# First insight of the response of great scallops (*Pecten maximus*) to drilling activities during the construction phase of an Offshore Wind farm

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## Introduction

Recently, Popper *et al.* [1] alerted on the substantial knowledge gaps regarding the responses of invertebrate to sounds and vibration associated with the construction of Offshore Wind farms (OSWs). With the recent development of such projects in close vicinity to large scallop (*Pecten maximus*) areas in France, particular attention has been paid to this species of great economic importance, likely sensitive to water- or substrate-borne vibrations [2; 3; 4].

Using innovative methods, this field-based study has been performed during the construction phase of the Saint Brieuc OSW to acquire first insight on the response of scallops to offshore construction operations (drilling; Fig. 1).

Figure 1. Deployment of RUBHY acoustic buoys in front of the drilling vessel Aeolus in the Bay of Saint Brieuc. © SOMME

## Methods

- Monitoring of scallop activity using valvometry:
  - Autonomous valvometers (Hall effect sensors and magnet; Fig. 2), Fs : 2Hz;
  - 30 scallops deployed at 3 distances from the drilling point (300m, 600m and 3000m) for 3 weeks (before, during and after drilling);
  - Comparable measurements (standardization of sensor attachment, calibration);
  - Signal processing : movement detection and classification (Jump-like movements).
- Acoustic monitoring:
  - 2 RUBHY buoys (RTSYS, Fig. 1) at 400 and 3000m, continuous recording, Fs : 156kHz
  - Hydrophone Colmar GP1516 (Sh: -168dB re 1V/µPa, BW: 5Hz – 70kHz);
  - SL calculated from RL@400m and a propagation model of -20log(r) derived from *in situ* measurements.

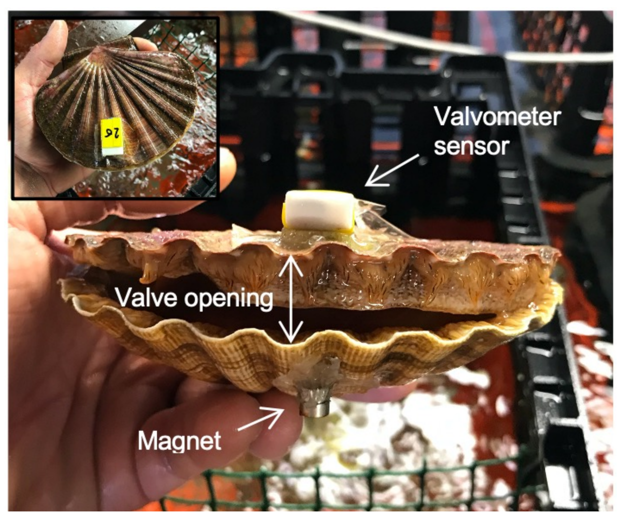


Figure 2. A great scallop equipped with a valvometer. © SOMME

## Results

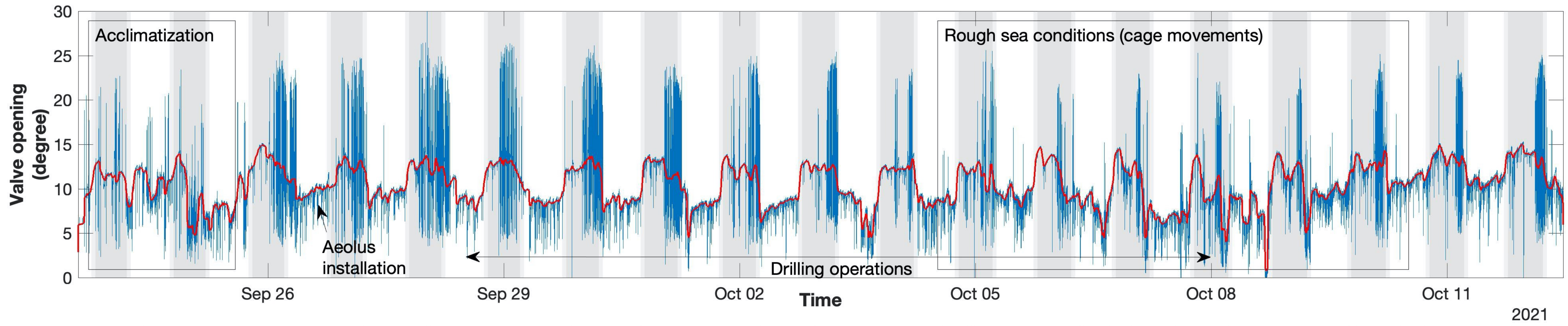


Figure 3. Temporal variation in gaping activity for a scallop monitored in the Bay of Saint Brieuc. The red lines represent the "base opening" calculated by applying a median filter of 1-h duration (7200 pts).

