The Collaborative Process in Environmental Projects, a Place-Based Coevolution Perspective

Kevin Daudin, Christiane Weber, François Colin, Flavie Cernesson, Pierre Maurel, Valérie Derolez

To cite this version:

Kevin Daudin, Christiane Weber, François Colin, Flavie Cernesson, Pierre Maurel, et al.. The Collaborative Process in Environmental Projects, a Place-Based Coevolution Perspective. Sustainability, 2021, 13 (15), pp.8526. 10.3390/su13158526 . hal-03321821

HAL Id: hal-03321821
https://hal.inrae.fr/hal-03321821

Submitted on 18 Aug 2021

sustainability

MDPI

Article

The Collaborative Process in Environmental Projects, a Place-Based Coevolution Perspective

Kevin Daudin [1,*], Christiane Weber [1], François Colin [2], Flavie Cernesson [1], Pierre Maurel [1] and Valérie Derolez [3]

[1] TETIS, Univ. Montpellier, AgroParisTech, CIRAD, CNRS, INRAE, 34000 Montpellier, France; christiane.weber@cnrs.fr (C.W.); flavie.cernesson@teledetection.fr (F.C.); pierre.maurel@inrae.fr (P.M.)

[2] G-EAU, Univ. Montpellier, AgroParisTech, CIRAD, IRD, INRAE, Institut Agro, 34000 Montpellier, France; francois.colin@supagro.fr

[3] MARBEC, Univ. Montpellier, CNRS, Ifremer, IRD, 34200 Sète, France; valerie.derolez@ifremer.fr

* Correspondence: kevindaudin@hotmail.fr

Abstract: Environmental research and management organizations are mutually dependent when it comes to produce and use knowledge in favor of responsible action in an increasingly uncertain world. Still, science and practice interfacing remains a challenge when it comes to implementing and sustaining a collaborative process. In this paper, we develop a descriptive framework to study the coevolution of scientific and planning activities embedded in a territorial system. Scientists and managers dynamically interact through institutional arrangements, operationalization of knowledge and information and communication tools. We propose an approach to systematically document transdisciplinary pathways and characterize the bounding process between organizations on a typical case-study, the coastal Thau *territoire* (Mediterranean Sea, France). By tracing, illustrating and analyzing coupled trajectories of environmental sciences and planning for the last decades, the Systemic Timeline Multistep methodology tackles cross-fertilization mechanisms. The relational analysis draws on the elaboration of a synchronic timeline to question co-evolution and grasp causal mechanisms of research projects interactions with management pathways. Its application on the Thau *territoire* shows that scientific activities and public actions shaped each other in a continuous process of interaction. It also gives insights into the contributive roles of long-term place-based research and intermediate organizations for the emergence of new sociotechnical arrangements.

Keywords: natural resource management; transdisciplinary research; sociotechnical transition; *territoire*; Thau lagoon; socio-environmental observatories; sustainability sciences

check for updates

Citation: Daudin, K.; Weber, C.; Colin, F.; Cernesson, F.; Maurel, P.; Derolez, V. The Collaborative Process in Environmental Projects, a Place-Based Coevolution Perspective. *Sustainability* **2021**, *13*, 8526. https://doi.org/10.3390/su13158526

Academic Editor: Antonio Miguel Martínez-Graña

Received: 1 July 2021
Accepted: 27 July 2021
Published: 30 July 2021

1. Introduction

Ecological knowledge seeks, more than ever, societal consideration as a common good, informing environmental actions and contributing to deal with the new challenges faced by humanity and the biosphere in which it is embedded [1,2]. Science–society interactions about nature conservation are not recent; articulation between researchers and representatives of the environmental action has already lead to successful impacts. Indeed, research organizations have been producing expertise for the elaboration of environmental policies for decades [3]. Moreover, cross-disciplinary studies in-between social and ecological sciences have been largely triggered by socio-political factors [4] and driven by what precisely result to be public policy hotspots [5]. Still, interactions are neither systematic nor simple, and a large amount of work from diverse disciplines and sectors is currently being achieved to support relevant interfacing between scientists and knowledge users.

