

Online supplementary materials

Figure S1

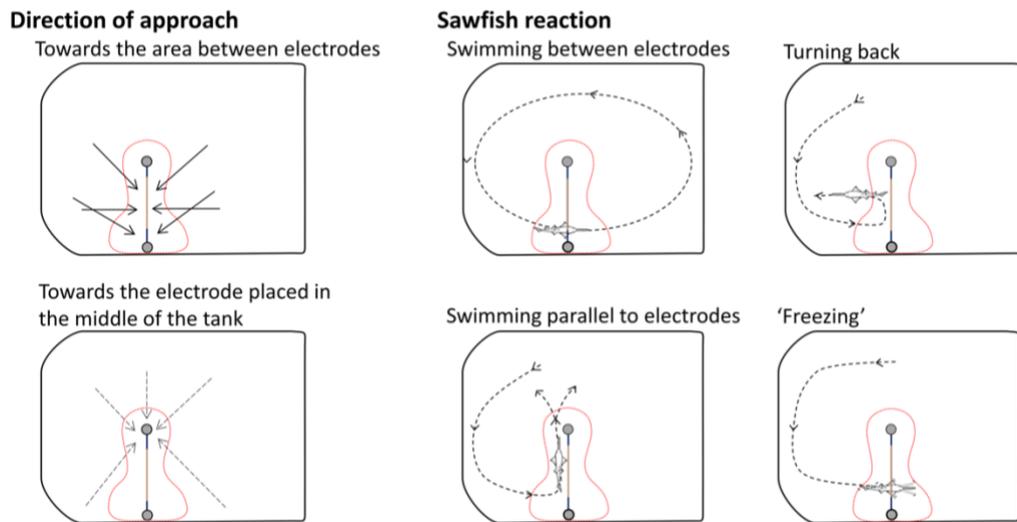


Figure S1. Diagrams showing (left) the direction of the swimming in relation to the electrode setup, and (right) movement paths of the four reaction types of the sawfish as they approached the electrode setup (brown line with two circles at the ends, represent the wooden beam and floats). The red dashed lines represent the theoretical electric field shapes at a hypothetical field strength (in $V \cdot m^{-1}$), where the effect of the non-conductive tank wall can be seen.. See Table 2 for a description of each reaction.

Figure S2

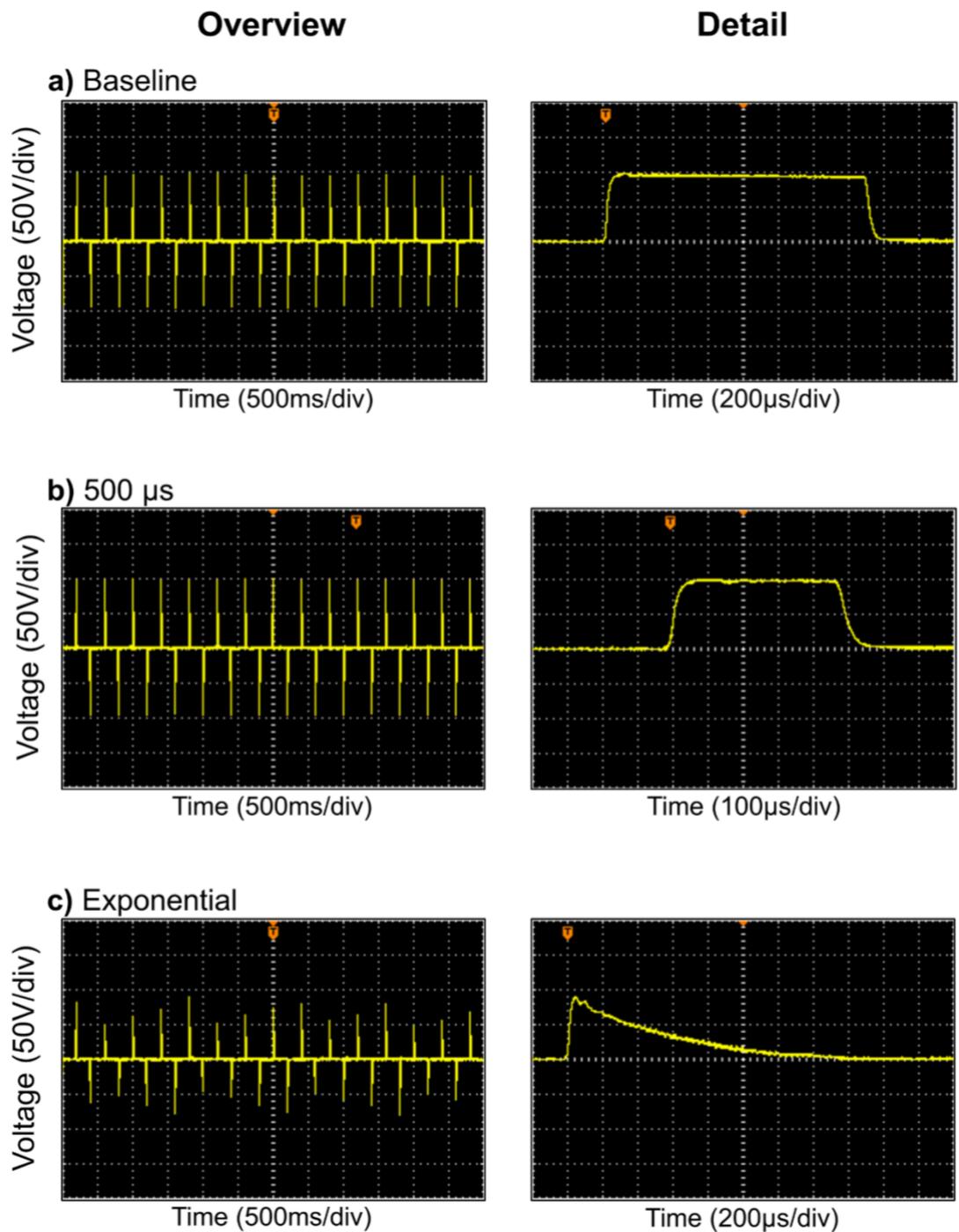


Figure S2. Overview of the electrical pulse stimuli used for the different experimental trials, measured at the electrodes in water, and plotted at longer (overview) and shorter (detail) time frames. Note the differences in both x- and y-scales. See Table 1 for detailed characteristics of each pulse. For the 'Exponential' pulse treatment, the apparently variable height of pulse amplitudes is an artefact of oscilloscope measurements and display (as it divides the chosen timeframe into 16384 measurements), due to the very narrow peak and sharp exponential decline, meaning the actual amplitude is higher than that shown in this figure.

