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3
4 **TITLE**

5 Socio-political acceptability of floating offshore wind farms in France: challenges and
6 perspectives for marine governance towards sustainability

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24 **INTRODUCTION**

25 In the early 2010s, a strong political ambition to develop offshore wind (OW) energy has
26 emerged in France. As part of the shift towards a decarbonized energy system and an increase
27 in the share of renewable energy in the national energy mix, the energy transition strategy
28 dedicated to offshore renewable energy quickly focused on the deployment of offshore wind
29 technologies (Nadaï and Labussière, 2014; Oiry, 2018). Bottom-fixed offshore wind turbines
30 first, then floating ones. Bottom-fixed OW is the most advanced technology, and it is
31 expected to be the main contributor to the growth of renewables energies in the electricity
32 mix. Concretely, this means four commercial offshore wind farms awarded in 2012, and a
33 steady rhythm of planning for new projects to date, corresponding to a total planned capacity
34 of six gigawatts by 2030. In parallel, in the mid-2010s, French political strategy started to
35 focus on floating OW, with the planning of four pilot farms, one in the Atlantic façade and
36 three in the gulf of Lion (Mediterranean façade) for an average of 30 megawatts of installed
37 capacity each. Since larger commercial floating offshore wind farms (OWF) projects are
38 already planned, the shift towards floating OW energy now represents a major technological
39 breakthrough. Floating OW turbines allow the exploration of offshore wind resources that

1 were previously out of reach, due to depth limitations, but which are considered more
2 abundant. Floating wind turbines could be installed up to 100 meters depth from the shore
3 (Rogier 2019) enabling to use ocean resources previously out of reach. In addition to
4 reinforcing French strategic position among the leading countries in Europe for the
5 development of an increasingly mature technology, floating OW turbines present another
6 notable asset. If conflicts with other uses will depend on the amount of area needed to achieve
7 the established production objectives (Steins et al, 2021; Spijkerboer et al, 2021), the initial
8 assumption was about improving a sector that could be, theoretically, less controversial or
9 disrupted than its bottom-fixed counterpart, in terms of cohabitation between other maritime
10 uses and due to the increase in distance from the coast (Hübner and Pohl, 2015; Oiry, 2015).
11 But, to what extent is this statement representative of the reality? How the implementation of
12 floating OWF projects is negotiated and what are the factors that influence their socio-
13 political acceptability? The issue of social acceptability emerges in contexts of transformation
14 of natural and social environments as a result of policies aimed at introducing new
15 technological systems (Devine-Wright, 2009; Aitken M., 2010). The notion refers to the
16 degree of reception of policies or projects by the stakeholders involved and/or concerned by
17 these projects. But rather than focusing on systematic oppositions, social acceptability
18 questions the mechanisms and processes of concertation that support the reception of these
19 projects (Flanquart, 2020; Devine-Wright, 2009) strategies deployed by the stakeholders to
20 defend their interests (Boissonade et al, 2016; Oiry, 2018), and the capacity of these processes
21 to deal with sometimes very contrasting visions (Nadaï and Labussière, 2014).
22 To better understand the socio-political impediments to the implementation of floating OWF,
23 we conducted a study of the local governance process around the implementation of one of
24 the first floating OWF farms in France, in the Bay of Biscay, Atlantic façade. This paper
25 focuses on the main local stakeholders' positions involved in the decision-making process
26 concerning the assessment of the environmental impacts of the project, as part of the licensing
27 process. Obtaining environmental permit for a given floating OWF requires from project
28 developers to conduct an Environmental Impact Assessment (EIA) on their project. The EIA
29 consists in identifying ecological receptors that may be impacted by the planned project, and
30 for which potential changes are predicted (Coston-Guarini et al, 2016). By "ecological
31 receptor", we mean the biological species, population or the ecological condition that could be
32 impacted (Fath et al, 2019). EIA also relies on the choice of spatial and temporal scale of
33 potential impacts and the determination of the impact magnitude. Environmental impacts then
34 characterizes interactions amongst the floating OW farm and the marine ecosystem. The EIA
35 validation is part of the application for an environmental permit. This validation is an
36 administrative process in which the range of stakeholders included is clearly identified, and
37 all must be consulted to collect their opinions (positive or negative) on the EIA results. We
38 argue that a deep insight into different decision-makers' visions of impacts within this process
39 is key to understand complex mechanisms that govern the issuance (or not) of environmental
40 permits in a specific context of marine adaptative management (Folke et al, 2005). This article
41 raises the following questions: how do political decision-making perceive, value and relate to
42 the marine ecosystem in presence of a floating OWF? How do ecological factors shape
43 decision making, and what ecological factors are involved? The paper suggests a network
44 perspective in the analysis of the local marine social-ecological system (SES) by: 1)

1 identifying nested social-ecological variables and key social-ecological networks influencing
2 the licensing process in the floating OWF sector in France, 2) analyzing the power positions
3 (Olsson et al, 2014) and the functioning of interactions through an ethnography of the
4 political-administrative process, and questioning in a pragmatic way the place of the
5 environment (Deldrève, 2020; Bödin and Prell, 2011) in a marine SES towards sustainability.
6 The remainder of this article is organized in five sections. Section 1 describes the conceptual
7 framework developed and applied to highlight complex social and ecological interactions
8 from different visions of impacts. Section 2 presents the case study of Groix & Belle-Île
9 floating OWF pilot project and the methodology for collecting survey data. Section 3 provides
10 the results of the complex interactions analysis, with the identification of key social-
11 ecological variables and networks. Section 4 discusses the relevance of the network
12 perspective in informing public management. Conclusions and policy implications are stated
13 in Section 5.

14 1. CONCEPTUAL FRAMEWORK

15 A conceptual framework (Fig. 1) was developed i) to understand the ecological factors most
16 likely to influence decision-makers' reception of floating OWF and ii) to map networks of
17 socio-ecological interactions that are driving the local marine environmental governance in
18 the process of implementing floating OWF. Grounded in the SES approach, the socio-genesis
19 of the conceptual framework echoes its objective and challenges. Making this conceptual
20 framework operational for our study implies coupling quite distant frames using a network
21 analysis. The study mobilized the network perspective to deepen the analysis of the reciprocal
22 interactions between technical objects and social-ecological systems in decision-making.

23

24 1.1. Sociogenesis

25 The SES approach has a long tradition of understanding complex systems (Gunderson et al.
26 1995) and is widely recognized in various fields to be able to deal with nonlinear ecological
27 and human dynamics in decision making (Schulter et al. 2012). Since the beginning of 00s,
28 there have been many advances in interdisciplinary research to analyze and model SES. They
29 have proposed a wide range of conceptual frameworks for the analysis of these intertwined
30 social and natural systems (Binder et al. 2011). Considering the conceptualization of
31 interactions between the social and ecological systems and its dynamics, the literature has
32 evolved from unidirectional interactions analysis to a focus on the reciprocity between the
33 social system and the ecological system including feedback loops and learning processes in
34 the social system in response to changes in the ecological system (Scholz 2011; Binder et al.
35 2011; Scholz and Binder 2003).

