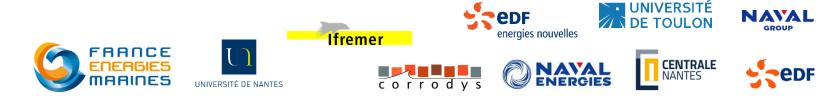
Towards improving biofouling knowledge within MRE environments

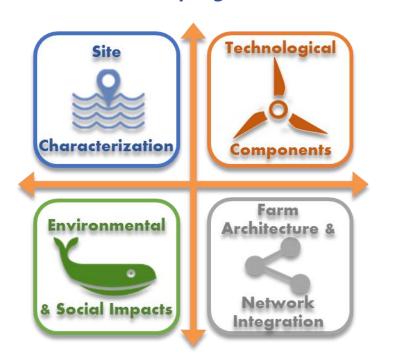
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*nolwenn.quillien@ite-fem.org



France Energies Marines (FEM) – a brief overview

- French national research institute of reference on MRE
- Supported by the National Research Agency (ANR)



A roadmap based on MRE sector objectives

4 Research programs

Mission:

Technology & Scientific environment coordination and valorization to overpass MRE locks

Key facts:

32 members 23 employees (permanent, PhD, postdoc & research engineer)

Budget: 2M€/year 21 actual R&D projects





Members: Research labs, industrial groups, SME, Coastal regions





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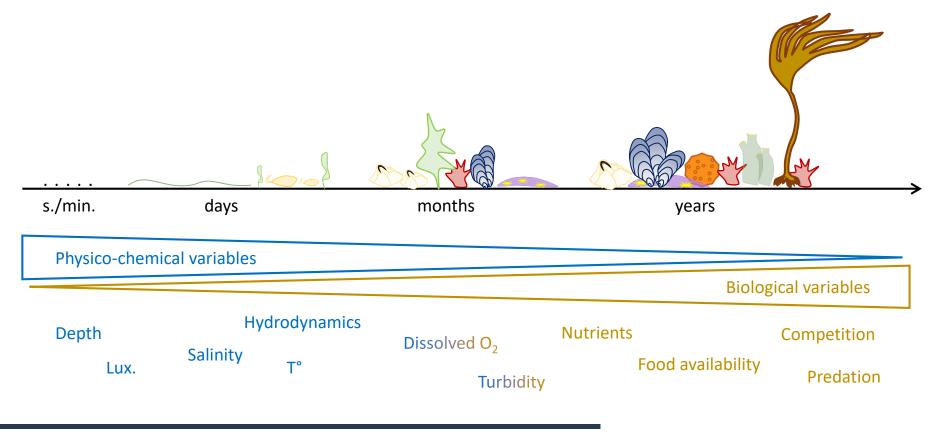


- Colonisation by living organisms of surfaces settled in aquatic ecosystems (biology)
- Accumulation of undesirable biological attachment to man-made structures (engineering)





- Colonisation by living organisms of surfaces settled in aquatic ecosystems (biology)
- Accumulation of undesirable biological attachment to man-made structures (engineering)





Le Contra la

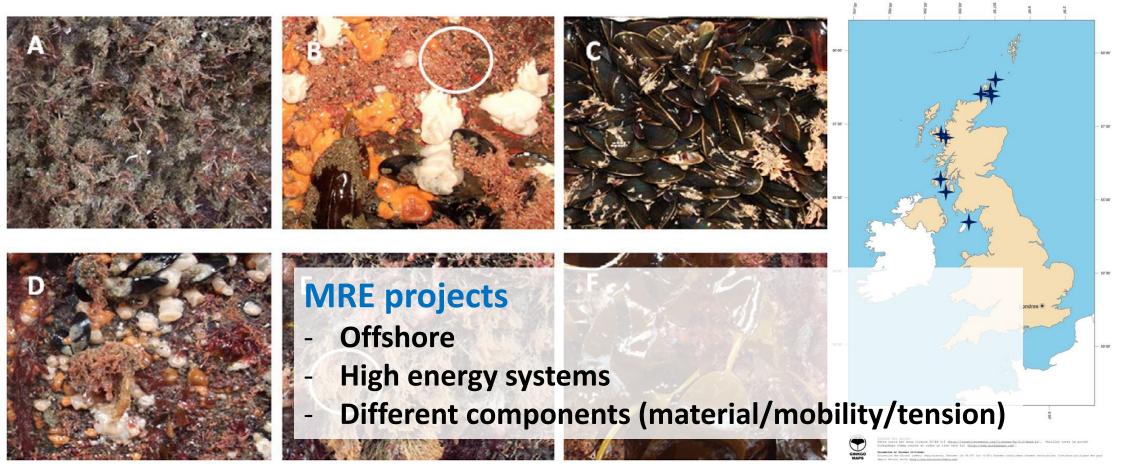
Tidal turbine removal after 3 years in canadian shallow waters (www.racerocks.ca)