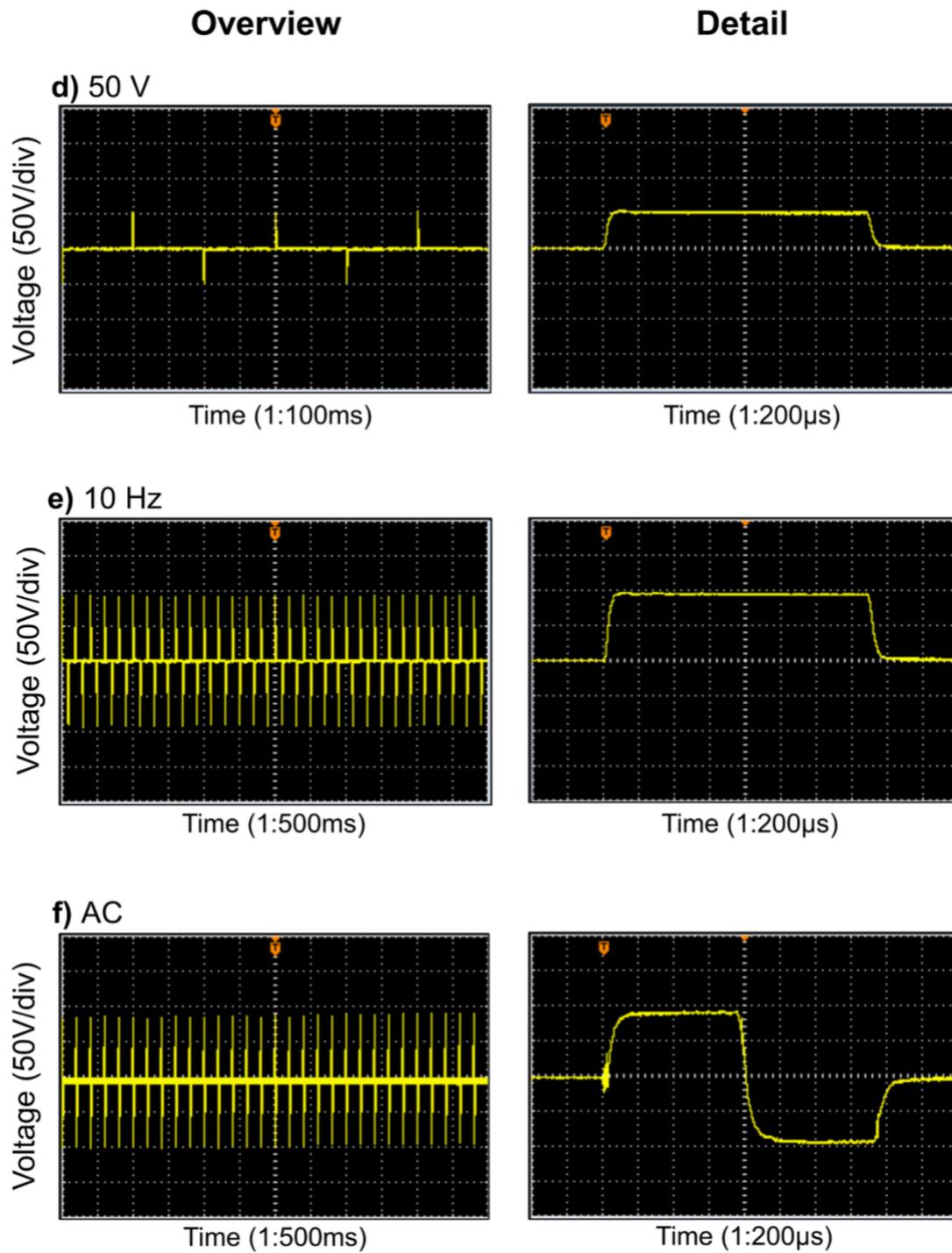
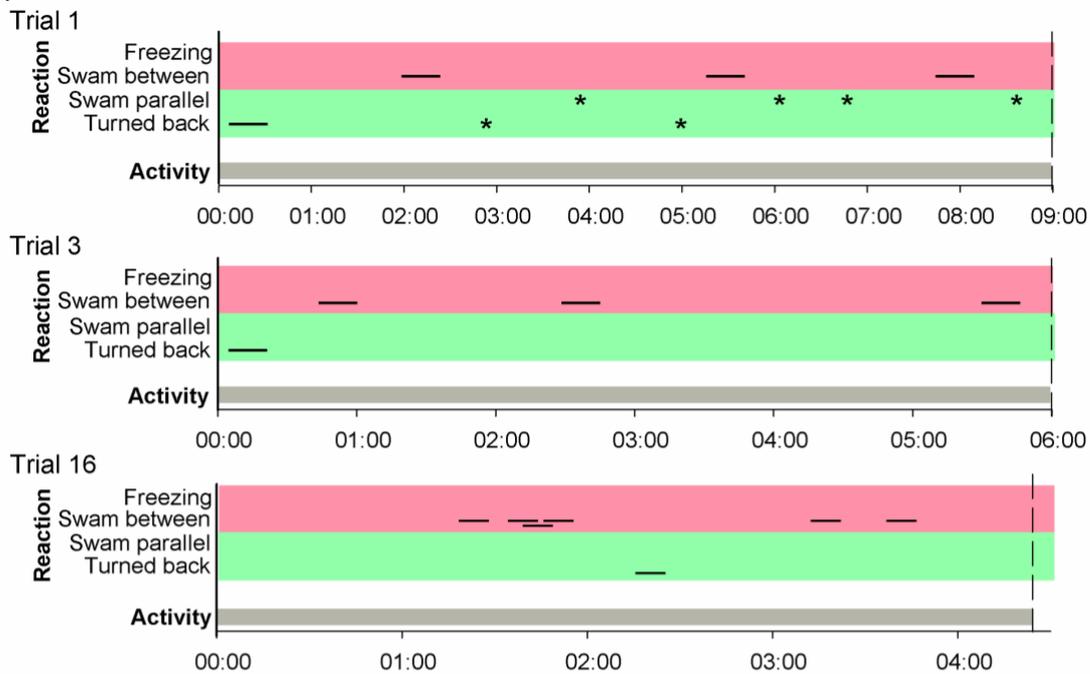


Fig. S2 (cont.)