Various terms have been used to describe collaborative research that address societal problems [6], underlining the diversity of approaches developed in the last decades to capture the complex adjustment processes between science and society [7]. The organization of dialog and cooperation between researchers and practitioners is now referred to as "transdisciplinary" [8,9], and the deliberate action of structuring spaces for "knowledge co-production" has been recently acknowledged as a tool for environmental governance and sustainability sciences [10]. While increasing recognition for better connecting research and action to address sustainable development issues, shifts to transdisciplinary research remain a challenge due to conceptual uncertainty [11] and the importance of contextual factors for successful implementation [12].

Environmental policies and sciences achieved significant progresses in the last decades, with a respective shift from sectorial to global and from disciplinary to interdisciplinary approaches. For the water sector example, first the Integrated Water Resource Management approach [13] empirically illustrates the explicit recognition of interdependencies between social and ecological subsystems, favoring integration of sectorial preoccupations, local knowledge and academic disciplines. Second, recent scientific works produced a shared conceptual representation of the water cycle, including humans and their activities [14–17]. While the promotion of integrated approaches for regulations and scientific knowledge generation is not recent, there are still difficulties in practical implementation. First, the diversity of planning instruments (disjoint relationalities) [18], the variety of organizational forms (distributed responsibilities) [19], and the power asymmetries between stakeholders [20] jeopardize management strategies. Second, the variety of academic disciplines and their related epistemologies present a big challenge for scientists trying to have a systemic approach on the nature–society interfacing [21,22].

Social–ecological interactions and feedbacks are increasingly studied through a systemic perspective. The Social-Ecological Systems (SES) concept plays a key role in the operationalization of the research process [23,24]. Indeed, the SES concept was originally developed as a scientific framework for the study of local resource management systems [25], considering environmental knowledge as a critical link between ecosystems and nested political institutions. The associated or derived research is vast [26] but globally oriented to address real-world problems by generating context-based understanding for the active shaping of social-ecological change (also referred to as "stewardship" [27]). Whatever the environmental challenge, stewardship is regarded as intimately connecting knowledge to action [28], both being produced within the shared activity of engaging with a particular situation [29].

To gain understanding on the complex interactions between ecological phenomena and social arrangements, the learning from practice and research approaches emerged in the late 1970s [30]. Since then, ideas of recursive learning spread all over communities of practices as a strategy to improve policies based on field observation and experimentation [31]. Still, environmental conservation projects duration bounds the identification and characterization of human–nature interactions and thus limits their broader impacts [32]. The nature of socio-environmental phenomena involves the acquisition of long-time series and multistakeholder perspectives. From the mid-1980s to now, research organizations have implemented a large number of Long-Term (social) Ecological Research (LTER) observatories in many places around the world to deepen understandings on transversal objects and questions and to give space and time for further dialog between scientists and natural resource managers [33–35]. Regardless of its initial origin and objective (questions may come from a scientific dynamic or a societal concern), long-term research observatories that focus on a single case study and follow its unique development are recognized as crucial for dialog between scientific and local stakeholders [36] and for the development of planning strategies [37,38]. Despite the many experimentations on socio-environmental observatories, there are still gaps to be filled for the adoption of a common operational framework able to bring research organization and management institutions in an adaptive governance framework [38].

In the last decades, many works have been accomplished to describe and analyze difficulties to connect research and sustainable development trajectories [39]. Today, the focus of many funding agencies on impactful research projects pushes for concrete problem solving and for the inclusion of socio-economic stakeholders in scientific activities [40,41]. While various insights into interactive arrangements between science and management organizations are available—especially in long-term observatories where local institutional arrangements facilitate collaborative practices—the coordination mechanisms between public institutions is still poorly documented [42]. Only a few evolutional perspective have been found in the literature [9,43,44], but original methodological developments are increasingly needed to better connect knowledge to action [41] and to gain clarity about roles and responsibilities among institutions [43]. This paper intends to fill this gap by proposing a framework for transdisciplinary capitalization studies, analyzing temporal evolution of environmental conservation projects in a specific place.

To capture the interaction dynamics between management and science public organizations, we hold a French social-geography perspective [44,45] and a landscape approach [46,47]. The spatial area of concern is an environment under various influences, including humans in interaction with their surroundings composed of natural elements and living beings (physical and biological entities). Human activities and technical infrastructures change over time following society's objectives and social rules. In this framework, we propose to use the concept of '*territoire*' to denote the building of collective strategies for the exploitation and conservation of natural resources. We intend to grasp the increase in the complexity of socio-political interactions through the evolution of local multistakeholder's decision-making processes towards sustainable development, framed by public policies and narratives induced by dominant worldviews [48]. Despite many similarities with the concept of social-ecological system [49], the *territoire* emphasizes on built-up social and technical infrastructures with a focus on collective choice.