- Direct and indirect effects of biofouling on MRE structures/at MRE sites
 - ↗ hydrodynamics loadings (structure, mooring) ullet
 - Soverall device production performance (tidal turbine, wave-energy, OTEC) •
 - Reef effect (production) •
 - Facilitation of invasive species expansion •
 - Changes in ecosystem functioning (nutrient cycling, new trophic links, C_{fixation})

Depending on the type of structure and components / type of fouling (community composition, biomass, geometry, flexibility, diversity, ...)



Highly variable in space and time

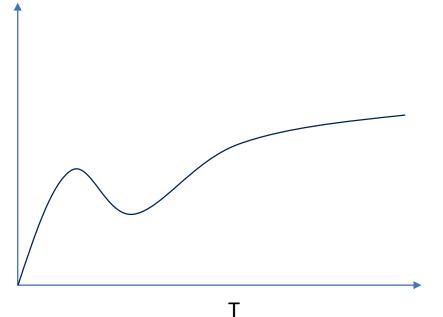


Royaume-Uni: carte des contours II

Strong need for:

- *In-situ* **knowledge** to better apprehend the process
- Quantification of biofouling with data useful for biology as well as engineering
- New approaches to measure biofouling in challenging systems/context (offshore, low cost, dynamics)
- Modelling the process of biocolonisation







ABIOP – as a first step to achieve these objectives



Accounting for BIOfouling through established Protocols of quantification

 \rightarrow Develop in depth **syntheses** on biofouling & monitoring methods

- → Develop **adapted methods** to characterize fouling in MRE context
- → **Testing** the developed methods & gathering data *in situ*

Talk by **Marine Reynaud et al.** Environmental monitoring on the SEM-REV sea test site Tomorrow, 14:10



Main

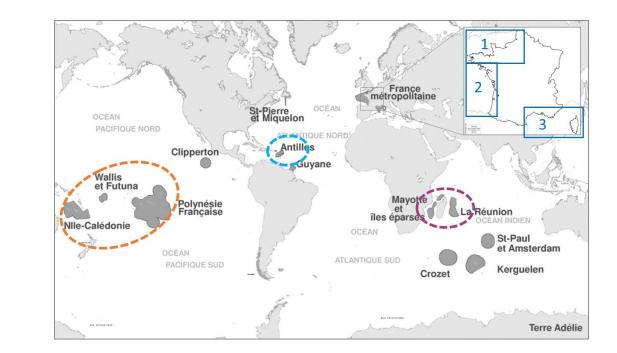
objectives





Literature review (n=71)

- Published articles
- Investigative reports
- Information from developers
- \rightarrow Methods
- \rightarrow Biological variables
- \rightarrow Environmental variables



