Investigating the onset of behavioural effects in juvenile seabass exposed to offshore wind turbine noise using a revisited dose-response methodology

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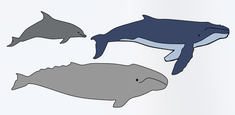
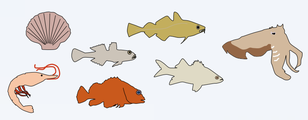
State of the art

The expansion of European marine renewable energy projects is increasing noise ocean emissions, significantly altering marine soundscapes.

Unbalanced studies (see Slabbekoorn *et al.*, 2010 & Popper & Hawkins, 2019)

Type of noise	 Impulsive noise during the installation phase	 Continuous noise produced by functionning wind turbines
Animal category	 Marine mammals	 Fish and invertebrates
Type of effects	Distribution changes Hearing loss	Behaviour (*e.g.* avoidance, swimming activity)

Aim of the work

This study aimed to improve our knowledge on potential effects of these emerging noise emissions on ichthyofauna by determining the intensity of an offshore wind turbine noise that may induce behavioural responses in juvenile fish.

Experimental floating wind turbine

Database of audio recordings
Sound emission: 10-1000 Hz

?

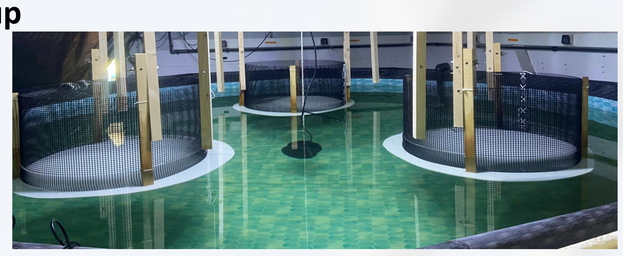
European seabass
Dicentrarchus labrax

Coastal fish species
Sound perception: 100-700 Hz
Lovell, 2003 & Kastelein *et al.*, 2008

Working hypothesis: increase of stress-related behaviours, such as burst (*i.e.* sudden accelerations) and motionless events with the increase of wind turbine noise intensity.

Materials & Method

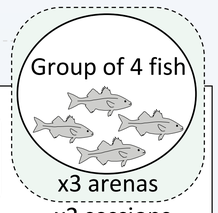
Setup



Experiments in controlled conditions:
11 m^3 indoor seawater pool
Water temperature: 16 ± 1°C
1 Clark Synthesis speaker
1 Neptune hydrophone
3 experimental arenas of ø80 cm
3 cameras

Protocole

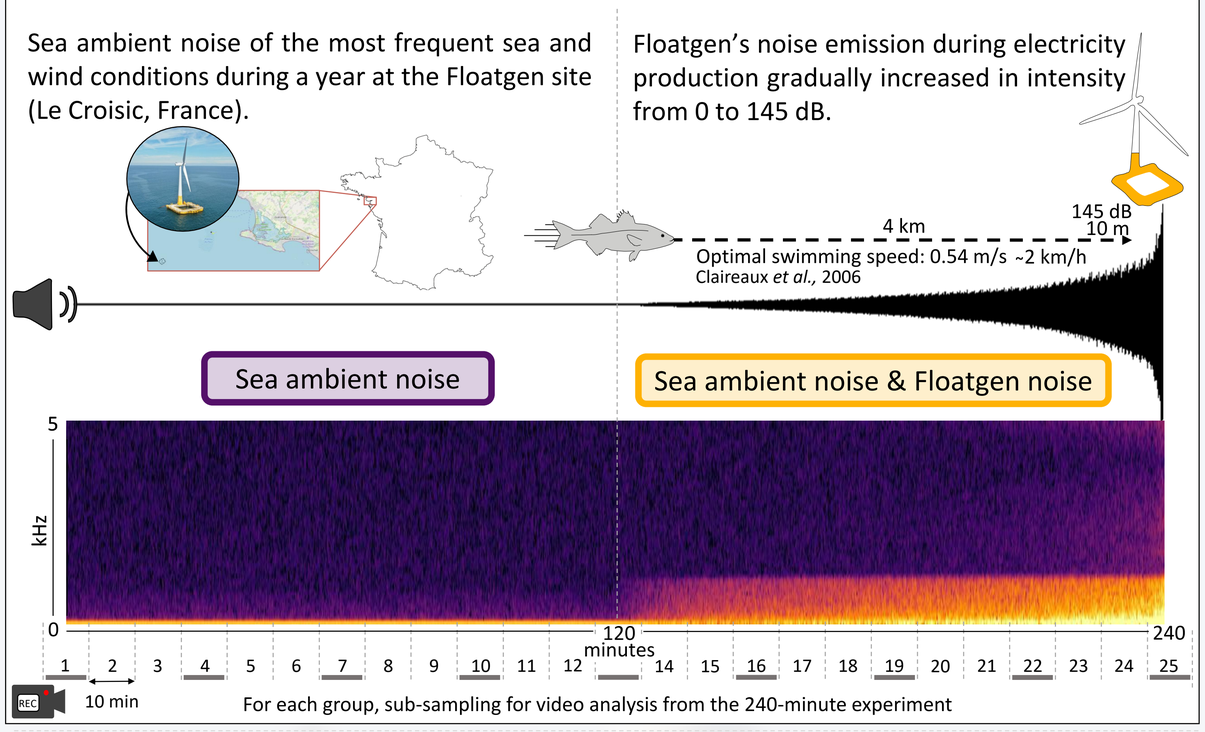
Objective: simulate the natural movement of the fish approaching the turbine base from an area outside the turbine noise influence