In this methodological paper, we hold a systemic perspective on the interplay between environmental scientists and managers which dynamics depend on and shape the broader *territoire* in which it is embedded. We suppose the system dynamics can be described through a retrospective analysis of past research and development projects. First, we describe a case study that benefited from long-term research involvement together with recognized investments in management efforts: the Thau coastal lagoon and its catchment (Mediterranean basin, France). Second, we propose a descriptive framework to analyze the transdisciplinary process and to question coevolution. To follow up place-based research and development projects, and retrospectively analyze the joint progresses of knowledge and action, we develop a multistep methodology. Conceptual and operational works are later referred to the "Systemic Timeline Multistep" methodology. Third, we test its implementation on the Thau *territoire*, which is a remarkable example of science-practice interactions in coastal areas. Finally, a reflexive discussion is proposed.

2. Materials and Methods

2.1. The Thau Case Study

Delimited by the coastal lagoon and its catchment (watershed and karstic aquifer), the Thau *territoire* is located on the French Mediterranean coast 20 km west of Montpellier (Figure 1). As part of the Mediterranean basin, the area is subjected to land use transformation (high demographic pressure) while being recognized a hotspot for biodiversity [50,51] and climate change [52]. The Thau *territoire* (later also referred to by 'Thau') is characterized by its variety of landscapes (coastal plain, "garrigue" reliefs, lagoons and wetlands) at the origin of important marine and terrestrial biodiversity. In the past, human activities consisted originally in winegrowing and thermal activities [53]. The exploitation of a karstic system of resurgences for freshwater resources then permitted the development of Sète harbor in the middle of the 19th century [54]. The 'Thau' reputation is now largely attributed to its shellfish farming, which economic development dates back to 1950s. Since late 1980, the tourism and the economic development of the Montpellier metropolitan area are the main drivers for urban expansion.

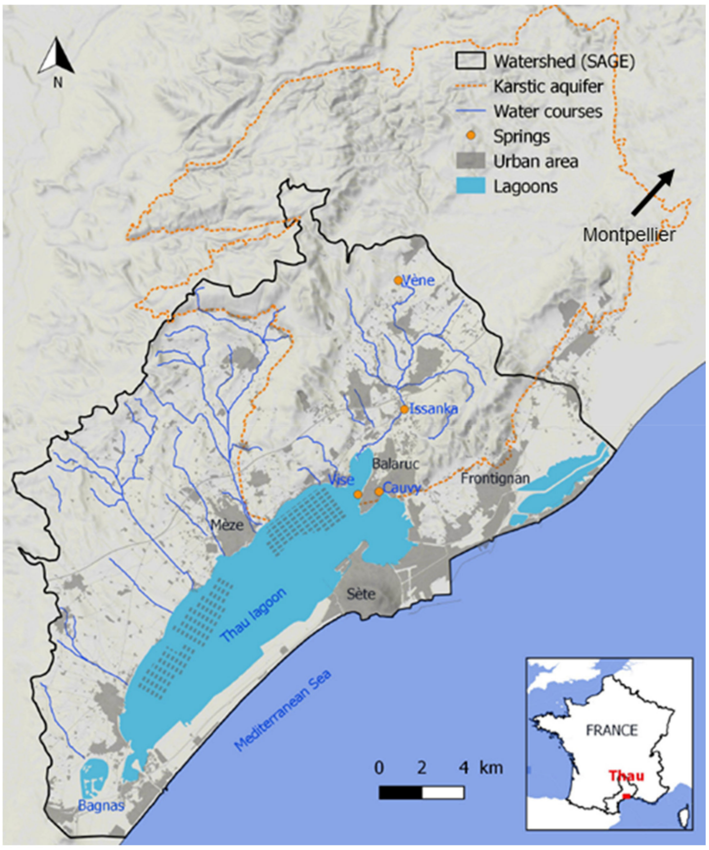

Figure 1. Thau coastal lagoon and its catchment. Source: SMBT for the watershed boundaries, BD LISA® for the limits of the karstic aquifer, BD TOPO® for streams and [55] for urban areas (shellfish farms are represented with grey rectangles).