- Construction of GIS
- Bibliometrics

Recommendations for future protocols



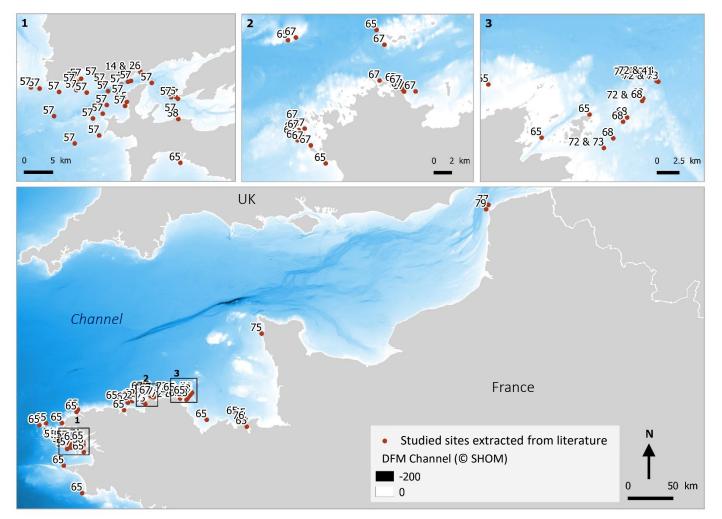


Database

- Temporal (duration, data acquisition frequency) and spatial (X, Y) scales
- Precise indications about protocols (sampling type, sample area, equipment, N_{samples}, numerical analyses, etc.)
- Investigated substratum (type of structure, material, positioning, complexity, history)
- Explanatory **physico-chemical** variables (*waves, T°, salinity, ...*)
- Explanatory biogeochemical variables (Si, P, etc.)
- Explanatory **biological** variables (Chl-a, competition, predation, ...)
- Response biological variables (coverage, abundance, species richness, roughness, biomass, ...)

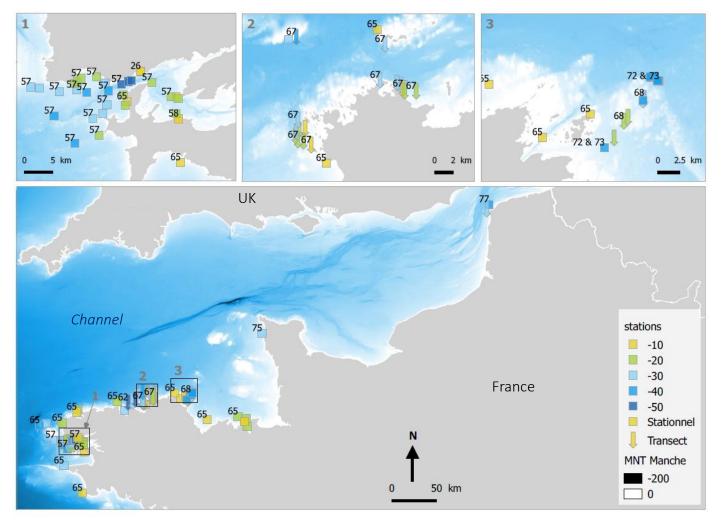
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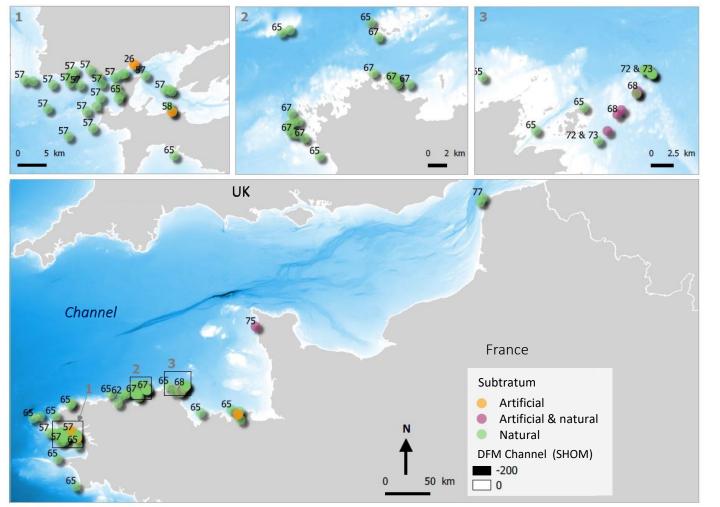
Maps showing studied sites