Figure S3.
a) Control



b) Baseline

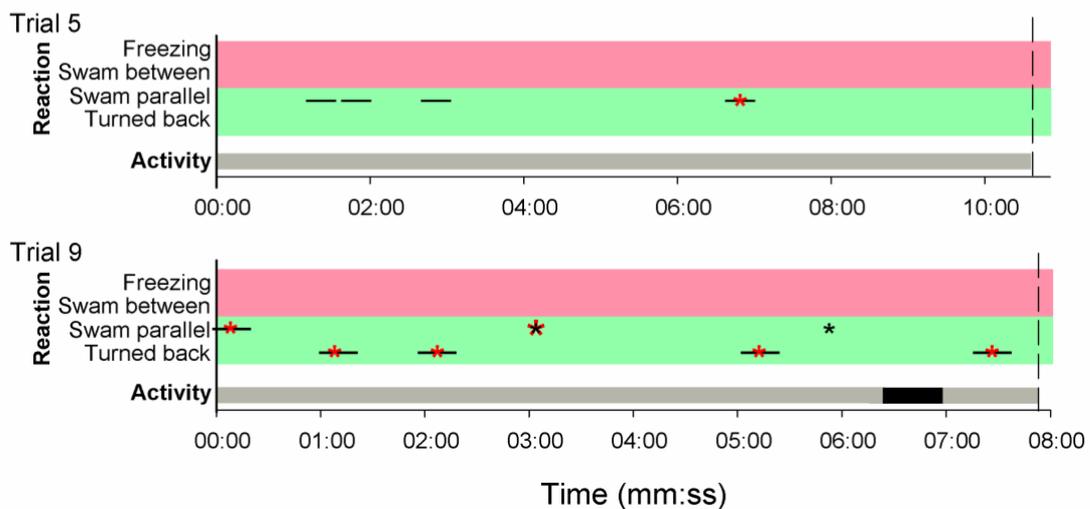
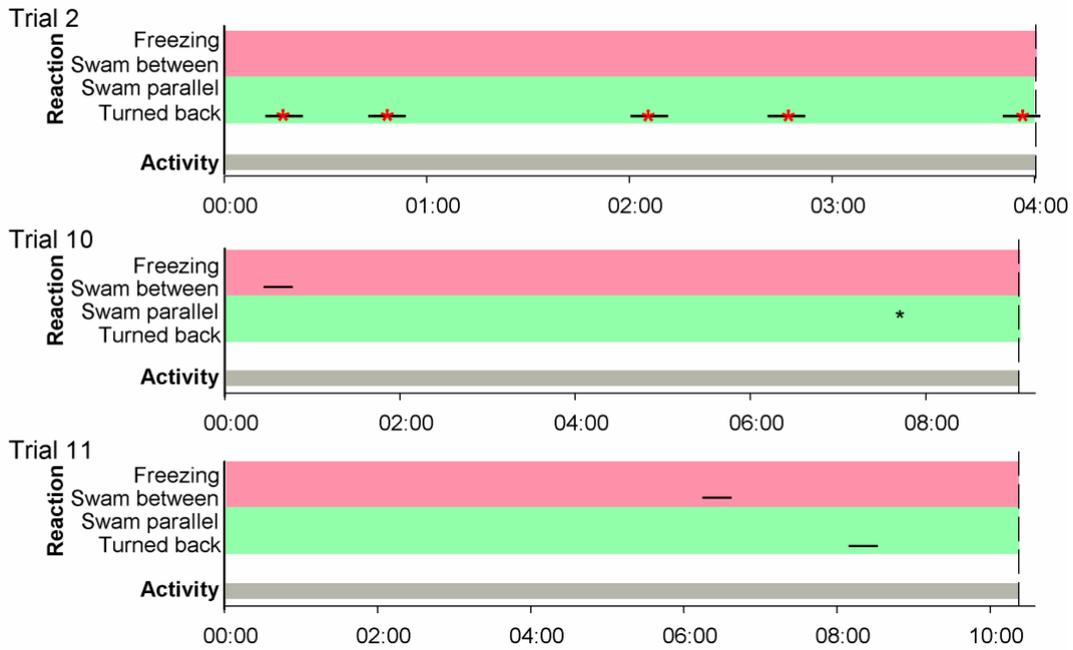


Figure S3. Timeline showing the reactions of sawfish 1 to the different electric fields from the beginning (time 00:00) to the end (vertical dashed line) of each experiment (note the difference in time-scales of the x-axes). For electrified treatments, this corresponds to the period of time from when the electrodes were turned on until they were turned off. – = Sawfish approaches the electrode setup, swimming towards the area between the electrodes; * = sawfish approaches the electrode setup, but swimming towards the electrode located in the middle of the tank. X = sawfish displayed ‘twitching’ behaviour. X = Sawfish freezing to the extent that electrodes had to be removed from the water. The region of the most desirable reactions is highlighted in green, and the region of least desirable reactions in red. See Fig. S1 for details of the approach and reaction types. Activity: grey - swimming; black - resting.