### The gaping activity of scallops

- 82% of individuals exhibited a **24-hour valve opening cycle with valves more opened at night** than during the day (Fig. 3, 4);
- Many large amplitude movements occurred throughout the second part of the night;
- Disorganized activity during the first 2 days of deployment: acclimatization period;
- Abnormal activity observed from 04/10/2022: period associated with rough sea conditions that caused cage movements. Non-usable data.

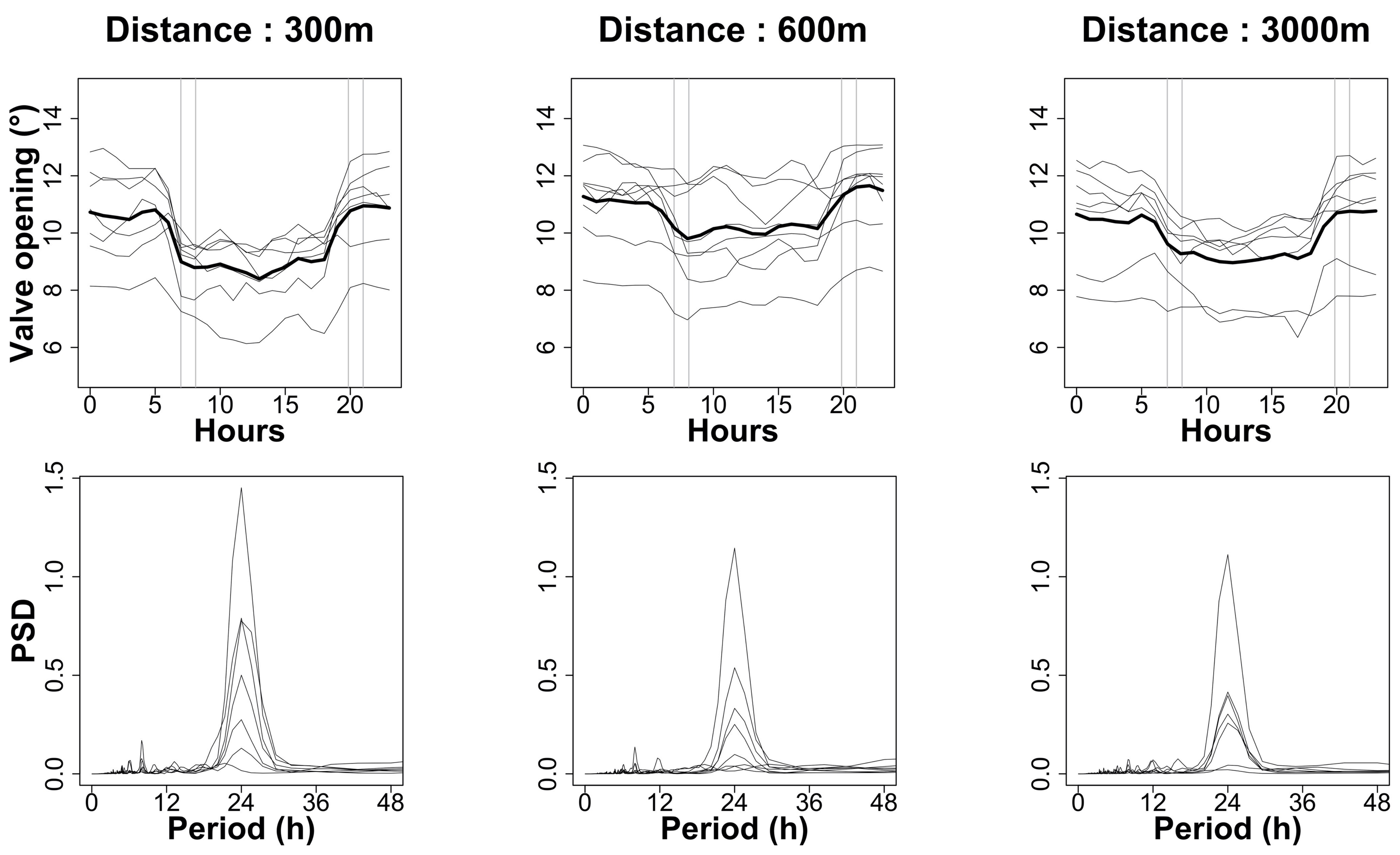


Figure 4. Pattern of daily mean opening and power spectral densities computed for each scallop monitored.