→Extraction of wind turbine noise as well as sea ambient noise from field audio recordings.

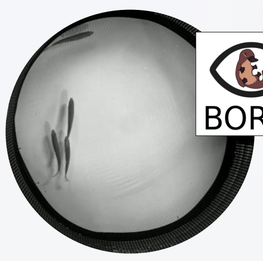
Sea ambient noise of the most frequent sea and wind conditions during a year at the Floatgen site (Le Croisic, France).

Floatgen's noise emission during electricity production gradually increased in intensity from 0 to 145 dB.



For each group, sub-sampling for video analysis from the 240-minute experiment

Studied variables



Burst events

Sudden acceleration shown by an individual is counted as a burst event. Acceleration of other fish within the following 10 seconds are not taken into account.

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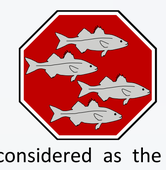
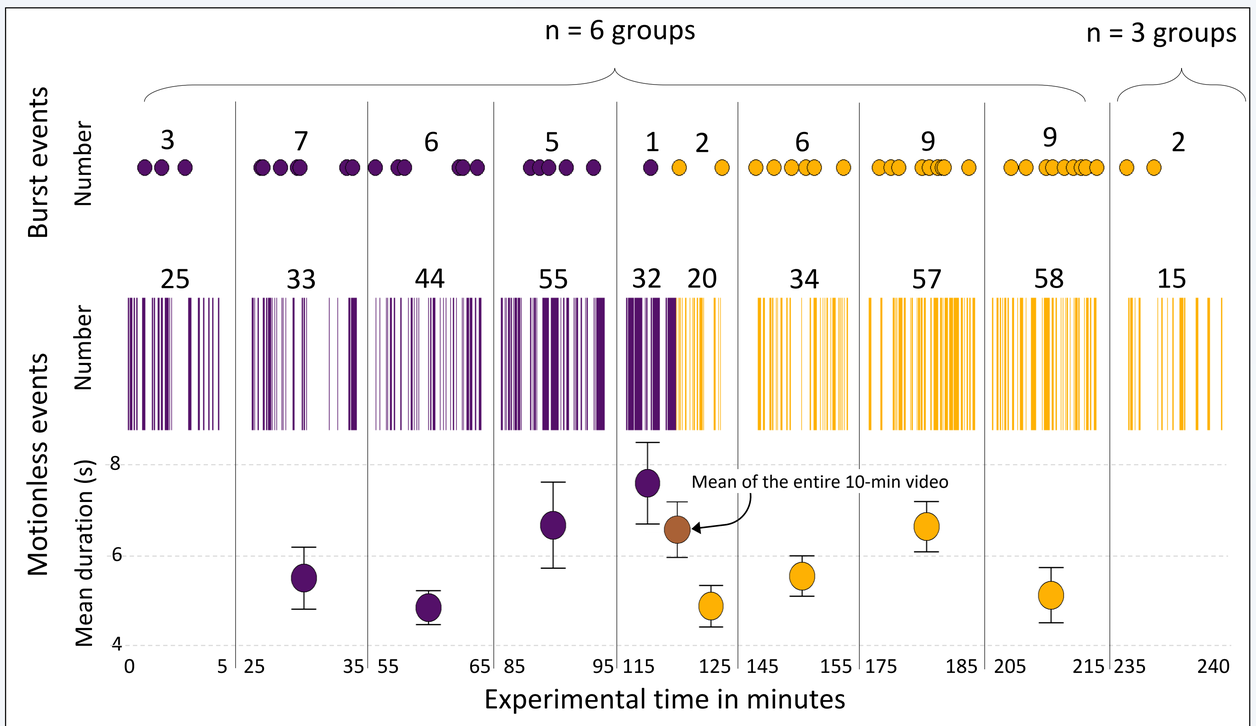
Motionless events + cumulative duration