c) 50 V



d) 500 μ s

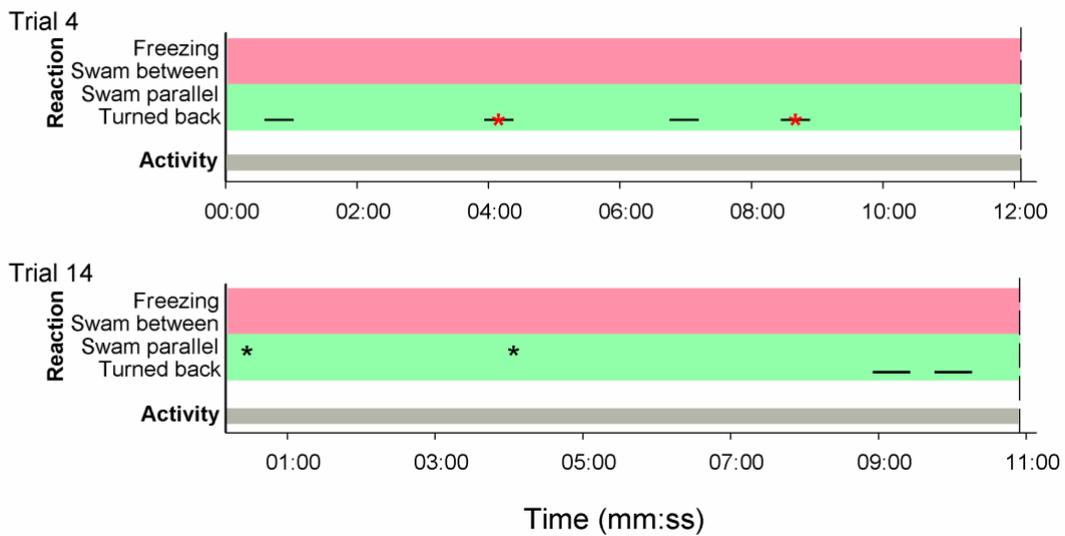
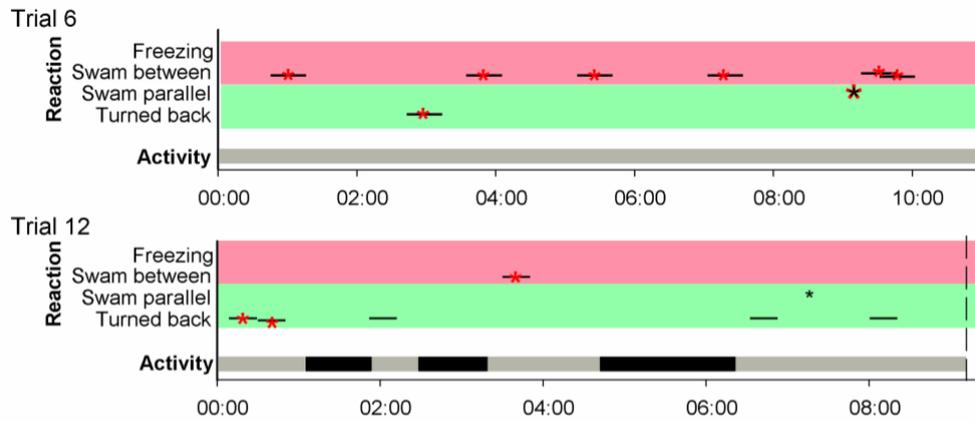
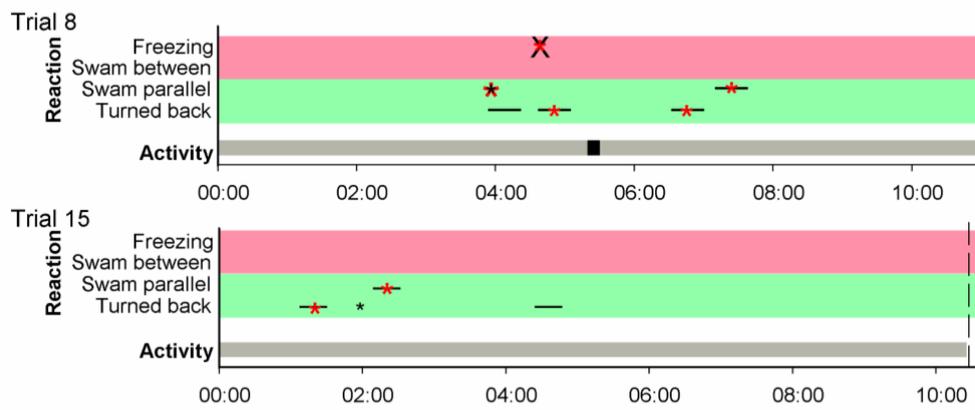


Figure S3 (cont.)

e) Exponential



f) 10 Hz



g) AC

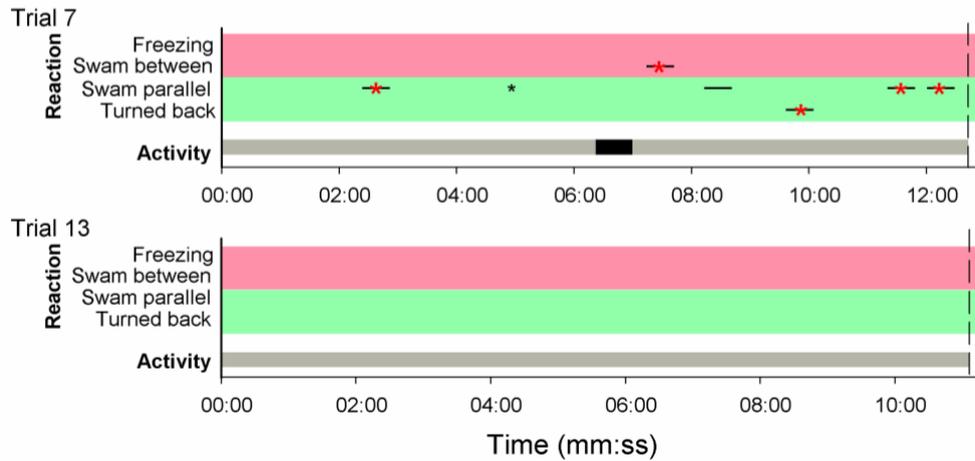
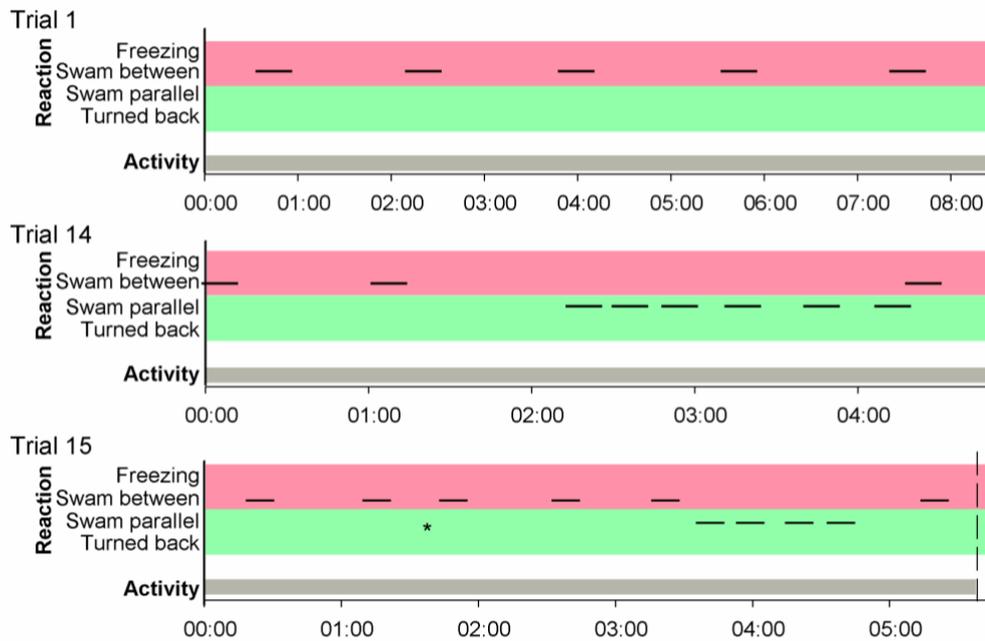


