | SSB 2010 | Catch 2010 | Discards 2010 | Landings 2010 |
|---|---|---|---|---|---|---|---|
| 1 | 0.27 | 0 | 76746 | 50278 | 14659 | 0 | 14659 |
| 0.8 | 0.29 | 0 | 78785 | 48349 | 14878 | 0 | 14878 |
| 0.6 | 0.30 | 0 | 80689 | 46531 | 15069 | 0 | 15069 |
| 0.4 | 0.32 | 0 | 82470 | 44816 | 15236 | 0 | 15236 |
| 0.2 | 0.34 | 0 | 84135 | 43197 | 15382 | 0 | 15382 |
| 0 | 0.35 | 0 | 85694 | 41669 | 15509 | 0 | 15509 |

*Table 2. Predictive effects on sole based on a range of uptake scenarios and based on the commercial vessel trial data.*

## Discussion

As one might expect, the analyses demonstrate that different results are obtained in model output depending on which data source is used (Table 3). For plaice almost all the differences are small. For sole, however, the differences are more apparent, particularly for initial losses in yield and SSB predictions. The differences in the results between the research vessel trials and the commercial trials are a major source of uncertainty in the analysis but might be attributable to the difference in towing speeds used.

The analyses were based on strong assumptions about future recruitment, mean weight-at-age and fishing effort. Recent recruitment for sole has been very low but the scenarios have assumed that future recruitment is back on the average level. The analyses that were conducted only explored deterministic projections.

| **Species** | **Plaice** | | **Sole** | |
|---|---|---|---|---|
| Source | RV | MFV | RV | MFV |
| Fishing mortality | -16% | -27% | +3% | -22% |
| Initial Yield | -13% | -14% | 0% | -19% |

| Species | Plaice | | Sole | |
|---|---|---|---|---|
| Yield by 2010 | 0% | -3% | -1% | -5% |
| SSB by 2010 | +27% | +34% | -2% | +21% |
| Cumulative Yield | +2% | -9% | +1% | -10% |

Table 3. Comparison of predictive effects of plaice and sole based on research vessel (RV) and commercial (MFV) catchability inputs assuming 100% uptake.

**Source of information**

Report of the Ad-hoc Group on Pulse trawl evaluation. ICES April 2006

Report of the Working Group on Fish Technology and Fish Behaviour. ICES April 2006

Reports of the EU funded IMPACT study which provides data on mortality caused by beam trawls, see review by ICES (ACME report 2001, CRR 248).

ICES (2006). Report of the working group on the assessment of demersal stocks in the North Sea and Skagerrak. Copenhagen, 6-15 September 2005. ICES C.M. 2006 / ACFM: 09.

Marlen, B. van, Grift, R., Keeken, O. van, Ybema, M.S., and Hal, R. van (2006). Performance of pulse trawling compared to conventional beam trawling. IMARES (RIVO) Report C014/06, March 2006.