







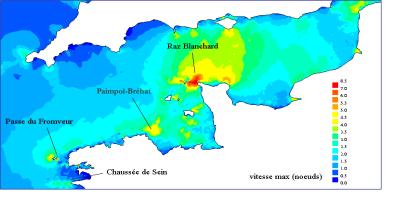
# Environmental monitoring of the Paimpol-Brehat tidal project

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## A step by step deployment

May 2011 Licensing Nov 2011 1st in situ turbine test 2012 Export cable laid 2013 stabilization of the cable 2014 In situ 500 h Turbine testing phase 1

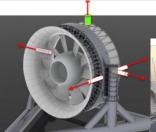
20 Jan 2016 Turbine phase 2 deployed

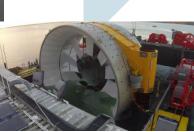
Spring 2016 tidal farm deployment



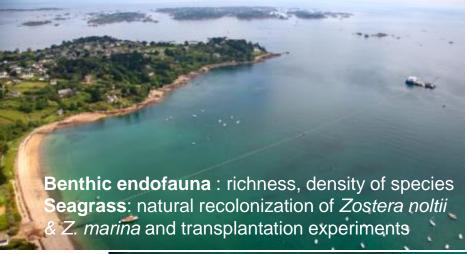




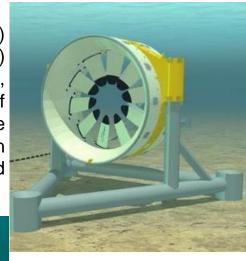




### Adapted environmental monitoring



Noise (drifting hydrophons)
Tidal currents (ADCP)
Fauna: for the time being,
only the initial state of
benthos and marine
mammals has been
assessed





#### Endofauna: localized and reversible impact of the cable work





May 2012			May 2013		May 201	4
<b>↓</b>				$\downarrow$	$\downarrow$	
before work	S1	S2	S3+	S3	S4	S5
425	194	282	913	826	457	346
45	31	27	56	48	53	34
	before work 425	before work S1 425 194	before work S1 S2 425 194 282	before work S1 S2 S3+ 425 194 282 913	before work S1 S2 S3+ S3 425 194 282 913 826	before work S1 S2 S3+ S3 S4 425 194 282 913 826 457

Indice	before work	<b>S</b> 1	<b>S2</b>	S3	\$4	<b>S</b> 5
average diversity	2,36	1,33	1,54	2,37	3,02	2,54
average equitability	0,84	0,57	0,65	0,70	0,88	0,88

August 2012

AMBI

I(%)

II(%)

II(%)

V(%)

67%

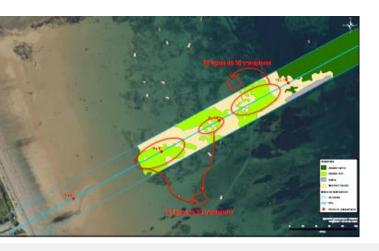
E1

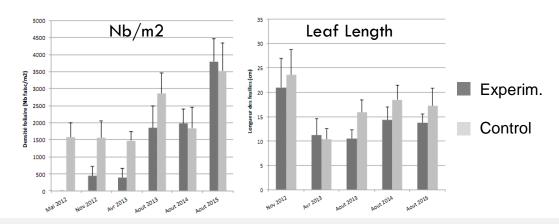
55

64%

August 2013

#### Zostera sp.: relatively successful transplantation of seagrass but...



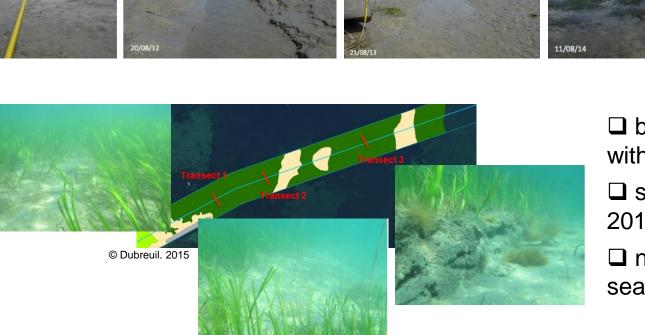


- Select the place of transplantation with care (a 2<sup>nd</sup> experimental zone failed)
- Z. noltii more successful than Z. marina



## Zostera sp.: natural recovery relatively quick for Z. noltii and slower for Z. marina

08.2013



07.2012

08.2012





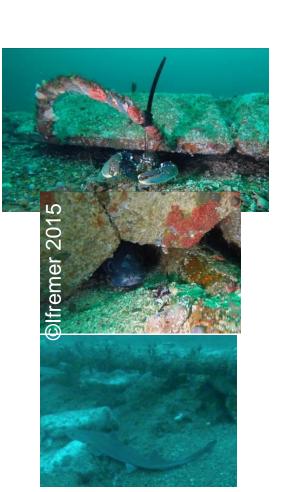
- ☐ begins after the trench refills with natural sediment (1 year)
- □ still on-going for *Z. marina* in 2015 (90m)
- ☐ natural recolonization from seagrass close to the trench

#### Biological colonization of the cable and matresses (1)

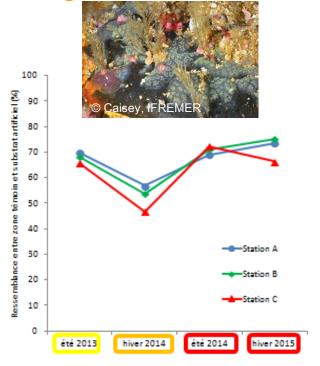


Benthic colonization is gradual with a high seasonal variability (winter/summer)