36 This feedback loop approach is particularly interesting in the analysis of the SES structure and
37 functioning when put in the perspective of the prism of politics and power (Olsson et al. 2014;
38 Bödin and Prell 2011), especially in marine SES (Mazé 2020). By anchoring both
39 sociopolitical and ecological issues in a context of technological changes, the feedback loop
40 approach under the prism of power present some analytical advantages for advanced research
41 on SES. One of them is about dealing with a critical challenge, that Binder et al. (2011)
42 formulated as follows: “to what extent are the social and the ecological systems treated

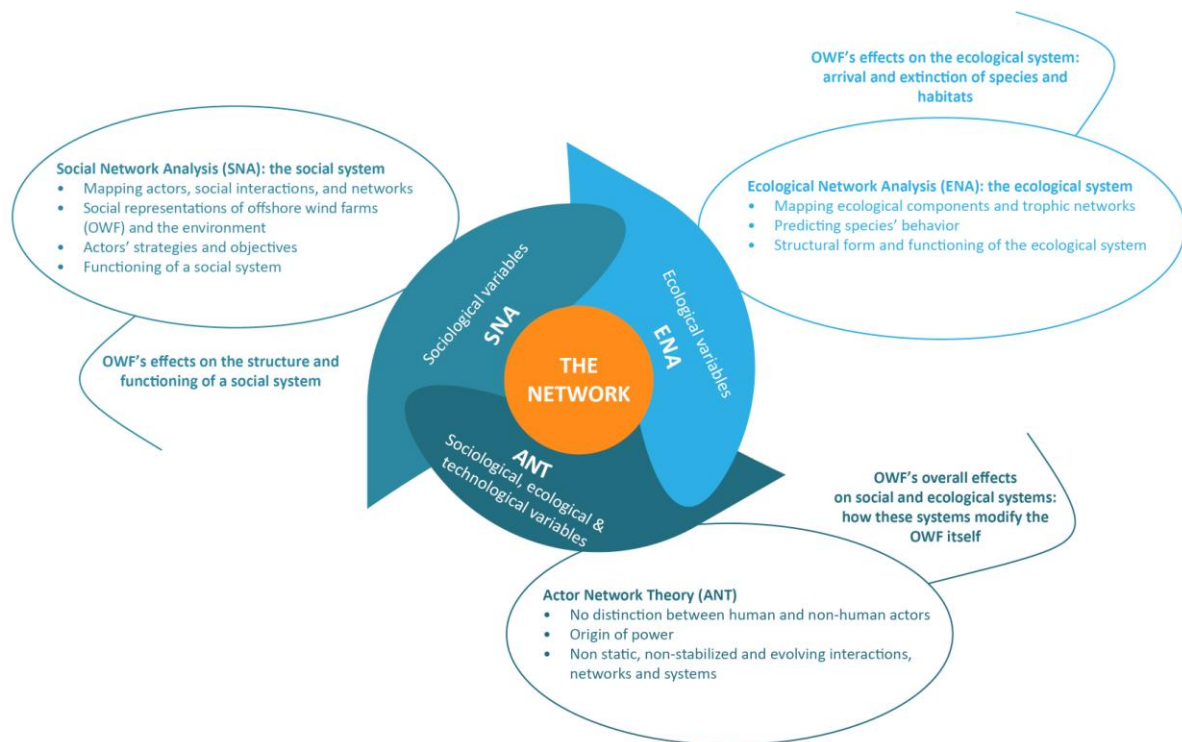
1 equally with respect to analytical depth?”. To address this critical issue, Niquil et al. (2021)
2 have deepened the instrumentation of this loop analysis framework applied to the
3 development of offshore renewable energies. Within the loop analysis framework, each
4 relationship between ecological and sociological variables, as well as changes appearing in
5 variables self’s dynamics, are included in a qualitative analysis. Our objective is to illustrate
6 the usefulness of the SES framework for identifying the nested variables that exist in complex
7 marine and coastal SES facing a major technological change, here the arrival of a new
8 floating OWF).

9 Treating complex reciprocal reactions in the SES is usually done using principle where “A”
10 *has an action on “B”, and in return, “B” modifies “A”*. However, the notion of feedback also
11 considers the temporal dynamics in interaction processes (Clauzel et al, 2018; Labussière and
12 Nadaï, 2020), and the impact these temporalities may have on both feedback trajectories in-
13 the-making and on the unexpected outcomes of a collective action (Ostrom, 1990). For this
14 reason, we include a second perspective where “A” *has an action on “B” until “A” realizes*
15 *that the action on “B” can be favorable to its own development* (Coston-Guarini et al, 2016).
16 These two principles of interaction combined are more strongly emphasized in the network
17 analysis (as developed below), which questions what the technic does to the SES and how the
18 SES responds to the technic.

19 Our proposal explores nested social-ecological variables by focusing on the network
20 perspective which we consider able i) to conceptualize ecological factors from an
21 anthropocentric perspective (since our entry point is the social-political reception of a
22 technical object and the perceptions of its potential ecological impacts); ii) to introduce a
23 common language to select and analyze different variables; and iii) to address both scientific
24 research and decision-making or practitioners. Therefore, the network is mobilized in this
25 study as a frontier-object (Mazé and Ragueneau 2016) between SES subsystems. By pushing
26 the limits of each subsystem (Ostrom, 2009), the network deal both with ecological
27 components or variables (resource units and systems) and social variables (actors, governance
28 rules and processes) and their crossed dynamics of interactions. Moreover, it contributes to an
29 equal exploration of these variables, as well as a holistic view of interactions that govern the
30 overall SES structure, functioning and managing. The objective of this article is to apply this
31 multi-scale and SES framework to investigate the socio-political reception of floating OW
32 turbines in a context of multiple transformations.

34 **1.2. The network perspective to address social-ecological interactions**

35 Building an integrative framework for an advanced natural and social sciences interface, in
36 presence of a floating OWF project, means coming back to our theoretical basis. The paper
37 explores possible connections between network approaches from the natural and social
38 sciences for an integrated view of interactions between variables (Fig 1). Rather than
39 opposing these different approaches, we try to consolidate the potential links and coherences
40 in the way of valuing network properties. The network perspective in our problematic directly
41 addresses building interdisciplinarity between natural and social sciences. It also deals with
42 the issue of informing marine governance on the nature and extent of social-ecological
43 transformations arising from OWF deployment.



1
 2 <Figure 1#> Applying the network perspective to investigate nested variables in a marine and coastal Social-
 3 ecological system. Following Ostrom (2009), we use the term “variables” to denote nodes issued from both social
 4 and ecological subsystems. If the term “variables” is common to marine ecologists, social scientists mostly use
 5 “actors” or “nodes”. We set up a common frame by denoting “sociological variables” and “ecological variables” for
 6 those related respectively to the social and ecological subsystems.

7 On the one hand, marine ecologists consider Ecological Network Analysis (ENA) as a
 8 “systems-oriented methodology to analyze within system interactions used to identify holistic
 9 properties that are otherwise not evident from the direct observations” (Fath and al., 2007;
 10 2019). Because a change in the structure and functioning of an ecological system is a response
 11 to both natural and anthropogenic stresses, ENA provides outputs to assess system
 12 development and resilience (Ulanowicz 1984, 2009; Saint-Béat et al. 2015). ENA is mostly
 13 applied to study ecological networks using metrics for assessment and management (Niquil et
 14 al. 2012, Safi and al. 2019). Rather than applying a fragmented approach to understand
 15 ecosystem changes, ENA applies a holistic function-based criterion and a wide range of
 16 indicators that captures the basic properties of ecosystem interactions and networks in space
 17 and over time (Kazanci and Ma, 2015; Fath et al. 2019).

18 On the other hand, social sciences developed Social Network Analysis (SNA), a major
 19 methodological and conceptual paradigm to understand actors’ behavior and social
 20 relationships, and social organizations (Galaskiewicz and Wasserman 1993). SNA qualifies
 21 relationships among social actors and social positions at large-system scales, either at the
 22 macro-level to describe the structure of a social system or at the micro-level to analyze face-
 23 to-face relationships (Goffmann, 1974), their characteristics, attributes, values and ego-
 24 centered networks (Laumann and Pappi, 1976). In addition to the development of new

1 methods to study social networks, SNA has some important theoretical outputs to incorporate
2 social network ideas in the theory of action (Galaskiewicz and Wasserman 1993).