Figure S3 (cont.)

Figure S4
a) Control



b) Baseline

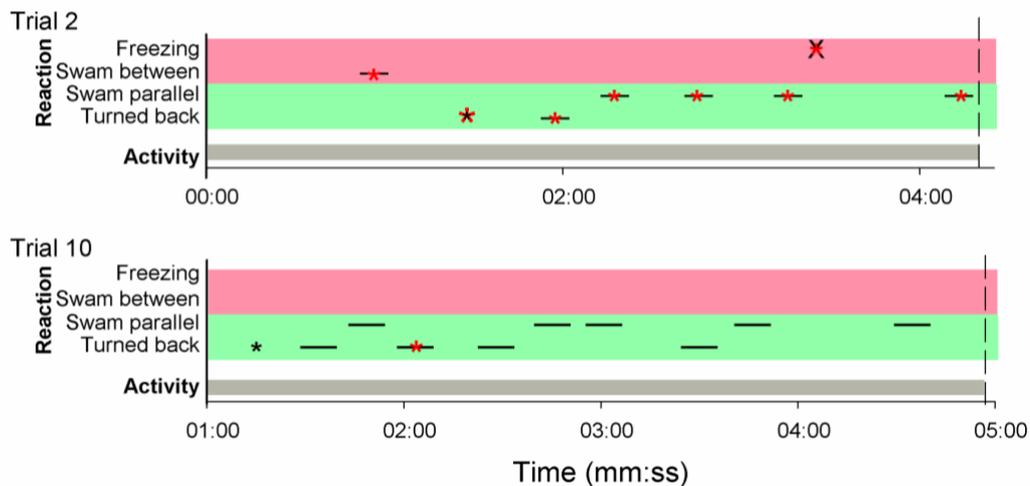
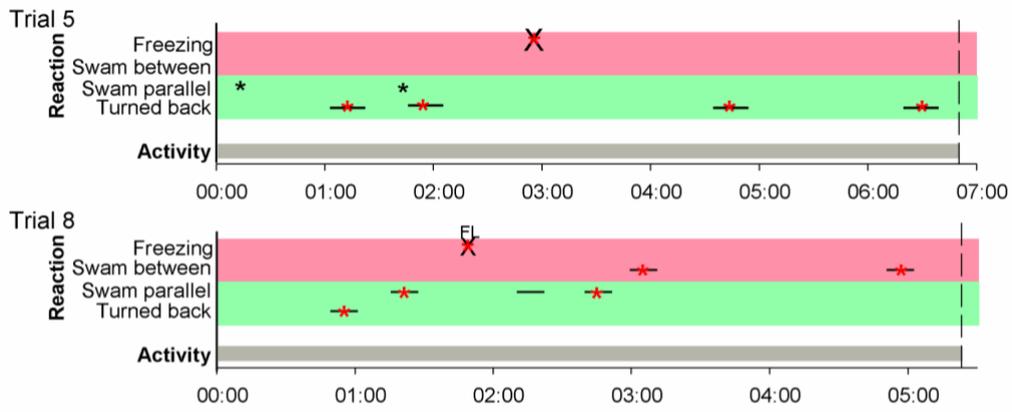
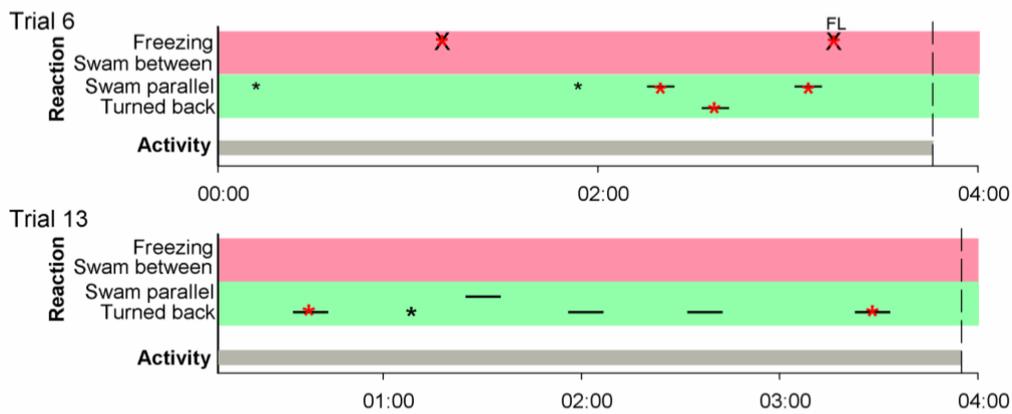


Figure S4. Timeline showing the reactions of sawfish 2 to the different electric fields from the beginning (time 00:00) to the end (vertical dashed line) of each experiment (note the difference in time-scales of the x-axes). For electrified treatments, this corresponds to the period of time from when the electrodes were turned on until they were turned off. – = Sawfish approaches the electrode setup, swimming towards the area between the electrodes; * = sawfish approaches the electrode setup, but swimming towards the electrode located in the middle of the tank. * = sawfish displayed ‘twitching’ behaviour. X = Sawfish freezing to the extent that electrodes had to be removed from the water. FL = electrode was removed from the water because the sawfish’s rostrum was caught in the fishing line that supports the electrode to the wooden beam. The region of the most desirable reactions is highlighted in green, and the region of least desirable reactions in red. See Fig. S1 for details of the approach and reaction types. Activity: grey - swimming; black - resting.