The Thau watershed (343 km^2) is typical of French Mediterranean coastal areas, ending up in an emblematic lagoon (10% of French shellfish aquaculture [56]). Over the 17 municipalities, Sète, Frontignan and Meze account for more than 60% of the 133,000 inhabitants. Besides shellfish farming and fisheries in the lagoon, the main activities concern wine growing, Sète's harbor industries (3.5 million tons of goods passed through the port in 2012), thermal baths (first spa resort in France with 53,000 patients in 2018), and seaside tourism (1.3 million tourist per year, mainly during the summer season).

In the Thau *territoire*, societal challenges emerged from water-related issues and more specifically from the succession of sanitary warnings on shellfish production. In the end of 1980s, lagoon microbial contamination and sanitary warnings, perceived as an environmental problem of great importance by shellfish farmers, gave opportunities for the reconfiguration of spatial organization and lead to upgrading of wastewater infrastructures for maintaining shellfish farming and fisheries (water quality standards). During 1990s and 2000s, freshwater increasing needs for urbanization, agriculture and thermal industry required water transfers from nearby watersheds. Water flows over space and time have thus been shaped by local coordination mechanisms between increasing issues and competitive needs [57]. Simultaneously, in the early 2000s, European planning instruments framed Thau's environmental actions and strategic planning: the Water Framework Directive (WFD) to identify water bodies and improve their quality and the Integrated Coastal Zone Management (ICZM) to integrate coastal ecosystems and their related economic activities. The agential role of water, e.g., the organization of societies to manage water [14], played a critical role in the development of Thau (multiplication of stakeholders, diversification of issues). A shift from technical infrastructure provision to coordination between actors and policies occurred during the 2005–2015 period notably through local implementation of integrated planning (coastal zone, land and water).

In parallel, the Thau *territoire* also presented many advantages for academics studying natural resources and competition between uses. As such, it has been intensively used as a case study in research projects. Historically, initial investigations date back to the establishment of a biological station in Sète in 1879. Studies were originally driven by the issue of shellfish farming, but since the 1980s, scientific initiatives increased in number and diversified across a wide range of disciplines (thanks to the geographical proximity with research teams in Montpellier). Indeed, Thau benefited from various funding schemes at different institutional level (regional, national and European), with telescoping research agendas oriented to gain understanding on human–nature interactions in coastal Mediterranean environments [5,58]. It resulted in sustained funding for multidisciplinary collaborations over Thau *territoire*, focusing on lagoon ecosystems, karstic aquifer and freshwater quality standards, but also in great attention to the coordination of various stakeholders.

Today, the Thau *territoire* is considered as an insightful case study to analyze political decisions and public actions that have or not taken into consideration academic knowledge. Regional communities of managers and scientists were bridged through solid collaboration practices. Notably 'sanitary crises' prompted the implementation of specific governance mechanisms with interventions across public policies and sustained interactions with knowledge production. This process of societal changes still lacks qualitative and diachronic attention on institutional dynamics and interactive arrangements that facilitated coordination between research and management organizations. Moreover, the succession, duration and simultaneity of both kind of public projects have not been pooled together. The initial objective of this work was thus to diagnose the relations between environmental issues (biophysical phenomena) and the organization of public actions through the tracing of the logics of research and development projects. As spatial delimitation is problematic in coastal systems [59], we considered different overlapping spatial scales for knowledge and action, mainly related to water management (lagoon, watershed, karstic aquifer and municipalities).

2.2. The "Systemic Timeline Multistep" Methodology

To question science–society coevolution on the Thau *territoire*, we develop a descriptive framework of the transdisciplinary process and propose a multistep methodology for its implementation.

2.2.1. Forewords: What We Mean by Science and Society

Environmental research activities are intrinsically embedded into the social-ecological system under study (science is part of society), whether or not scientists are explicitly engaged in evidence-informed action (operationalization of knowledge to deliver usable/relevant information to local stakeholders). Uncertainties do not prevent action; it is rather based on a resilient strategy with the ability to integrate new knowledge in real time. Actionable knowledge is interdisciplinary, systemic, people oriented, and co-produced with users.