3 In this study, we consider institutions or organizations as the product of interactions (1) that
4 are not stable and (2) that occur between many networks involving human and non-human
5 actors (Callon 1986, Latour 1987 [2005], Law 1982). The two assumptions developed by
6 actor-network theory (ANT) underpin our analysis of marine SES and closely orient the way
7 we explore SNA methods. Actor-network theory invites us to think about the role of objects
8 (i.e., non-human actors) in the transformation of social systems, mechanisms by which social
9 actors and groups are transformed - at the same time as they are exploited or used - by
10 ecological objects. ANT also examines new mediations and new forms of interactions
11 between society and environment (Akrich 1987), thereby revealing the parallel between
12 socio-institutional responses to environmental change and environmental reactions to a shift
13 in the socio-institutional and socio-political contexts.

14 Concerning new mediations and forms of interactions that could occur in a transforming SES,
15 we assume -in agreement with SNA- that those techniques play a significant role by
16 mediating actors' relations with their biophysical environment. Techniques are built and exist
17 in relation to the society that defines its social character. As they are tools that have been
18 created and designed to respond to specific social needs, techniques such as offshore wind
19 energy are considered as technical objects (Akrich 1987). Their primary function is to make
20 available to society, offshore renewable resources that were previously inaccessible. Thus,
21 they materialize ongoing economic, social-political and energy strategies related to the marine
22 environment. Furthermore, with their networking capacity (Simondon 1960), technical objects
23 attract the membership, and sometimes lead to the exclusion, of one or more social groups of
24 actors who are interested in the use and exploitation of the offshore renewable resources
25 (Callon 1986). Socio-technical mediations are not only about human-environment
26 interactions, but also about how actors interact in their face-to-face relationships with the aim
27 of gaining control or management of their environment (Goffman 1974). In these face-to-face
28 interactions to which actors bring their own history, values, and interests, two complementary
29 processes should be considered: how actions and expectations originating from a
30 heterogeneous chain of social agents can converge in specific social and political forms
31 (Latour, 1987 [2005]); and mechanisms by which technical objects, actors and social
32 structures bring their heterogeneous components together (Law 1992). The SNA theoretical
33 framework allows analysis of complex systems as it incorporates, in a non-linear perspective,
34 a large number of social, technical and ecological entities that interact at different levels. As
35 the analytical framework has major consequences for the methodological choices we made
36 with SNA modeling, ANT nicely fits our analysis of marine social-ecological networks.

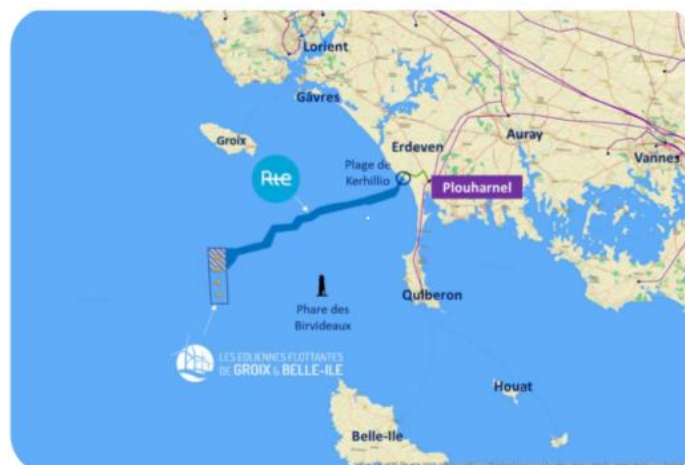
37 Finally, the common element between the two frameworks (ENA and SNA) is the Network,
38 not only the syntax, as we saw. While ENA focuses on ecological interactions, with the
39 support of ANT, SNA emphasizes the complex interactions between human and non-human
40 actors, connected via a technical object.

2. MATERIALS AND METHODS

To apply our network perspective, we considered the study case of the floating OWF pilot project of Groix & Belle-Île (Bay of Biscay, France). The survey methodology combines semi-structured interviews with ethnographic observation.

2.1. Study Case: the floating OWF pilot project of Groix & Belle-Île

In the last ten years, French policies have tackled climate change by establishing a national time frame to foster the development of renewable energies in the national energy mix. In particular, OW has become central to this political strategy. Within the national scheme, Brittany Region has partly oriented its territorial development toward OW energy. With the technical support of recent innovations (floating wind turbines (Rogier 2019), wind generators and float efficiency), the financial and political support of the government, Brittany Region's strategy of development emerged with a representation of the marine space as a future "Sea-licon valley" of the OW industrial sector (CESER Brittany Region 2017). Brittany Region will host the first OWF pilot project (Fig. 2) in the French Atlantic façade, Bay of Biscay, planned for implementation in 2023. The pilot project will involve three turbines of 9,5 megawatts each on an OWF area of about 14 km². The environmental impact assessment covers the OWF area, a remote zone of the OWF area (the surrounding ecosystem) and the electrical connection zone (the land-sea continuum). But potential impacts are not limited to the ecological system. Local marine ecosystem and several human activities may potentially be affected (fisheries, maritime transport, recreational activities, and tourism).



<Figure 2#>: The Groix & Belle-Île pilot offshore wind farm project. The rectangle represents the offshore wind farm area with the three offshore wind turbines located off the two islands of Groix in the North and Belle-Île in the South. The electrical connection is illustrated by the dark blue line. © Eolfi-Shell: <https://eoliennes-groix-belle-ile.com/>

This pilot OWF is the result of a call for tenders launched by the French government in 2015. The consortium selected in 2016 to develop the park is led by the company Eolfi-Shell. RTE (*Réseau de Transport Electrique*), the public electrical transmission operator ensures the electrical connection of the park.

2.2. Data collection

Data were collected from public and private actors involved in the process of decision-making concerning the Groix & Belle-Île floating OWF pilot project. Once designated, Eolfi-Shell

1 and RTE run the public consultations to get administrative permits that will enable the final
 2 project implementation. Amongst these permits: the environmental authorization, a
 3 declaration of public utility and a concession for use of the public maritime domain. An
 4 exemption for Natura 2000 areas was also required insofar as the park and its electrical
 5 connection path area overlapped 1% of the Natura 2000 area.

6 The data collection concerns the process of obtaining the environmental permit, which is
 7 supported by the validation of the EIA provided by Eolfi-Shell and RTE. This is an
 8 administrative and political process where the two coordinating prefects (Maritime Prefect
 9 and Regional Prefect) consult with several key stakeholders to give their opinions on the
 10 consistency of the EIA considering: i) the identification of ecological receptors that may be
 11 impacted by the planned project, and for which potential changes are predicted, ii) the
 12 methodology of impacts assessments, meaning the choice of spatial and temporal scale of
 13 potential impacts survey; and finally iii) the determination of the impact magnitude
 14 concerning each receptor.

15
 16 The opinions thus focus mainly on environmental concerns but could also address
 17 technological and socio-economic issues (fisheries, marine spatial planning, marine security)
 18 related to OWF. Consulted stakeholders can give a positive, negative or under reserve
 19 opinion. The prefects consider an opinion as favorable if the consulted stakeholder does not
 20 respond.. Each opinion collected by the Coordinating Prefects constitutes a corpus of official
 21 documents that we have examined. A total of 37 official opinions are involved.