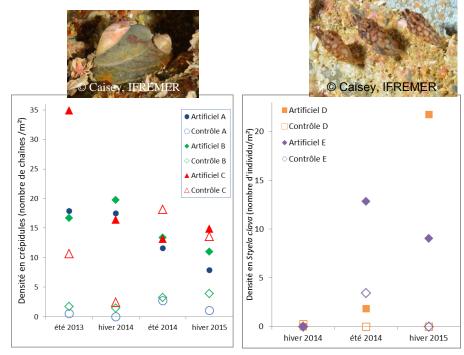
Matresses are significant habitats for Crustaceans (lobster, ...), Fish (conger, ..) and are attractive for numerous other fish (pollock, dogfish...)



Biological colonization of the cable and matresses (2)



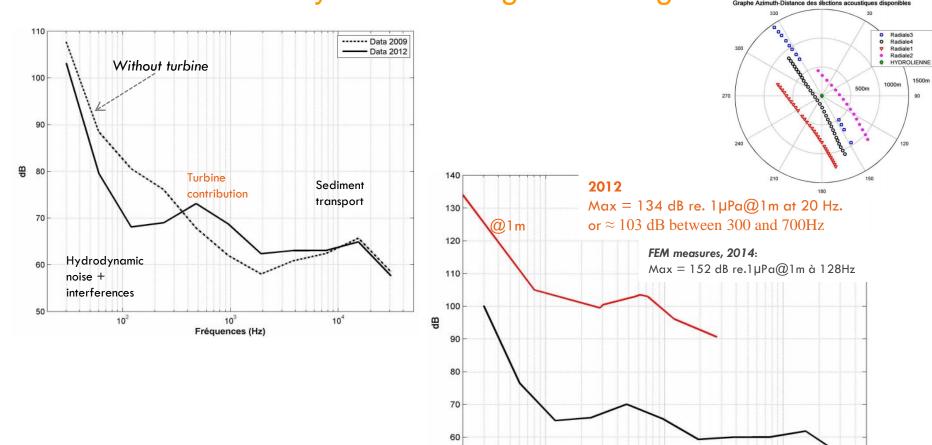
Biocenoses are 60-70% similar to the natural control ones



Introduced species show different dynamics of colonization on artificial substrates:

- •Decreasing density over time for common slipper limpet;
- Increasing density for Styela clava

The turbine is as noisy as small tugs or fishing boats
Graphe Azimuth-Distance des élections acoustiques disponibles



50

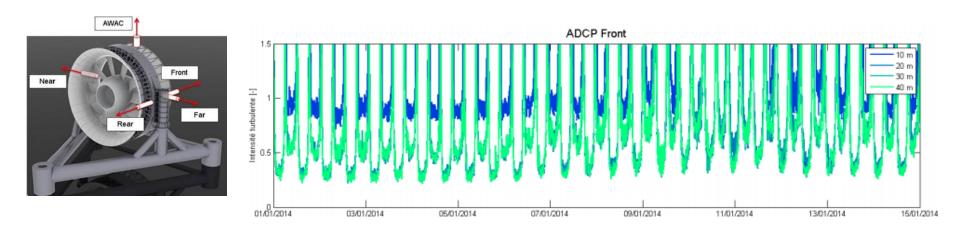
10<sup>2</sup>

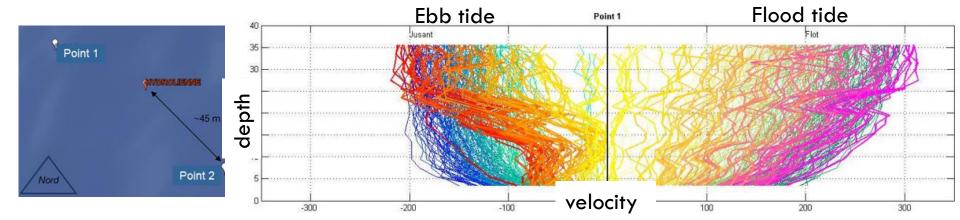
10<sup>3</sup>

Fréquences (Hz)

10<sup>4</sup>

#### Influence of the turbine on the flow velocities





#### Messages to take home

- Cable (muddy sediment): High localized impact on fauna and flora. Recovery within one year (fauna, Zostera noltii) or when the trench is refilled (2 to 3 years for Z. marina in deepest zones)
- □ Zostera transplantation experiment: effective, providing the zone is chosen with care.
- Cable and matresses (rocky substrate): progressive biological colonization with 60-70% similarity of the communities (compared to control); introduced species colonize artificial substrates more than natural ONES. Matresses attract crustaceans (lobsters) and fish (conger, ...)
- □ **Current:** localized wake effect (30-50% reduction of velocities at 45m; no further disturbance of turbulence intensity after 40m). The wake effect is perceptible up to 250m at ebb tide and 800m at flood tide.
- Noise: the site is noisy; turbine makes little noise which is not discernable from 500 to 1200 m away (depending on tides) (20 − 4000 Hz; 134 dB re. 1µPa@1m at 20 Hz).
- □ **Bio-monitoring**: highly difficult because of depth (up to 35m), distance (15 km out of sea), and ... current
- □ Next step: monitore the farm noise (impact on marine mammals) and the benthos