Citizens, politics and technicians are actively shaping land planning (action implementation emerges from actors' configuration). Because there is no collective action without instruments and tools, societies act upon their environment through technical systems and develop management practices that are framed by institutional logics and policies. Practitioners (stakeholders, decision-makers, resource managers) do not mirror society or local knowledge, but they have a unique experience of their *territoire* and they are required to implement development projects for a common valuable objective.

2.2.2. Transdisciplinary Collaborative Process

Many environmental scientific communities are involved in the challenge of producing knowledge adapted to action [41,60–62]. Discussions about the various modes of knowledge production began in the 1990s in scientific communities [63]. The ideas were to challenge the classical representation of knowledge creation coming before practices and their relative disconnection from development's trajectory. Today, various types of interactions have been identified [64], and the experience gained through case studies [9,11,12,39,65–68] gave insights into the mechanisms and the components of "successful" collaboration practices. First, trust-based relationships and frequency of interactions between researchers and practitioners (informal meeting, workshops, and seminars) is a cornerstone for the construction of strategic coalitions able to engage in societal issues. Second, communication (sharing of information, delivering research results in various forms) determines the quality of facilitation and mediation. Engagement and communication are facilitated by "boundary works" [41], a cross-cutting concept referring to organizations and objects supporting the establishment of a common understanding across worldviews and academic disciplines [69]. Boundary organization, also referred to multistakeholder arenas [70] or institutional spaces [71], are formal and informal rules that make the link between multiple sources of knowledge and capacities from diverse stakeholders. Boundary objects [69,72,73] help coordinate different groups by proposing shared vocabulary and communication tools. Interactive dynamics between science and practice thus calls for rethinking the roles and relationships of their representatives [7], social context and organizational structure being significant in this process [67].

Historical cultural norms of organizations and the institutional context shape the engagement of human resources and time in the collaborative process, and so they play a significant role in developing a shared understanding of their interactions [74,75]. Today, management agencies, funding mechanisms and academic institutions are "pushing and pulling" [76] to study environmental complexity and act in an increasing uncertain world. Iterative frameworks have already been established to analyze the dynamics of knowledge (research process, [77]) and action (policy cycle, [78]) towards one another. Because there is no single causal link between research and its outcomes and impacts [39], transdisciplinary works rest on the dynamics of research and development programs enabling long-lasting alliances between science and society representatives. In the French water sector, for example, environmental researchers and managers jointly progress in favor of dynamic adjustment, interfacing and building community capacity [79]. Water agencies connect managers and academics in the declination of national and European policies concerning water (where and how to act? what impacts of the intervention? what tools for decision support?), while long-term research technical platforms leverage integrative research and long-term partnerships with managers. Specific interfaces have been established in the long run, but the negotiation process between organizations has not been documented and many questions arise about the dynamics of interactions and the mechanisms that operate in the mutual shape of knowledge and action: How did scientific activities contribute to territorial development and how do actions on natural resource systems trigger research questions? What is the role of research in multistakeholder networks? How does continuous interfacing change collaborative practices?

2.2.3. Conceptual Framework

In this work, we consider that the connections between knowledge producers and users pre-exists in any situation [80], but we also acknowledge the step-by-step progress towards deliberate collaboration initiatives to cross the usability gap [10]. Hence, we pose that the collaboration process between science and management organizations is constantly evolving and transformative [9,29,79] in the sense of leveraging the positive impacts of knowledge and action. In this paper, we argue that a dynamic system perspective on the transdisciplinary process could help to have a clearer understanding of the interplay between environmental scientists and managers. We put emphasis on the notion of driving mechanisms to analyze the interaction dynamics and characterize complex feedbacks mechanisms [26,81]. Besides vagueness of concepts like knowledge and action, we intend to grasp different kind of information and develop a theoretical contribution on the dynamics of collaborative practices. Our starting point is that both are embedded in a broader system and interact with each other through time (coevolution).

The unit of analysis is delimited by ecological and institutional framings, which can be designed through various overlapping concepts (Social-Ecological System, *territoire*, landscape). Research activities and management institutions are embedded in the *territoire* and shape its trajectory (beyond other social-environmental interactions), in particular through socio-technical interactions. Initially developed by Science and Technology Studies, the concept of "evolving relationships between societies and their technical environments" led to the notion of trajectory with different pathways [82]. The system under study is composed of successive bundles of research and development projects, which forms a given sociotechnical configuration that fulfill specific functions (Figure 2). Note that we assimilate "knowledge" to academic knowledge and we consider "action" through collective planning projects and governance events. Moreover, we do not expect that changes in collaboration practices between researchers and managers can be attributed to a specific project (we are interested in the oriented changes achieved through the contribution of several successive projects).