22 We also collected data in semi-structured interviews with actors who participated in this
 23 political and administrative process of EIA validation. 14 semi-structured interviews were
 24 then conducted (Table 1) between October 2018 and April 2019, each lasting an average of 1
 25 hour. Considering the floating OWF timeline, interviews were set up as project developers
 26 had just submitted their applications for the environmental permit, and both consenting
 27 (public consultation) and permitting processes were ongoing.

28

Actor's profile	Official opinions collected	Interviews conducted
Civil/military navigation/navy	6	-
State services	8	-
State technical operators	3	2
Local authorities	13	2
Socio-economic groups and Unions	3	3
Public independent entities	3	1
Academic research	1 (Ifremer)	4
OWF industries	0	2
Total	37	14

29

30 <Table 2#> Materials for the study. The table displays the number (37) of official opinions collected during the
 31 administrative process and the number (14) of interviews that we conducted with actors.

32

33 The table illustrates types of actors involved. The civil and military navigation actors involve
 34 for instance the commander of the maritime area and the local nautical commission. Among

1 the state services are the departmental directorates for the territory and the sea (DDTM) or the
2 regional directorates for the environment and coastal development (DREAL). The State also
3 relies on the opinion of its technical services such as the French Biodiversity Office (OFB).
4 13 co-visibility municipalities were consulted as local authorities. The most important socio-
5 economic group here is represented by the regional and departmental fishing committees. As
6 independent bodies, these include the environmental authority, the national council for nature
7 protection (CNP) and the expert commission for risk assessment, nature and landscape
8 (CDNPS). Finally, following the administrative process, we crossed paths with scientific
9 research institutions as IFREMER in Brest, which brings together specialists in the Bay of
10 Biscay's marine ecosystem.

11 The data collection was complemented by 2 ethnographic observation notes. The notes are the
12 result of ethnographic observations of interactions during monitoring meetings of the OWF
13 pilot project and during a research campaign at sea to characterize the marine ecosystem (Le
14 Loc'h and Grall, 2018: APPEAL ATL 18-1). In the first case, we primarily observed
15 interactions between actors, as well as the potential blockages (ecological, socio-economic,
16 technological) as the implementation project evolves. In the second case, the observation
17 focuses on the method of selecting and making visible the ecological components in the very
18 first phase of characterizing their environmental status.

19 Our method is based on the identification of co-quotes by the different actors involved in a
20 corpus of diverse texts (37 official opinions, 14 interviews and 2 ethnographic observation
21 notes). The extraction of co-quotes was done manually (Barthe et al, 2016) while the NVivo
22 software served for building the network sociogram.

23

24 3. RESULTS

25 3.1. Summary of nested variables in the Groix & Belle-Île SES

26 The Figure 3 (see the table version in the supplementary material) below details the list of
27 nested variables that exist in the Groix & Belle-Île SES. These are the social-ecological
28 variables that stakeholders in the decision-making process co-quote as key and that justify
29 their positions regarding the park. There are 111 variables, including 61 sociological variables
30 and 50 ecological variables.

Type of actor	Sociological variables/actors	Abbreviation	Scale	Type of actor	Sociological variables/actors	Abbreviation	Scale	Type of actor	Sociological variables/actors	Abbreviation	Scale
State services	Atlantic maritime prefectorate	PREMAR	R		Direction for safety of military aviation	Direction_military_aviation	R	Local authorities	Municipality of Erdeven	Mun_Erdeven	L
	Brittany Regional Council	Regl_council	R		Regional agency for health	Health_Agency	R		Municipality of Etel	Mun_Etel	L
	Departmental commission for nature & landscapes	CDNPS	L		Regional direction of Archaeology	DRAC_SRA	R		Municipality of Groix	Mun_Groix	L
	Direction for sea & coastline	DLM	R	State technical operator	Center of studies on risks & environment	CEREMA	N		Municipality of Le Palais	Mun_LePalais	L
	Direction for water & biodiversity	Direction_water	N		Natura 2000 area	Natura_2000	R		Municipality of Lorient	Mun_Lorient	L
	General commission for sustainable development	CDGG	N		French Office for biodiversity	OFB	R+L		Municipality of Plouharnel	Mun_Plouharnel	L
	Agency for the environment & energy efficiency	ADEME	N		French national hydrographic service	SHOM	N		Municipality of Plouhinec	Mun_Plouhinec	L
	General direction for civil aviation	Direction_civil_aviation	R	Civil/military navigation/navy	High nautical commission	High_nautical	L		Municipality of Quiberon	Mun_Quiberon	L
	Interregional direction for the North Atlantic & West English Channel seafront	DIRM_NAMO	R		National navy	Navy	N		Municipality of Saint Pierre Quiberon	Mun_ST_Pierre	L
	Morbihan Departmental direction for territories & sea	DDTM	L		Local nautical commission	Local_nautical	L		Municipality of Sauzon	Mun_Sauzon	L
	Morbihan Prefecture	Morbihan_pref	L		National fisheries committee	CNPMEM	N		Communities of Auray Quiberon	AQTA	L
	Regional direction for the Environment and coastal development	DREAL	R		Fisheries sector	Fish_sec	N	Engineering offices	Setec In Vivo	Setec	L
Socio-economic groups and Unions	Departmental fisheries committee of the Morbihan	CDPMEM	L		Fishermen	F	N		Nass&Wind	N_W	L
	Regional fisheries Committee 22	Rgnl_fish_com	R		Grand Site of Gâves-Quiberon	GD_sites_sync			Creocean	Creocean	L
Independent entities	Commission for public enquiry	Comm_public	L	Environmental organizations	Bretagne Vivante	Bretagne_viv	R+L	QWF Industrial sector	EOLFI	EOLFI	L
	National committee for the nature conservation	CNPN	L		Union Belloise pour l'environnement et le développement	UBED	L		Les Fermes éoliennes flottantes de Groix & Belle-Île	FEFGBI	L
	Environmental Authority	Ae	N		Union pour la mise en valeur esthétique du Morbihan	UMIVEM	L		CGN Europe Energy	CGN_EE	N
	Departmental commission for environment, risks & health	CODERST	L		Fédération Bretagne Nature Environnement	FBNE	R		Naval Energies	Naval	N
Scientific research	FREMER	IFREMER	N		France Nature Environnement	FNE	N		Saint Brieuc offshore wind farm	BN	L
	The Museum national d'histoire naturelle	MNHN	N		Eaux et Rivières de Bretagne	ERB	L		Saint Nazaire offshore wind farm	BO	L
	France Energies Marines	FEM	N						RTE	RTE	L
Ecological variables		Abbreviation		Ecological variables		Abbreviation		Ecological variables		Abbreviation	
Algae		Algae		Burrowing megafauna		Burro_megafauna		Ecological biodiversity		Eco_biodiv	
Anguilla Anguilla		A_Anguilla		Cetorhinus maximus		C_maximus		Elasmobranchii		Elasmobranchii	
Aquatic environment		Aquatic_env		Crustaceans		Crustaceans		Eryngium maritimum		E_maritimum	
Benthic bioecose		Benth_bio		Delphinidae		Delphinidae		Fishes		BE	
Benthic habitat		Benth_hab		Diadromous fish		Dia_fish		Gâves-Quiberon & dunes bank		G_Q	
Benthic species and population		Benth_spp_pop		Dianthus hyssopifolius subsp. Gallicus		D_hyssopifolius		Green and blue corridor		G&B_corridor	
Biological environment		BF		Dunes of Pouharnel and Erdeven		BK		Special Area of Conservation Groix Island		G_ZSC	
Habitat of Dunes		Dunes		Marine environment		Marine_env		Parentucella latifolia		P_latifolia	
Hard Substrate		Hard_substrate		Marine fauna/ species		BP		Pennatulacea		Pennatulacea	
Ichthyofauna		Ichthyofauna		Marine mammals		BD		Petromyzon marinus		P_marinus	
Laminaria Herbarium		Laminaria_herbarium		Molluscs		Molluscs		Phoca groenlandica		BL	
Land area		Land		Natural environment		Nat_env		Phytoplankton		Phyto	
Maerl		Maerl		Nephrops norvegicus		N_norvegicus		Polychaeta		Polychaeta	
Marine cetaceans		BM		Pancreatium maritimum		P_maritimum		Protected species		Protected_spp	
Raised fauna		Raised_fauna		Ray		Ray		Salmon		Salmon	
Sediments		BI		Soft substrate		Soft_substrate		Tursiops truncatus		T_truncatus	
Zooplankton		Zoo									