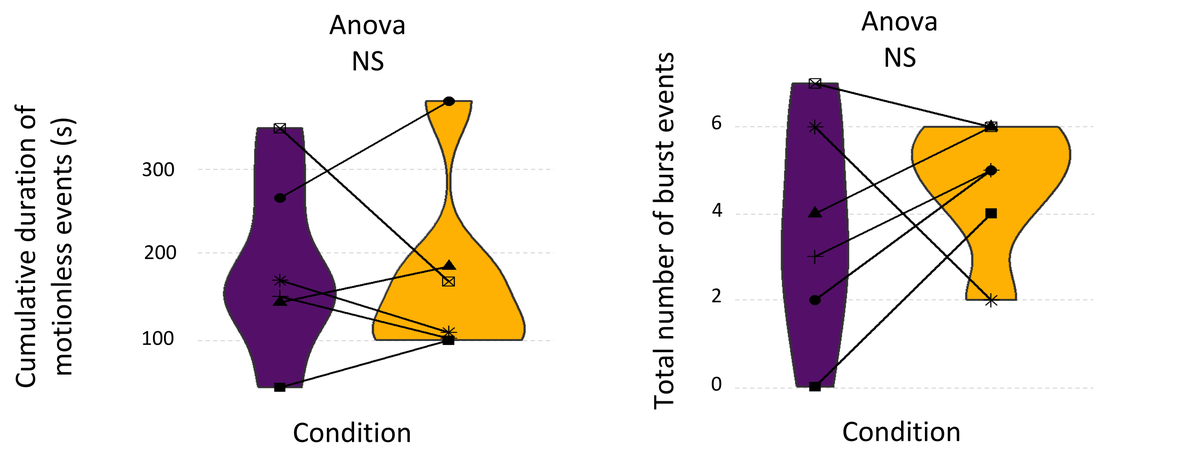
Motionless is considered as the group scale *(i.e.* when the four fish show immobility). Number of events are counted and their mean duration is calculated for each video as well as their cumulative duration over the entire experiment.

Preliminary results



Throughout the 240-minute experiment, results suggest that seabass exhibit similar patterns of burst and motionless events when exposed to sea ambient noise alone or in association with increasing wind turbine noise intensity.

Each symbol represents a group of fish



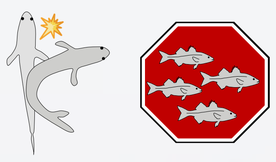
Inter-group variability: experimental groups display different response tendencies.

No difference was observed when behavioural variables were considered on a global scale either.

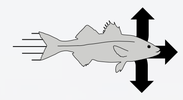
Discussion & Perspectives

Preliminary results did not validate our **working hypothesis**, they suggest no strong behavioural responses contrasting with impulsive noise studies(*e.g.* Pearson *et al.*, 1992 & Neo *et al.*, 2014).

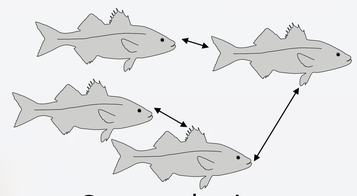
However, Burst events & Motionless events = only 2 variables among a panel of stress-related behaviours



↳ Study of supplementary behavioural features such as:



Trajectory & swimming speed



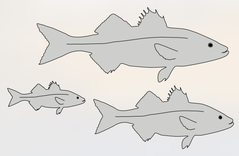
Group cohesion

Use of tracking software

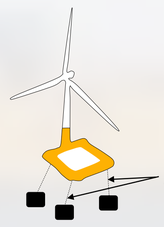
DeepLabCut: a software package for animal pose estimation

WINanalyze

In addition, conduct complementary experiments:



Exposing fish of other size range



Anchor lines

Include other sounds generated by the Floatgen structure

Long-term exposition
Chronic stress & habituation

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