c) 50 V



d) 500 μ s



e) Exponential

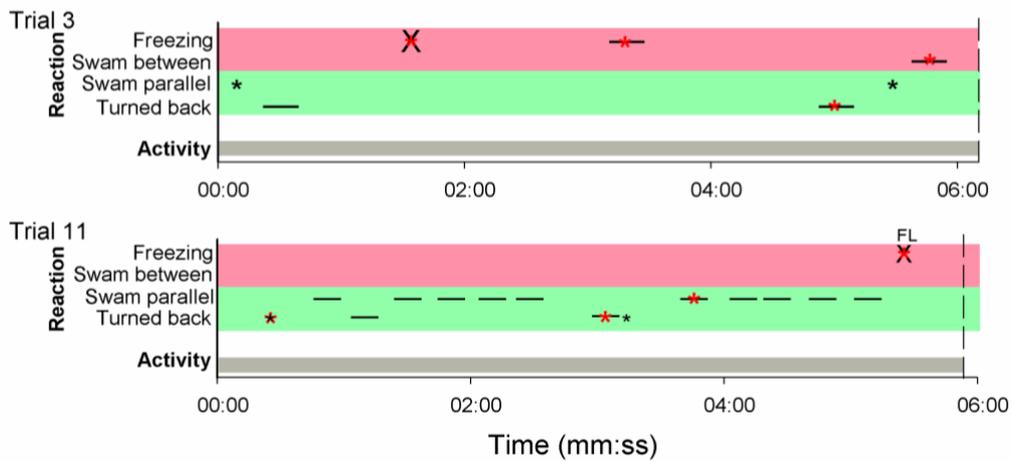
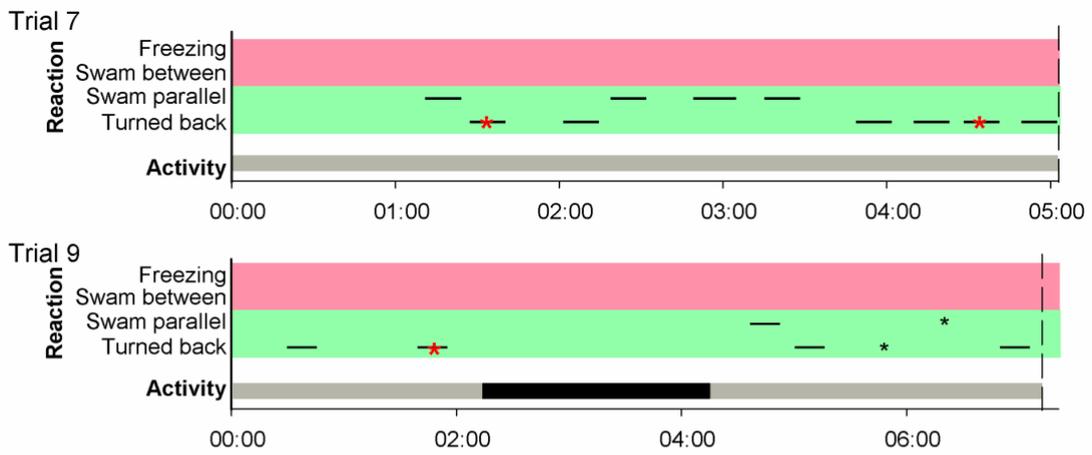


Figure S4 (cont.)

f) 10 Hz



g) AC

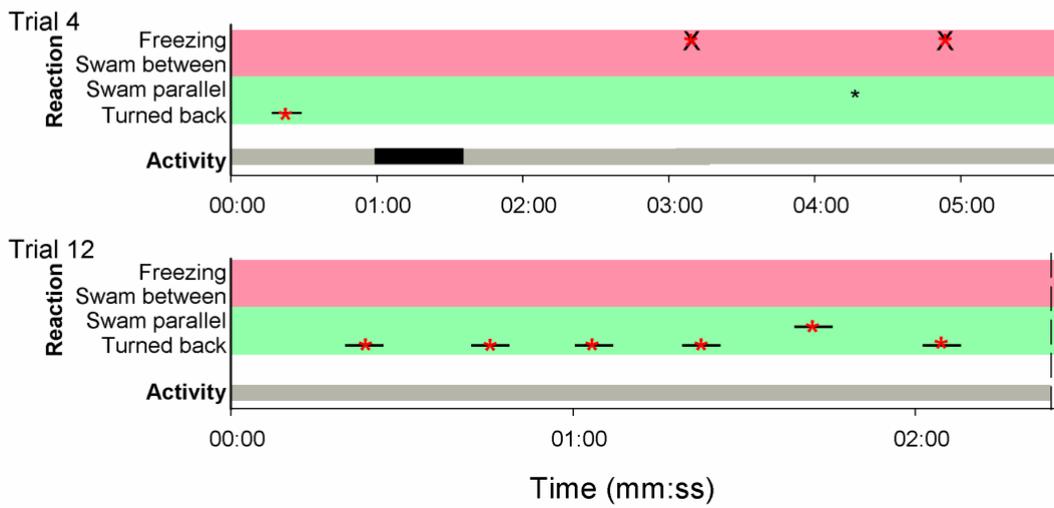


Figure S4 (cont.)