- Maps showing studied sites
- Depth & type of sampling





- Maps showing studied sites
- Depth & type of sampling
- Type of substratum

Slate

PVC

Rocks

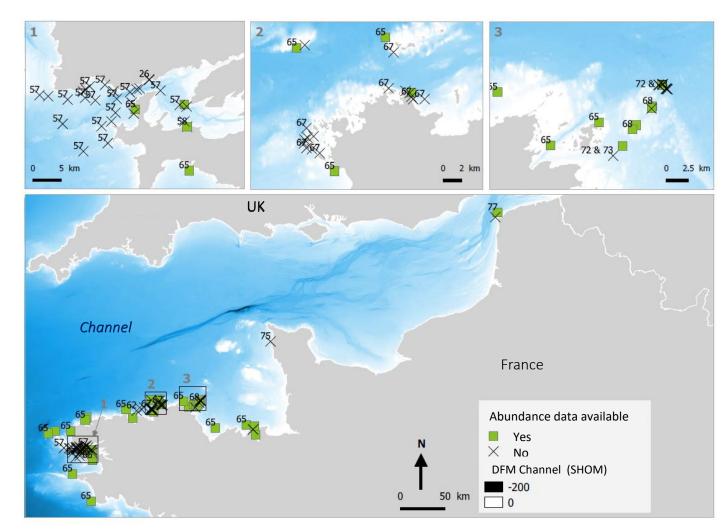
Glass

Metal

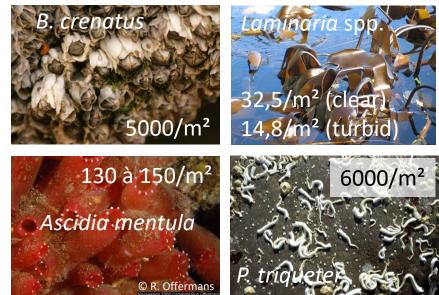
Concrete

Plexiglass

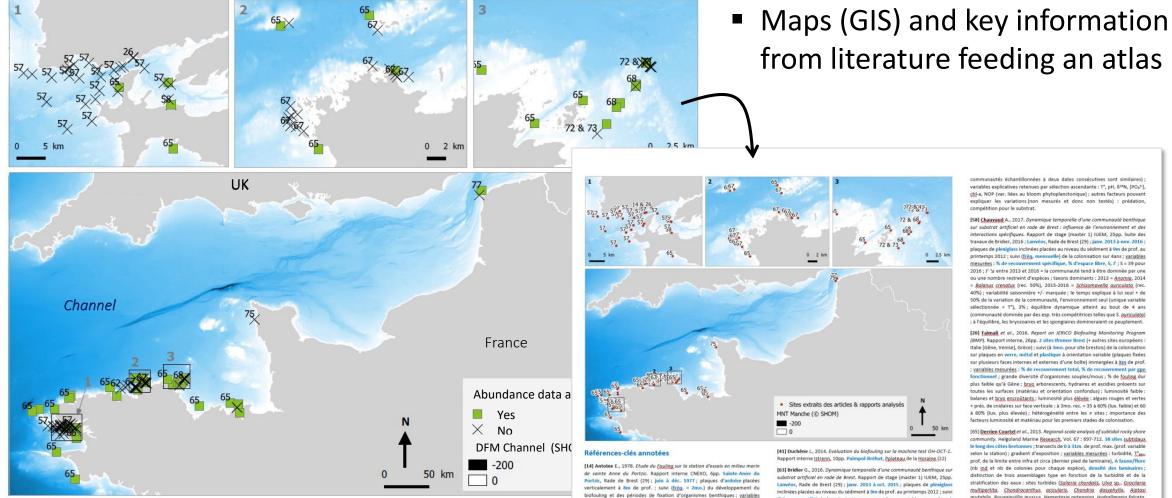




- Maps showing studied sites
- Depth & type of sampling
- Type of substratum
- Availiability of response Δ







mesurées : abondance absolue, abondance relative, % de recouv

bryozoaires et serpules (juillet et août).

taille moyenne espèce ; au bout de 6 mois, colonisation > 100% (les organismes

se recouvrent les uns, les autres) ; variabilité interannuelle des périodes de

fixation mais ordre identique : ascidies (mai et juin), balanes (juin et juillet),