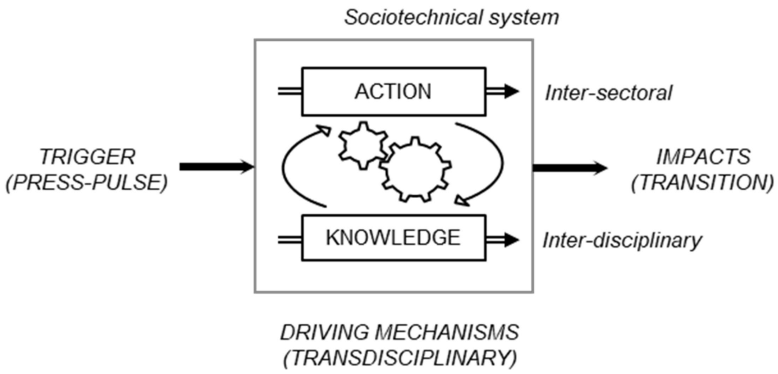

Figure 2. Conceptual framework for the transdisciplinary process in a given *territoire*.

A trajectory is marked by the succession of relatively stable periods, or regimes (given configuration of the collaboration in which different types of interactions can occur simultaneously) globally oriented by transitions (shift from one regime to another revealed by an evolution in collaborative practices). The system arrangement can be described by internal mechanisms—within regime dynamics [81], stability of institutional formal and informal rules [83], homeostatic properties [84].

A regime is the result of a dynamic process of interfacing between the knowledge and action subsystems (interactions across trajectories), which have their respective evolution (towards intersectoral and interdisciplinary). External disturbances ("trigger") refer to social and ecological press-pulse forces [37]. It grasps structural and contextual factors (international regulation, environmental standards, innovations and information and communication technologies) and environmental hazards (biophysical disruptions). A regime shift emerges from the system and might have transformative influence on the *territoire* ("impacts"). Today, many scholars claim that social–ecological transitions are manageable and that a governance organization can prevail in each period of stability and during transitions [85]. Social-environmental observatories, and the sociotechnical system they support, are great opportunities for insights into adaptive co-management [86,87], valorizing existing tacit and expert knowledge of researchers and managers about collaborative practices and learn from them for improving coordination. Reflexive insights on the coevolution process (explicit will or exogenous factor, cross-fertilization process) can support the establishment of collaborative governance approaches where multiple actors engage in a transition (change trajectories, transform scientific outcomes into policy framework).

2.2.4. Multistep Methodology

We draw from and operationalize the conceptual framework to propose an original methodology which objective is to bound professional organizations trajectories. It relies on the study of the emergence and stabilization of sociotechnical regimes within a given *territoire*.

The Systemic Timeline Multistep (STM) methodology takes a multilevel perspective to trace, illustrate and analyze trajectories of research and development on a case study. Its implementation objective is to identify regimes and transitions in the timeline and characterize driving mechanisms of the collaboration arrangement and triggers and impacts of the regime shift. Past environmental conservation projects are analyzed through a diachronic and dialectic approach [88,89].

First, system boundaries (spatial and temporal) have to be drawn. For sociotechnical systems it is generally achieved at the sectoral level [83], but it is an iterative process as the analysis reveals new processes to be captured [81]. The degree of hindsight is then provided by a relevant starting point (a shock, a new regime emerging from previous dynamics [90]).

Second, a capitalization step (data collection) relies on the inventory of projects and their contextualization (broader societal and governance events). The objective of this step is to identify the assemblage of geographic, historical, ecological and political circumstances that produce a given arrangement (synchronic), as well as to consider what might bring about change in the collaboration practices. This can be achieved in various ways. For the Thau case study, we benefited from embedding into relations with scientists and managers of the *territoire*. We developed a hybrid deductive–inductive approach consisting of a literature review guided by interviews (open-ended questions, acronyms and literature referring to projects) and workshops (collective meetings) with a set of senior researchers in a diverse sample of disciplines. Scientists who worked on the Thau case study consolidated the listing of projects (key-words) and gave explicative factors of respective pathways, cross-checked with information gathered through managers (strategic reports, field trips and seminar in 2019 and 2020). Concerning research activities, we started with a limitation to ambitious multiyear research projects that left digital records.