### Effects of drilling operations

- **Sound levels:**

| | Arrival of the drilling vessel | Drilling operations |
|---|---|---|
| Sound type | Low frequency noise, maximum intensity in the 100Hz- 1kHz band | Continuous noise, maximum intensity < 10kHz |
| $RL_{rms}$ measured | 140.6dB re 1µPa @400m<br>129.3dB re 1µPa @3km | 130.5dB re 1µPa @400m; blended with ambient noise @3km |
| $SL_{rms}$ | 192.6dB re 1µPa @1m (maximum level during the installation) | 182.5dB re 1µPa@1m (median level over the drilling period) |
| $RL_{rms}$ estimated | 143.1dB re 1µPa @300m<br>137dB re 1µPa @600m | 133dB re 1µPa @300m<br>126.9dB re 1µPa @600m |

- **Scallop activity:**
  - The scallops **maintained their cycle throughout the drilling period** (Fig. 3, 4);
  - No difference observed in terms of base opening (distances, monitoring phases);
  - **Increased occurrence of jump-like movements during the Aeolus installation** (daytime). **Return to normal activity a few days later despite drilling activities. Decrease in response with distance to drill point** (Fig. 5).

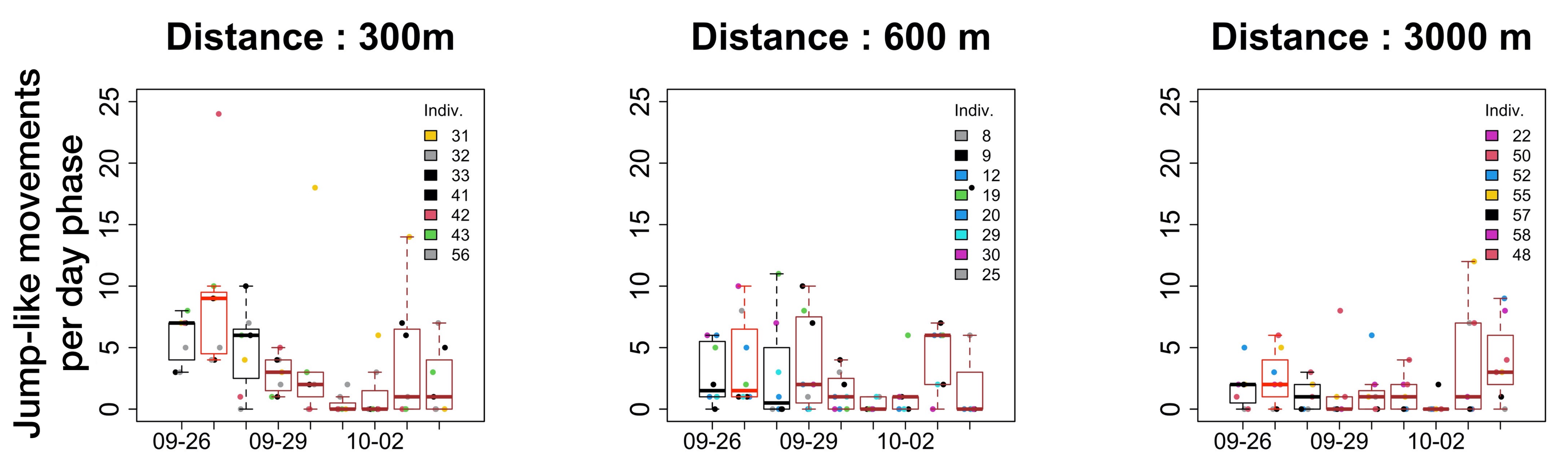


Figure 5. Number of large amplitude movements realized per scallop during the day phases.

## Conclusions

- The nocturnal activity of scallops: **new information on the biology of *Pecten maximus*** [5]:
  - Consistent with previous tank experiments (Tinduff hatchery, Plougastel-Daoulas);
  - Similar gaping rhythms have been observed for other bivalves (*e.g.*, mussels) and interpreted as a strategy to feed while minimizing the likelihood of predation;
  - Baseline knowledge (natural gaping behaviour) necessary to study the response of scallops to external factors.
- **Scallop response** to the Aeolus installation: increase in the number of Jump-like movements produced
  - **Delicate interpretation** of this observation because the scallops just emerged from their acclimatization period;
  - **Effect limited** in terms of range (< 600m) and duration (limited to the arrival of the Aeolus and a few days later);
  - Impossible to know whether this response was generated by the vessel noise or by other factors such as substrate vibration.
- **Technical advances**:
  - Suitability of autonomous valvometry sensors to study the effects of offshore activities such as the construction of OSW on bivalves under real conditions (despite the inherent operational constraints: remote location and co-activity on site);
  - Method improvements: substrate of the cages, autonomy of the sensors, additional sensors (*e.g.,* OBS, particle motion).

## References

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