16/22 – Biofouling & MRE – EIMR conference – 24/05/2018

FRANCE

ERGIES MARINES

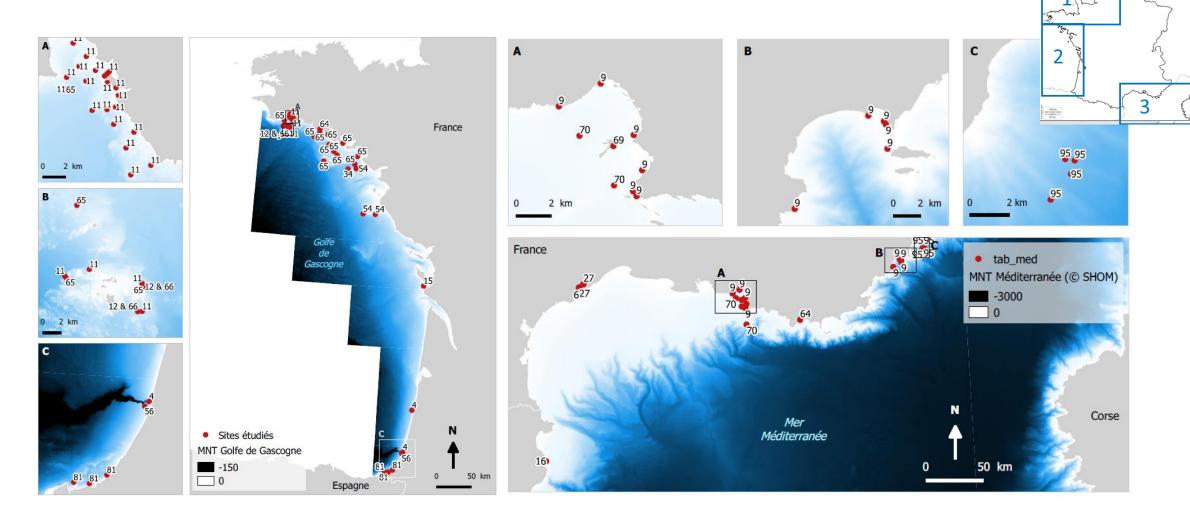
inclinées placées au niveau du sédiment à 9m de prof. au printemps 2012 ; suivi (frég. mensuelle) de la colonisation sur quasi 3ans ; variables mesurées : A spécifique, S ; S = 79 ; identification de cycles dans la succession des espèces (sauf pour les serpulidés) ; diminution de la densité (parfois jusqu'à disparition) de certaines espèces pourtant présentes aux 1ers stades de la macrocolonisation (ex. bryozoaires et ascidies); Balanus crenatus et Anomia ephippium dominent très largement le peuplement en termes d'A : variabilité nterannuelle du % de recouvrement ; autocorrélation temporelle positive (les

communautés échantillonnées à deux dates consécutives sont similaires) variables explicatives retenues par sélection ascendante : Τ*, pH, δ¹⁵N, IPO₄⁵1 chl-a. NOP (var. liées au bloom phytoplanctonique) : autres facteurs nouvant expliquer les variations (non mesurés et donc non testés) : prédation,