Figure S5

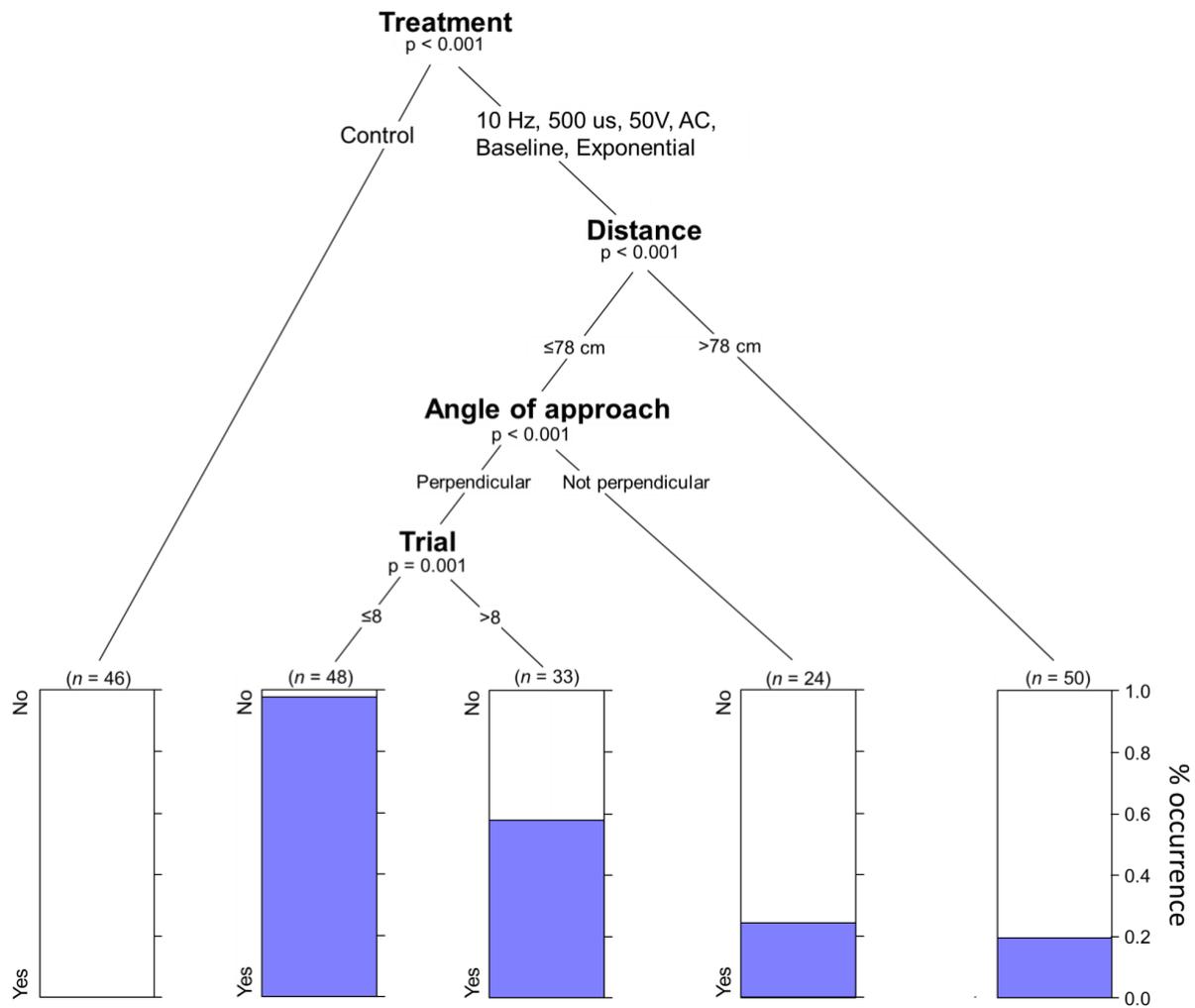


Figure S5. Conditional inference tree on the effect of the different explanatory variables (see Table 3) on the presence/absence (Yes/No) of twitching behaviour (proportion).

Figure S6

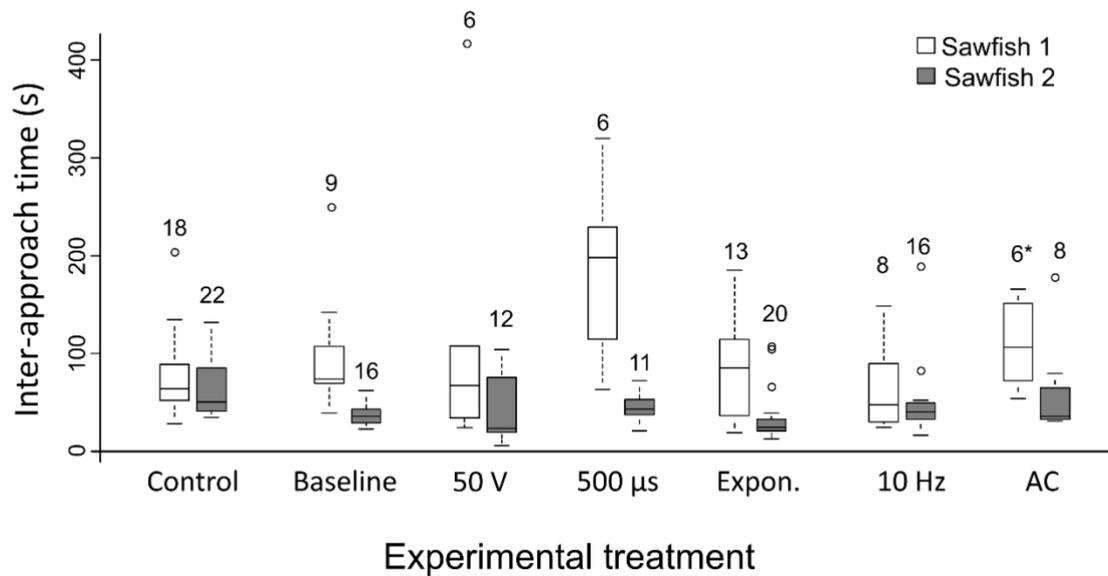


Figure S6. Inter-approach times (i.e. time between two consecutive approaches to the electrode setup) for each treatment and for each sawfish. Box and whiskers plots show the upper and lower quantiles (boxes), medians (lines within boxes), minimums and maximums (whiskers) and outliers (circles). Numbers above plots are number of replicates, i.e. number of inter-approach intervals. Intervals that included any resting periods were removed before analysis. * for one of the two ‘AC’ treatments, sawfish 1 did not go close to the electrodes during the whole experiment.