Third, to represent the coevolution of knowledge and action, the dynamics of projects and events are illustrated by superimposed horizontal bands in a synthetic timeline representation (Figure 3). The objective is to envision the coupled dynamics between research projects, development projects and markers in geohistorical trajectories (public policies and biophysical disruptions). The illustrative process has been derived from "chronosystemic timelines" [91–94] as multi-temporal and multi-factorial capitalization tools for an integrated vision of the social–ecological trajectory. As such, the illustration step can help engage dialog between scientists and with managers on capitalization issues in long term territorial observatories. Note the illustration of respective evolutions in asynchronic pathways (without pre-identification of vertical connections) provides an interpretative tool for the analysis of the transdisciplinary process.

Fourth, the analysis of the overall trajectory is conducted through a relating process, linking an observation (projects' role) to context variables (events, policies) affecting the patterns of interactions and outcomes [95]. Attention has to be paid on confounding factors [96] which may retrospectively explain a trajectory but may not be a causality of the pathway. The objective of this final step is to study synchronicity and question coevolution between research and management projects. Hence, we propose to compose a narrative of the evolution and transformation of the transdisciplinary collaborative process. Note that we consider the narration as a story of a place which involves scientists and managers, *territoire* and time. It gives space for the emergence of hypotheses and explanations that could account for the observed change.

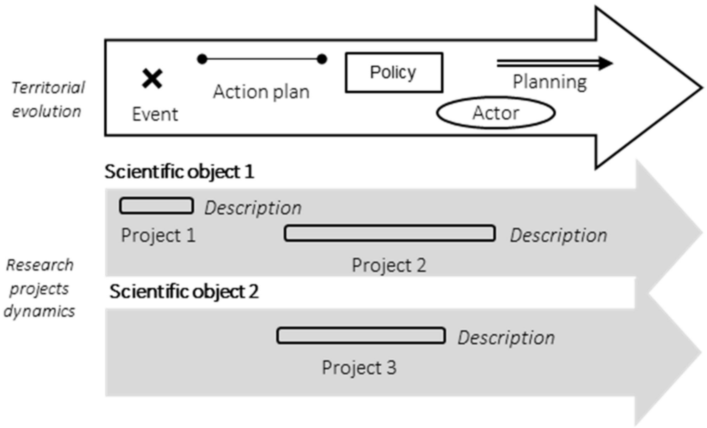

Figure 3. Representation of research and development parallel trajectories.

3. Results

The STM methodology implementation on the Thau case study has been realized in two steps. The capitalization is based on a collective work with a set of scientists (17 researchers in 8 disciplines, from various research organizations located in Montpellier) and a qualitative literature review on the case study (127 scientific articles and 53 reports, including strategic planning documentation). The illustration and analysis steps have been achieved during reflexive workshops with a restricted number of scientists, mainly geographers.

3.1. Territorial Evolution

The frequency and intensity of two process-based phenomena (water-related issues) acted as presses for collective actions. Unlike freshwater competitive needs (technically solved by transfers from nearby basins), the succession of sanitary crises due to microbial contamination had disastrous effects on public health and on the reputation of shellfish activities (repetition of environmental problems perceived as negative events). Intensively reported in regional media, the 1989 Christmas bacteriological fecal contamination deeply affected public opinion and put on the spotlight the high dependency of the lagoon activities on water quality. This event made the relationships between natural resource systems and human activities more complex.