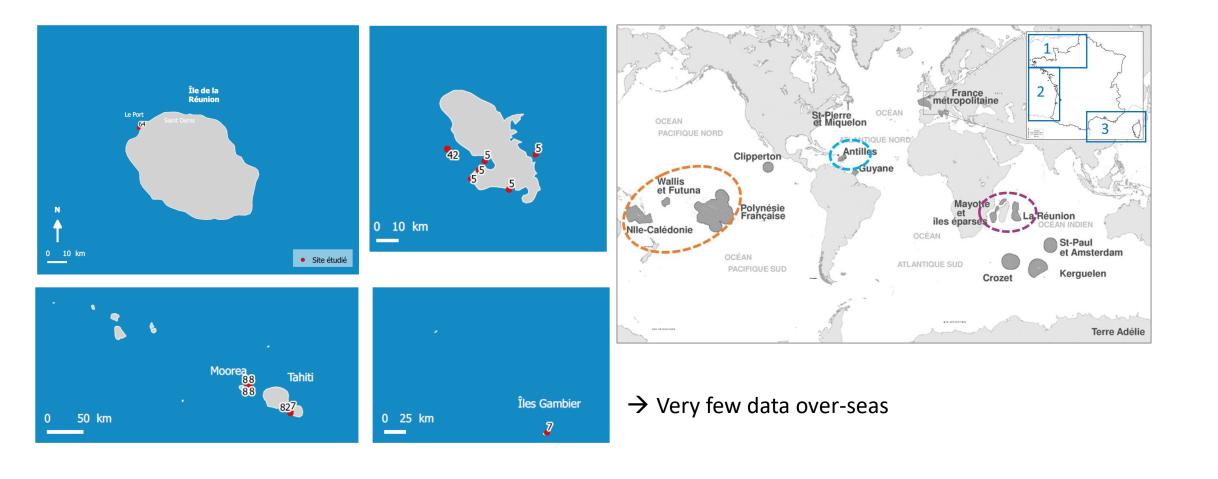
[58] Chauvaud A., 2017. Dynamique temporelle d'une communauté benthique sur substrat artificiel en rade de Brest : influence de l'environnement et des interactions spécifiques, Rapport de stage (master 1) IUEM, 25pp, Suite des travaux de Bridier, 2016 : Lanvéoc, Rade de Brest (29) : jany, 2013 à nov, 2016 : plaques de plexiglass inclinées placées au niveau du sédiment à 9m de prof. au printemps 2012 : suivi (frég. mensuelle) de la colonisation sur 4ans : variables mesurées : % de recouvrement spécifique, % d'espace libre, 5, J' : 5 = 39 pour 2016 ; J' 'v entre 2013 et 2016 = la communauté tend à être dominée par une ou une nombre restreint d'espèces : taxons dominants : 2013 = Anomia, 2014 = Balanus crenatus (rec. 50%), 2015-2016 = Schizomavella auriculata (rec. 40%) : variabilité saisonnière +/- marquée : le temps explique à lui seul + de 50% de la variation de la communauté. l'environnement seul (unique variable sélectionnée = T°), 3%; équilibre dynamique atteint au bout de 4 ans (communauté dominée par des esp. très compétitrices telles que S. guriculata) ; à l'équilibre, les bryozoaires et les spongiaires domineraient ce peuplement

[26] Faimali et al., 2016. Report on JERICO Biofouling Monitoring Program (BMP). Rapport interne, 26pp. 2 sites Ifremer Brest (+ autres sites européens Italie [Gêne, Venise], Grèce) ; suivi (à 3mo, pour site brestois) de la colonisation sur plaques en verre, métal et plastique à orientation variable (plaques fixées sur plusieurs faces internes et externes d'une boîte) immergées à Xm de prof. ; variables mesurées : % de recouvrement total, % de recouvrement par gps fonctionnel ; grande diversité d'organismes souples/mous ; % de fouling dur plus faible qu'à Gêne ; bryo arborescents, hydraires et ascidies présents sur toutes les surfaces (matériau et orientation confondus) ; luminosité faible : balanes et bryo encroûtants ; luminosité plus élévée : algues rouges et vertes + prés. de cnidaires sur face verticale ; à 3mo. rec. = 35 à 60% (lux. faible) et 60 à 80% (lux. plus élevée) ; hétérogénéité entre les # sites ; importance des facteurs luminosité et matériau pour les premiers stades de colonisation

[65] Derrien Courtel et al., 2013. Regional-scale analysis of subtidal rocky shore community. Helgoland Marine Research, Vol. 67 : 697-712. 38 sites subtidaux le long des côtes bretonnes : transects de 0 à 31m, de prof, max, (prof, variable selon la station) ; gradient d'exposition ; variables mesurées : turbidité, Tierre prof. de la limite entre infra et circa (dernier pied de laminaire), A faune/flore (nb ind et nb de colonies pour chaque espèce), densité des laminaires distinction de trois assemblages type en fonction de la turbidité et de la stratification des eaux : sites turbides (Salieria chordalis, Ulva sp., Gracilaria multipartita, Chondracanthus, acicularis, Chondria, dasyphylla, Aiptasi mutabilis, Bougainvillia muscus, Nemertesia antennina, Hydrallmania falcata. Aplidium elegans, Morchellium argus, Tethya aurantium, Polymastia penicillus, Sabella spallanzanii, Ophiathrix fragilis), sites eaux-claires stratifiées (forêts à Sacchoriza polyschides avec Pterosiphonia complanta, Hypoglassum hypoglossoides, Lamentaria clavellosa, Marthasterias glacialis et Asterias rubens) et sites eaux claires homogènes (forêt à Laminaria hyperborea avec Desselaria sanguinea, Phyllopora crispa, Plocamium cartilagineum, Meredithia