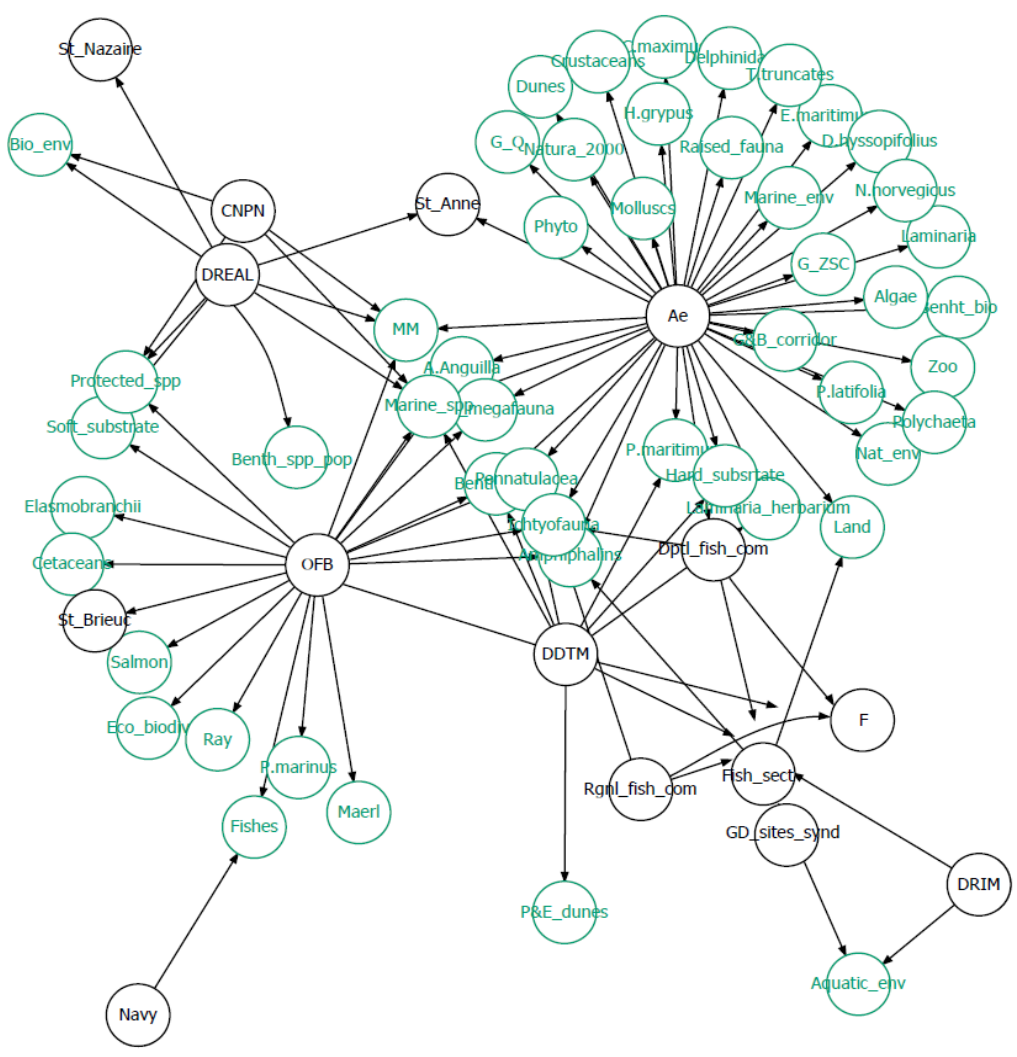
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<Figure 3#> Identification of 111 nested variables in the Groix & Belle-Île Social-Ecological System.

3 The first part of the table cites all the sociological variables while the second part identifies
4 the ecological variables that decision-makers mention. Sociological variables are classified by
5 type of actors with a color code for each category. The scale of intervention is also specified
6 (N=national, R= regional or L= local). Among the sociological variables, we can find actors
7 consulted within the administrative process of the EIA validation and outside this process,
8 such as environmental organizations, engineering firms and offshore wind industries.
9 If the number of variables on both sociological and ecological sides is quite balanced, this was
10 not a constraint at the beginning. This highlights one of the main strengths of our
11 identification approach: the number of variables is not limited or mandatory. It is important to
12 identify and include in an exhaustive way all sociological and ecological variables that can
13 have an influence on stakeholders' position regarding the park.

14 **3.2. Identification of key social-ecological networks**

15 Links between the variables in Figure 3 (see also the supplementary material) were analyzed
16 using the NVivo software. According to the findings in Table 2, two Nvivo cases were
17 considered: "Species and ecological components" and "Actors". The links between these two
18 cases were of a "*who cites who*" (*or what*) type, to make visible ecological concerns from the
19 social system perspective. This is indeed a one-directional coding where the interaction seems
20 to act in one direction only. But the ANT framework has shown that if they are not directly
21 expressed, the ecological elements emerge in the decision-making process through mediators.
22 Mediators are of twofold relevance to decision-makers: facilitating dialogue between different
23 points of view and balancing sometimes contrasting interests



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<Figure 4#> Crafting the Groix & Belle-Île Social-Ecological System model using the network perspective. This is illustrated through connections between the nodes “actors” (dark nodes) and “ecological variables” (green nodes) in a framework coupling SNA and ENA networks for analyzing SES in OWF context.

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3.2.1. Synergies and tradeoffs over benthic habitats: actors' power as main driver

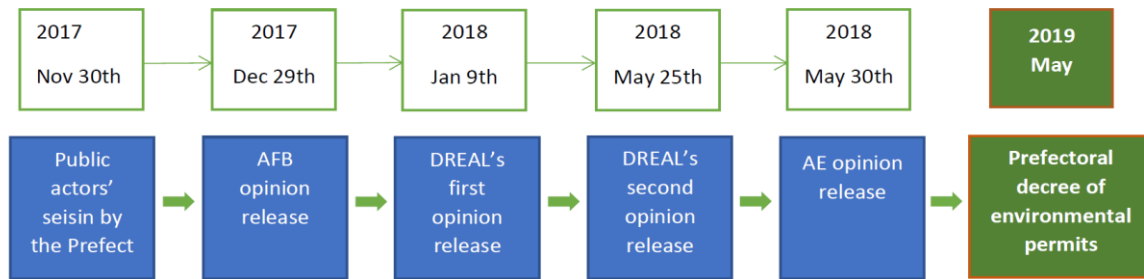
Figure 4 shows the positions of different ecological and sociological variables in the networks. The direction of the arrow heads denoted that the “nodes” actors expressed their interests (to protect, use, or manage) for the nodes ecological variables, which therefore influence actors' positions in the consenting process.

The first observation is the centralized nature of the networks. The structure of the networks highlights the pivotal positions of both the Environmental Authority (Ae) and the French Office for the Biodiversity (OFB) when it comes to environmental impacts, the identification of key receptors and the determination of impacts magnitude.