Figure S7

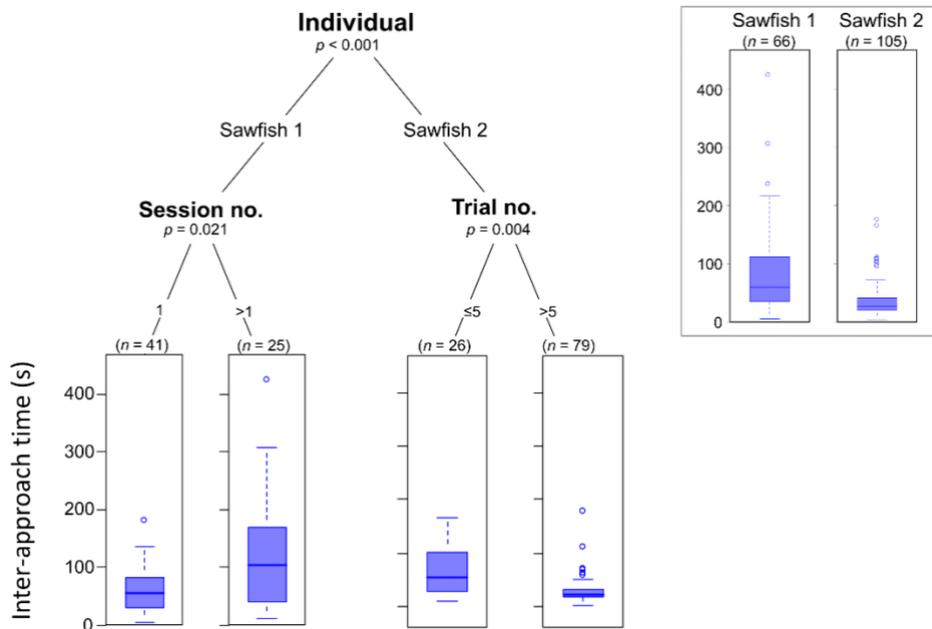


Figure S7. Conditional inference tree on the effect of the different explanatory variables (see Table 3) on inter-approach time, i.e. the time between consecutive approaches to the electrode arrangement. Inset plot on the right is the distribution of inter-approach time for the first split of the tree. Box and whiskers plots represent the distribution of inter-approach times, showing the upper and lower quantiles (boxes), medians (lines within the boxes), minimums and maximums (whiskers), and outliers (dots). Intervals that included resting periods were removed before analysis.

Figure S8

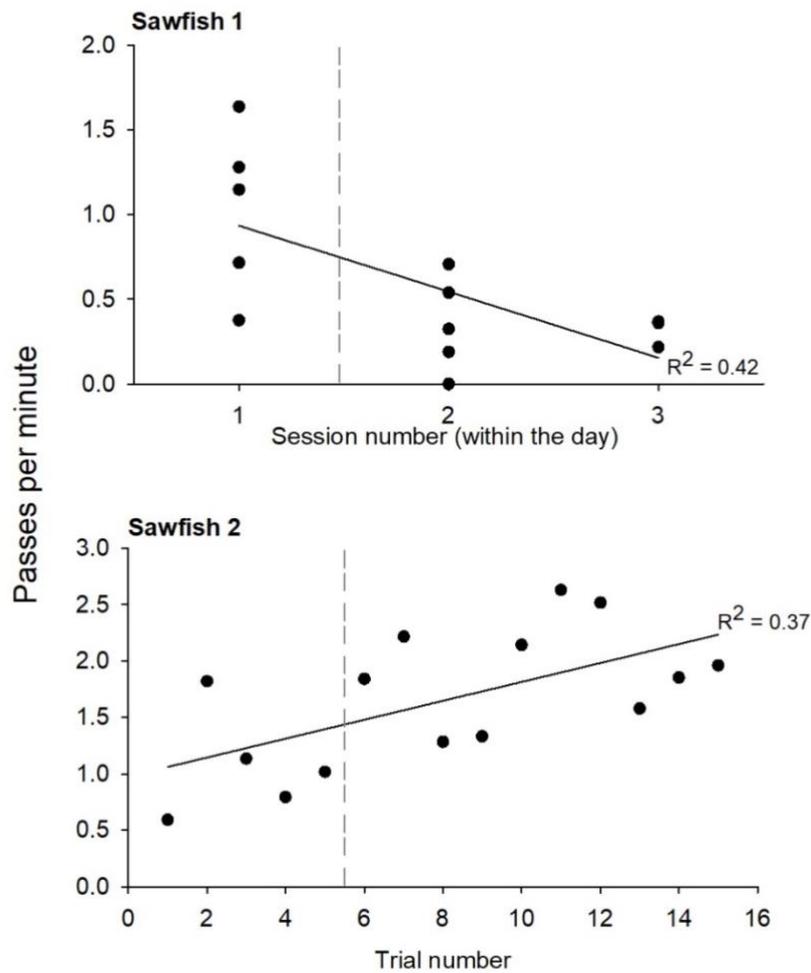


Figure S8. Approaches per minute as a function of session number for sawfish 1 (top) and trial number for sawfish two (bottom). For sawfish 1 (top), a significant negative relationship between session number and number of approaches was found ($p = 0.0164$), while for sawfish 2 (bottom) the significant relationship was with trial number ($p = 0.0153$). Grey dashed lines delimitate the value at which the tree split the dataset (see Fig. S7). Intervals that included resting periods were not included in this analysis.

Videos illustrating sawfish response to electric fields*

Video S1. [Sawfish 2 turning back upon encountering the electric field produced by the '500 \$\mu\$ s' treatment \(top view\)](#)

Video S2. [Sawfish 1 turning back upon approaching the electric field produced by the '10 Hz' treatment \(underwater view\).](#)

Video S3. [Sawfish 2 swimming parallel to the electrode setup upon encountering the electric field produced during the 'Exponential' treatment \(top view\).](#)

Video S4. [Sawfish 2 swimming between the electrodes during the 'Baseline' treatment \(top view\).](#)

Video S5. [Sawfish 1 swimming between the electrodes during the 'Exponential' treatment \(underwater view\).](#)

Video S6. [Sawfish 2 showing freezing behaviour upon entering the electric field during the 'Exponential' treatment.](#)

Video S7. [Sawfish 1 swimming between the electrodes during the Control treatment.](#)

Video S8. [Sawfish 2 approaching the electric field towards the electrode placed in the middle of the tank.](#)

**These links refer to the videos on youtube.com. The videos are also available on the publisher website at https://www.int-res.com/articles/suppl/n046p121_supp/*