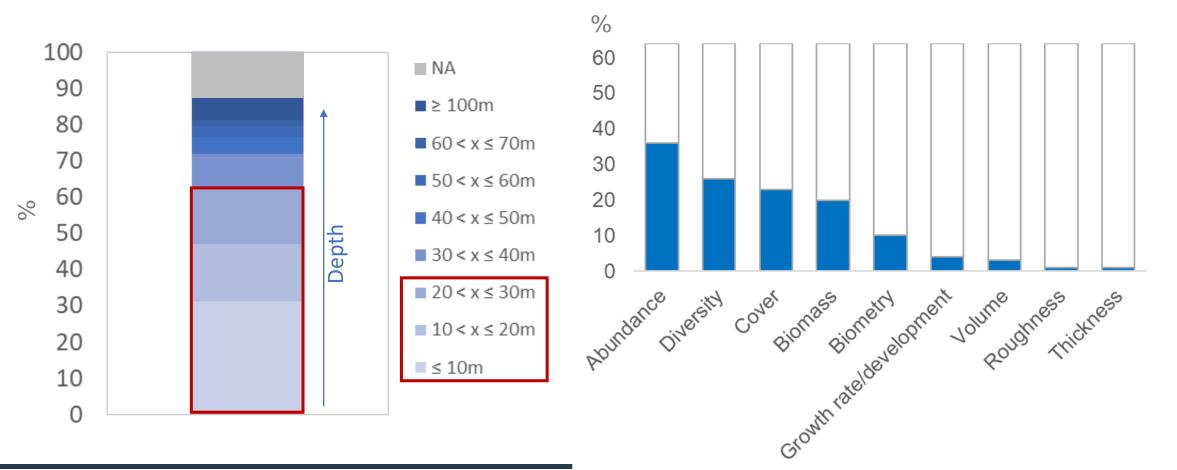








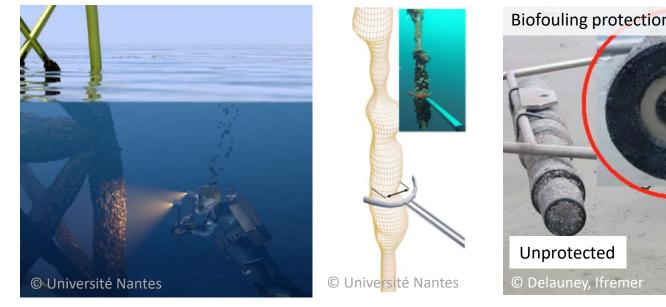
Bibliometrics





- → Data extracted mainly relevant for biological analyses in the frame of EIA
 → Feeding scenarios / models
- → Lack of mesurements of biological **variables** needed for **engineering** and at **MRE sites**

\rightarrow Development of specific protocols, methods

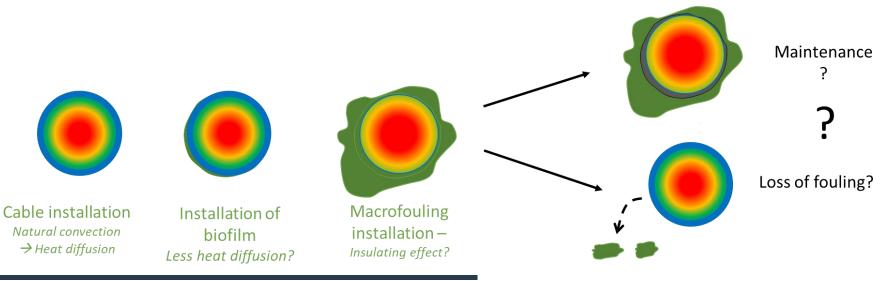






ABIOP+ to carry on ABIOP R&D efforts

- ABIOP = 1 year project
- 3 years progam to keep going on biofouling research (CoReD 2018)
- Main objectives:
 - → Provide **standardized** & **target-oriented protocols** for biofouling assessment in MRE context
 - \rightarrow Assess the biocolonisation effects on specific MRE components
 - → Gather and share data at MRE sites representative of future commercial sites





Thank you for your attention!

www.france-energies-marines.org nolwenn.quillien@ite-fem.org



Some references

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