Ae and OFB fulfill their traditional role in defending marine ecosystem. But these two major environmental representatives are not alone, as also intervenes the regional direction for the Environment and coastal development, DREAL. But DREAL's missions are not restricted to marine ecosystems preservation, as it coordinates the coastal and marine socio-economic development.

Ae, OFB and DREAL share another interest in the network as they are specifically closed to benthic habitats and benthic species: megafauna, algae, laminar and sea pen. Benthic habitats and species where two sticking points on which discussions on environmental impacts of the OWF focused before and during the administrative process for obtention of final administrative permits or authorizations. One specific case clearly illustrates this focus point on benthic habitats/species and how it has transformed social-political and social-ecological interactions as the approval of the OWF project was involved. Indeed, by emphasizing the ecological variable “laminar”, these three actors provoked the modification of the initial path of the submarine power cable for electric connection intended by RTE, the electrical transmission operator of the OWF project.

OFB, followed by DREAL and Ae (Fig. 5), was the first actor to stress the importance of benthic habitats and species. In its opinion released in December 2017, the OFB started by highlighting that the EIA did not consider the two receptors sea pen and megafauna. Therefore, OFB introduced in the debate on environmental impacts, these two variables which were excluded. In a second time, OFB noted that if the EIA mentioned a zone of laminar, there was no precision on the percentage of laminar zone potentially impacted (or not) by the path of the submarine power. Finally, OFB's opinion concluded with a strong opposition to the intended path of the submarine power cable to avoid a major ecological zone of laminar. In the same vein, DREAL's first opinion also stressed the necessity to provide alternative measures to the intended path.



<Figure 5#> Timeline of opinions releases of the three main actors highlighting the Benthos.

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66 This timeline (Fig. 5) shows 1) the temporal evolution of interactions that are not static in
67 time and 2) the impact of these temporal trajectories on the processes of interactions in-the-
68 making. DREAL released two times its opinion, the first one expressing its reserves and the
69 second one after the responses of the industrial project leaders, to confirm its positive opinion.
70 OFB, DREAL and Ae finally released a positive opinion to the OWF project, but with
71 technical and scientific reserves. The reactions of the project developers (Eolfi-Shell and
72 RTE) to the first strong opposition from OFB and DREAL and the adjustment measures
73 negotiated within the network have led to a progressive shift in the positions in favor of
74 obtaining environmental permit.

75 According to the EIA published in 2017, the best technical and financial solution to implant
76 the submarine power cable was involving a zone of laminar. Therefore, the EIA proposed
77 certain measures to reduce and monitor potential impacts on this sensitive habitat. In fact,
78 geotechnical studies and campaigns started in 2016 were still ongoing. Thanks to additional
79 campaigns and due to the joint emphasis of OFB and DREAL, the electrical operator RTE
80 started to consider other options for the submarine power cable's path. Among these options,
81 avoid the total location of the zone of laminar was not an alternative considering diverse
82 financial and technical constraints. Indeed, for the best scenario, the path of the submarine
83 power cable may still involve 1% of this zone of laminar. By this way, it would be possible to
84 reduce the residual impact of the project, from "high" to "marginal". A document which
85 summarizes complementary studies to the EIA on this subject was published in July 2018. It
86 gives new clarifications on environmental impacts and responses to public actors' opinion.
87 The final path of the submarine power cable has been discussed until the end of the
88 administrative instruction of the OWF project in 2019. An administrative instruction closed
89 with the obtention of the environmental permit (the prefectoral decree of May 2019) to
90 implement the grid connection, but without a clear obligation in this permit related to the
91 avoidance of laminar.

92 However, the prefectoral decree stressed out another issue about the design of the submarine
93 power cable and its trenching, to minimize impacts of the electromagnetic field on marine
94 environment, notably the benthos. If the previous concern was about maintaining a specific
95 range of the marine biodiversity (by avoiding it), the actual one is related to how to minimize
96 impacts that could not be avoided. There are here two approaches of the conservation where
97 the second focuses on measures for reduction of risks (known and unknown), mid and long-
98 term reporting to control the potential changes, due to this electromagnetic field, on species
99 behavior and the ecosystem functioning all along the submarine power cable lifecycle. The

100 main measure of impacts reduction presented by public environmental actors here is the
101 trenching of (rather than rip rap) the submarine power cable. RTE initiated closed discussions
102 with OFB to understand its position on laminar and to negotiate an alternative solution to the
103 path which could satisfy ecological stakes, remain technically feasible and economically
104 viable regarding the total cost of the project. The intensity of the interactions between OFB,
105 DREAL and RTE by the mediation of laminar has been built through meetings RTE initiated
106 all along the process of administrative related to the obtention of administrative permits.
107 The ethnography of the decision-making process reveals how actors at the regional scale
108 (OFB and DREAL) lead a dynamic role. In the dynamics of the implementation of new OWF
109 projects, the environmental public action is territorial, focused on issues and actors of the
110 territory of implementation. From a legal and formal point of view, the OFB's opinion is only
111 consultative. However, in an informal way, OFB's favorable opinion is essential before the
112 end of the administrative instruction. As a State technical operator providing expertise on
113 biodiversity, a scientific and technical support at the local, regional and national scales of
114 governance, OFB support policies on best ways to reconcile technological development and
115 the environment protection. That explain the need of its consent which could be, as we see in
116 our case study, the result of a negotiated process between ecological issues (species, habitats)
117 and other economic, technical stakes. This negotiated process can be seen as an obligatory
118 crossing point (Callon, 1985, 1986) as OFB position could 1) enrich and orient decisional
119 actors' consents, 2) influence Ae's opinion which intervenes further downstream in the
120 decision process and 3) can be relayed through opinions expressed by the public and various
121 environmental organizations during the public concertation.

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123 3.2.2. Social-ecological networks valuing ecological clusters among individual species

124 The analysis of social-ecological networks shows the prevalence of ecological clusters among
125 individual species or variables when it comes to valuing marine ecosystem. Three main
126 ecological clusters emerged: protected species and areas, fisheries, and the land-sea
127 continuum.

128 The first cluster on protected species and areas involved, besides OFB and DREAL, the
129 National committee for the protection of the nature, CNPN, a public independent entity
130 dedicated to providing environmental expertise on OWF impacts. The category "protected
131 species" gather specific ecological groups and populations. Avifauna on the one hand,
132 including breeding and non-breeding populations: balearic shearwater, northern gannet, gulls
133 (lesser black-backed gull, European herring gull, great black-backed gull). Marine Megafauna
134 (marine mammals and elasmobranchs) on the other hand: dolphin, ray, basking shark, sea
135 turtle. Concerning protected areas, we mean zones, locations that form an ecological niche for
136 specific species. The area *Natura 2000* notably appears in this cluster, as well as some special
137 zones of conservation (Groix, Etel), the Quiberon Bay and the dunes (of Erdeven, Plouharnel
138 and Gâvres in Quiberon). Due to their reglementary status (European Union Framework
139 Directive on habitats, flora and fauna, IUCN red lists), the presence of protected species and
140 protected areas played a "lamp" effect all along the permitting process. Indeed, they have
141 particularly been stressed from the beginning of the OWF project and this stress has gradually
142 grown. OFB for instance underlined the underestimation of magnitude of pressures and

143 impacts associated in mentioned protected species as well as the necessity to involve as
144 ecological receptors all current protected species when they are not cited into the EIA. Special
145 derogations had to be fulfilled, which confirm residual impacts of the pilot OWF, or
146 acknowledge that adequate measures have been taken to reduce, compensate impacts and to
147 report risks.

148 The second cluster representing fisheries is to promote fishermen interests. The most cited
149 variables here are then fisheries sector and fishermen. Fisheries and ichthyofauna are two
150 closed variables. But while fisheries highlight the commercial value of the ichthyofauna (the
151 regional and departmental fisheries committees), the mention of ichthyofauna itself (OFB) is
152 more in a conservative approach. According to the fisheries statistics SACROIS which
153 provides one of the most accurate and complete information on fisheries in the Bay of Biscay
154 (Ifremer, 2013), three main commercial species structure fisheries in the Bay of Biscay: the
155 sole (*Solea solea*), the hake (*Merluccius merluccius*) and the lobster (*Nephrops norvegicus*).
156 Species are not specifically cited in our cluster that highlights instead a description of a major
157 socio-economic sector (fishing fleet, fishing areas) and how (far) the pilot OWF could
158 potentially impact the density, availability of fishing productions and therefore fishermen's
159 incomes.

160 At last, the third cluster focuses on the sea-land continuum and its patrimonial value. There
161 are two approaches to patrimonial value here: from an ecological point of view and from an
162 aesthetic perspective. The patrimonial and ecological value of the land-sea continuum in
163 Gâvres Quiberon has been recognized through the "Grand Site" national labialization in 2018
164 and the creation of the Grand Site Gâvres and Quiberon Union to safeguard the largest dune
165 massif in the Brittany region. The Gâvres Quiberon Union pointed out (with the DREAL) the
166 necessary coherence of the grid connection landing with the protection of the dunes. Legally,
167 the opinion expressed by the Gâvres Quiberon Union does not have a binding force. In reality,
168 the labialization occurred during the permitting process has resulted in an increase in the
169 power position (and potential blocking capacity) of the Union. Obtaining the Gâvres Quiberon
170 Union consent on the grid connection landing was a critical issue for the pilot OWF project.

171 This cluster also highlights aesthetic issues of the coastland as "*remarkable landscapes*". The
172 debates at this point mainly concern the visual impacts of OW turbines on four main
173 municipalities of co-visibility: Groix (14km off the park), Belle-Île (19km) Quiberon (23km).
174 The coastlands areas of these localities are acknowledged for their beauty, their touristic and
175 patrimonial values. The focus point was then about a potential degradation of the quality and
176 values of these landscapes. Concerning OWF impacts on landscapes, one of the most
177 important opinions expected is from the departmental commission dedicated to nature,
178 landscapes, and territories, the CDNPS. The members of this independent entity are from state
179 services, territorial collectivities, local NGOs specialized on landscapes and environment,
180 landscapers, landscape architects and academics.

181 Finally, our results converge on local scale leadership on representing current environmental
182 stakes. Some of these issues are more visible due to the regulatory "lamp" effect (protected
183 species and areas). But many remain hidden or specific to the local marine ecosystem
184 (laminar, avifauna, Grand Site, remarkable landscapes).

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4. DISCUSSION

188 The goal of this research was to identify key social-ecological drivers that influence the socio-
189 political acceptability of a floating OWF project in France. Based on an ethnography of the
190 decision-making process related to the validation of the EIA, the study summarized the nested
191 social-ecological variables to consider and highlight the most relevant social-ecological
192 networks driving this decision-making process, regarding the way actors value the local
193 marine ecosystem. Two points of discussion can be raised from our results: a discussion
194 regarding how the information obtained from network perspective could be implemented or
195 used to inform management and a discussion on the framing of the administrative and
196 political process of the EIA validation.

197 **4.1. From science to permitting: using the network perspective to inform** 198 **decision-making and management**

199 The network perspective provides management with a clear operational links between humans
200 and natural issues. This helps to efficiently guide decision-making towards sustainability
201 (Janssen et al, 2006; Bretagnolle et al, 2019) and beyond the existing approaches on
202 identification and hierarchization of barriers to OW (Dhingra et al, 2021; Apolonia et al,
203 2021). Our results highlight a map of synergies and trade-offs between stakeholders and with
204 the environment. Coupling ENA, SNA and ANT frameworks was a challenge for
205 interdisciplinarity in building an integrative framework for an advanced natural and social
206 sciences interface to support sustainable management (Mazé et al, 2018). Since large-scale
207 commercial floating OWFs are already planned in France and in the Bay of Biscay, the
208 network perspective provides a long-term approach of SES to support integrate and
209 sustainable OW energies policies. The analysis showed how ecological variables sometimes
210 carry a strong social-political content (Akrich, 1987; Olsson et al, 2014), orienting the
211 decision-making about their management. Instead of being strictly anthropogenic or
212 ecological (Binder et al., 2011), the network perspective fully operationalizes the
213 hybridization of networks, variables and sub-systems of the marine SES (Callon, 1986; Latour
214 1996). It contributes to strengthening the capacity of the decision-making to deal with the
215 wide range of current knowledge on SES and their complexity.

216 The analysis of interactions and power positions between variables contributes to policy
217 learning of transformations of an offshore environment for wind technology (Mazé, 2020). It
218 is also a political learning of local strategies within an institutional framework designed at the
219 national level to influence the local implementation of national policies (Lascoumes, 2012).
220 Public action cannot be reduced to conflicts and institutional struggles. Technological objects
221 (floating OWF) and their cognitive frameworks play an important role in underlying this
222 public action infrastructure, its schemes and mechanisms, more or less transformed and stable
223 (Akrich, 1978; Latour B. 1987 [2005]). By relying on the analysis of sociotechnical networks
224 (SNA-ANT) coupled with the ecological network analysis (ENA), the network perspective
225 shows how this public action is shaped, which (environmental) issues it problematizes and
226 how, and finally the ways in which responses to these problems are constructed. The analysis
227 of power relations in institutional arrangements (Ostrom, 1990) clarifies the understanding of
228 the informal political weight of stakeholders providing the environmental expertise (Sareen,

229 2021). Further analysis using the network perspective could investigate the reciprocal
230 dependency relation in a comparative approach between marine SES facing OWF
231 deployment. This would feed an observatory of socio-ecological transition dynamics to guide
232 governance.

233 Several feedbacks on the implementation of offshore wind farms in Northern Europe show the
234 evolution of pre-post construction perceptions and policy implications towards offshore wind
235 farms (Bingaman, et al, 2022; Penneman et al, 2022, (de) Vasconcelos et al, 2022). Exploring
236 the shift over time of decision-makers values and institutional practices (Spijkerboer et al,
237 2021) could complement the analysis on the evolution of social-ecological system dynamics.
238 An application of this temporal perspective could also inform the socio-ecological
239 determinants of OW governance within the long-term perspective of their life cycle. The
240 consenting instances from licensing and construction phases are replaced by instances of
241 regulation during operational phase. Actors' strategies and the way of valuing ecosystems
242 evolve as well. If the familiarization (Penneman et al, 2022,) and the multiplication of cases
243 of co-use of maritime space (Schupp et al, 2022; Steins et al, 2021) seem to be major factors
244 of de-risking of consenting procedures for OW, the call to anticipate blockages at the scale of
245 maritime spatial planning is more and more emphasized ((de) Vasconcelos et al, 2022).

246 **4.2. The network perspective to address the framing of decision-making** 247 **processes**

248 If the issue of environmental and socio-economic impacts is one of the main factors of
249 opposition for OWF, these oppositions can also be crystallized on the procedure and its
250 framing (Nadai and Labussière, 2014, Flanquart, 2020). In the context of the implementation
251 of floating OWF, the issue of environmental impacts is addressed by a standardized process in
252 which stakeholders are administratively selected, as well as the nature, form, or the legal
253 scope of their opinions. All stakeholders are also subject to the temporality of public action as
254 trade-offs mechanisms must occur within a time frame punctuated by the State. The State
255 decides on the framing, from the launch of the consultation on the EIA to the end of
256 interactions with the decree of authorization. This State is thus omnipresent in those processes
257 insofar as it not only decides on the management rules, but also intervenes through its
258 decentralized services. The issue of time frame in our case study also illustrates the tension
259 between the long term sustainable energy transition and a short term subject to the need of
260 making investments and projects concrete in the temporalities of public energy action
261 (Labussière and Nadai, 2020).

262 Two observations may arise in relation to the framing of the EIA validation process where all
263 opinions do not have the same legal force. Opinions of the navy representatives are mandatory
264 while environmental experts' opinions are merely consultative. This may raise the question of
265 why, in an application for environmental permit, national security issues take priority over
266 environmental issues (Deldrève, 2020, Bödin and Prell, 2011)? One can also question the
267 relevance of including the fisheries sector in this environmental process insofar as they
268 represent a vision in terms of the availability of marine ecosystem services (spaces and
269 species) and not in terms of ecological conservation *per se*. While the issue of trade-offs
270 between the main maritime socio-economic activities is also addressed, the exclusion of other

271 socio-economic sectors from this process brings to the forefront a criticism of conservation
272 policies that are often considered elitist (Deldrève, 2020; Larrère et al., 2009) and that would
273 be more efficient if more equitable (Schrekenberg et al., 2016).

274 CONCLUSION

275 The paper intended to highlight main factors orienting the decision-making process around
276 the implantation of one of the first floating OWF project in France. The network perspective
277 in this study proceeded from the need of an integrated approach for understanding social-
278 ecological reciprocal interactions that structure the local marine SES and to inform decision-
279 making towards a sustainable energy transition. We have therefore focused our attention on
280 the ethnography of the EIA validation process which determines the issuance (or non-
281 issuance) of the environmental permit.

282 The results show the reception by decision-makers and investigated how they perceived
283 socio-technical and ecological transformations towards the sustainability of marine
284 ecosystem. Our results then unravel 101 nested social-ecological variables involved in the
285 local marine SES and the key social-ecological networks that influence the management
286 decision. We have analyzed the power positions within the network, describing actors'
287 mechanisms over the reconfiguration of the floating OWF technical characteristics. The
288 results show highly centralized networks in which the OFB, Ae and DREAL play a leading
289 role in identifying the most critical environmental receptors for decision making. The results
290 also conclude on the functioning of an SES that value most the protection of ecological
291 groups and clusters over individual species.

292 The validation of the EIA takes place in parallel with the public consultation, and in which
293 some of the stakeholders in the decision-making process also participate. We thus observe
294 intertwined temporalities that aim to accelerate the rhythm of project sitting. As a result, the
295 ways of qualifying the environment and impacts are entangled and are supposed to converge
296 in the Prefect final decision (permit). One of the most absent or less visible actors in this
297 process are probably the engineering firms who carry out the EIA under the supervision of the
298 project developers and remain in the '*back office*' of the whole administrative process.
299 However, their primary role and scientific legitimacy in the production of impact assessment
300 is sometimes questioned.

301 Finally, from science to permitting, this research contributes to better link basic research to
302 final decision making. The results at the interface of natural and social sciences contributes to
303 addressing an operational challenge both for scientific research and decision making, namely,
304 treating equally social and ecological variables in a SES. It then offers a more detailed
305 understanding of the social-ecological barriers in terms of the background (impacts) and the
306 design (framing) of political permitting process. The study unravels tensions, strategies and
307 trade-offs in a political process that French managers should anticipate to rollout floating
308 OWF. A research perspective would be to analyze the shifts decision-makers' positions on
309 valuing environment, in a global European context of technological upscaling, from pilot to
310 large-scale, and from bottom fixed to floating wind farms. Although the knowledge of
311 impacts is increasingly mature, the gigantic development of OW turbines in Europe is paving
312 the way to new strategic issues such as cumulative impacts. This highlights the relevance of

313 exploring the implications for environmental governance of pushing the frontiers for future
314 OW expansion. The challenge would be to investigate by hypothesis, if environmental
315 expertise achieved on bottom fixed OWF projects allow (or not) for less controversial
316 deployment for floating OW, from the point of view of both environmental impacts and
317 marine co-uses.

318 ABSTRACT

319 In the early 2010s, the French government officially launched its energy transition strategy
320 dedicated to offshore renewable energy. The government launched, since 2011, several calls
321 for tender for the construction of commercial fixed offshore wind farms in the English
322 Channel and the Atlantic façade. In parallel, in the mid-2010s, the French State showed an
323 interest in floating wind energy, with the planning of four pilot farms in the Atlantic and the
324 Mediterranean façade. If the offshore wind energy is growing in Europe, floating offshore
325 wind energy deployment is currently at an early stage. Floating offshore wind energy
326 represents a major technological breakthrough, allowing the exploration of offshore energy
327 resources that were yet out of reach, but which are recognized as more abundant. In addition
328 to strengthening French strategic positioning among the pioneer countries in Europe for the
329 development of an increasingly mature technology, floating wind turbines present other
330 assets: diversifying the French offshore renewable energy mix, improving an offshore sector
331 that is, apparently, less controversial or disrupted than its bottom-fixed counterpart (in terms
332 of cohabitation with other maritime uses and preservation of marine ecosystems). To better
333 understand the socio-political impediments to the implementation of floating wind farms, we
334 conducted a study of the local governance process around the implementation of one of the
335 first floating offshore wind farms in France, in the Bay of Biscay. This study focuses on the
336 analysis of perceptions of floating OWF impacts by decision-makers involved in the
337 validation process of the Environmental Impact Assessment: how do these decision-makers
338 perceive, value and relate to the marine ecosystem in presence of a floating OWF? How do
339 ecological factors shape decision making, and what ecological factors are involved? The
340 paper applies a network perspective in the analysis the local marine social-ecological system
341 (SES) to: identify nested social-ecological variables and key social-ecological networks
342 influencing the licensing process in the floating OWF sector in France, 2) analyzing the power
343 positions and the functioning of interactions through an ethnographic of a political-
344 administrative process, and questioning in a pragmatic way the environmental governance of
345 energy transition towards sustainability.

346 KEY WORDS

347 social-ecological systems, network perspective, floating offshore wind farm, Environmental
348 Impacts Assessment (EIA), socio-political acceptability, France.

349 HIGHLIGHTS

- 350 ❖ A network perspective combining three distinct theoretical approaches was used to
351 enhance the analysis of intertwined interactions between social and ecological systems
352 in a marine social-ecological system (SES).
- 353 ❖ The study conducted an ethnography of the political-administrative process of the
354 Environmental Impact Assessment (EIA) validation during the licensing process.
- 355 ❖ The results summarize social-ecological key drivers of floating offshore wind farm
356 (OWF) political acceptability in France, highlighting what decision-makers value in
357 the environment in presence of OWF, and how.
- 358 ❖ The network perspective also unravels power positions and mechanisms that shape
359 local public action.
- 360 ❖ The proposed operational framework contributes to better connect basic research to
361 final decision-making, while questioning in a pragmatic way marine energy transition
362 governance towards sustainability.

363

364 AUTHOR CONTRIBUTIONS

365 RFG drafted the paper with inputs from CM, NN, GS and FLL. The design of the
366 methodological framework was done by CM, NN, NC and RFG. NN and MT formatted figure
367 3. All authors have made a substantial, direct, and intellectual contribution to the work, and
368 approved it for publication.

369

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375

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