Environmental management for the Thau watershed was first imposed in 1995 by the French government with the implementation of the first Sea Exploitation Scheme (French acronym SMVM), supported by two successive bay contracts to upgrade domestic wastewater infrastructures [97]. However, difficulties were encountered by stakeholders in taking a position and enforcing legitimacy in terms of technical expertise, as illustrated by the 2nd bay contract that was partly implemented by state engineers and a local association [98]. Despite watershed management prioritizing shellfish and fishing activities, sectorial measures were unable to stop sanitary crises and the lagoon downgrading was enforced in 2004 (a depuration was then required before human consumption). In the frame of the WFD and in exchange for the funding of the next action plan, the French State and the Water Agency (public institution in charge of implementing the objectives and provisions of the French management plans of the WFD) proposed the creation of a public organization in charge of land-use planning, water management and protected areas conservation. The "Syndicat Mixte du Bassin de Thau" (French acronym SMBT) was created in 2005 based on intercommunal collaboration and lead by elected officials. From the beginning, the SMBT was dedicated to apply Integrated Coastal Zone Management (ICZM) principles [99] and as such took a role of mediation and translation. The SMBT's positioning between technical and scientific knowledge, administrative procedures and local stakeholders profoundly changed the collaboration practices. Committed to the integration of sectorial public actions with exemplary participatory process, the SMBT facilitated connections between multiple governance units and stakeholders [97]. The specificity of this organization relies on its involvement in a combined diagnosis for land planning and water management, looking for consistency in local directives. Currently the SMBT intends to integrate a regional scheme for green and blue infrastructures.

3.2. Research Dynamics

Twenty research projects have been identified from 1986 to 2017, which corresponds approximately to 100 cumulated years of funded activities. The data collection is summarized in Appendix A. The relevant information is sorted based on the project' boundaries (temporal duration and spatial extent), research object, funding opportunity and coordinator. While the spatial extent progressively shifted from the lagoon to the watershed and the intermunicipalities level (called *territoire* in French), the research topics switched from mainly ecologically oriented to a more comprehensive perspective including social sciences. On the basis of respective objectives and challenges, six research objects (e.g., scientific topics) are attributed to groups of projects: 1. Lagoon ecosystem, 2. Flows from watershed, 3. Lagoon water quality, 4. Karstic aquifer, 5. Innovative management and 6. Global changes.

Note that this inventory does not grasp studies that were conducted out of the framework of a multiyear funded project, while many research activities can occur simultaneously and be important in the global dynamic. For example, a PhD dissertation [97] concerning the Thau territorial diagnosis triggered other researches, ranging from environmental evaluation [100] to detecting opinion in planning documents [101]. This PhD resulted in the involvement of new scientific disciplines. Other activities may also come from a more detailed analysis of data collected in previous projects. For example, based on previous stakeholder's interview records, analysis of the narrative dimension of public policy highlights the prominent role played by politics in the social regulation of water use [102]. Finally, multiple co-occurring funded projects procured researchers with co-funding opportunities, for example, in works concerning flows of pollutants from the watershed to the lagoon [103,104].

3.3. Synthetic Timeline

The timeline presented in Figure 4 synthetizes both territorial evolution and research projects dynamics in a single graphical illustration. It is organized by horizontal bands, with the upper x-axes related to events, public action, planning and policies, and the rest representing the dynamics of research activities (topics and investigations). Note that a distinction is made between scientific coordinated research projects and "boundary" projects, e.g., research projects managed by territorial stakeholders (see "Coordinator" column in Table A1 in Appendix A).

The timeline first highlights the multilayered and successive scientific and development projects deployed in Thau. In the late 1980s, the sequencing of sanitary events coincided with the structuration of research activities on lagoon ecosystems, followed by a progressive consideration of watershed inputs in research projects and sustained investment on sewage infrastructures. Occasional studies on the functioning of the karstic aquifer have been carried out following events of intrusion of salty water from the lagoon into an underwater freshwater spring.

The synthetic timeline does not show any redundancy concerning research topics. Increasingly detailed understanding of the biophysical functioning and its embedding in sociopolitical processes have been achieved through mutually helpful works. For example, better knowledge on lagoon ecosystems (Chantier Lag. Med.) and on freshwater resources quality (TEMPQSIM) were combined in the RESTHAU project making the link between land and lagoon waters. These projects then permitted the building of integrative modeling and management tools to support political and economic decisions (DITTY, SPICOSA and OMEGA THAU projects). Continuity of research themes and involvement of the same actors may explain the good articulation of researches in terms of disciplines involved. However, the sequential shift from ecology to global change via social issues hides an imbalance between research objects and scales: the lagoon attracted much of the attention for the last 31 years, and sometimes a lack of connections between research projects (for example SYSCOLAG with the rest of research projects of topic 5). Despite some considerations or difficulties in between research teams, the timeline also reveals that research and planning activities were mutually helpful from 2005, with an overall consistency between research and management scales and temporalities. Hence, the establishment of an intermediate organization and confident relationships between scientists and managers supported continuity in actions and shared knowledge.

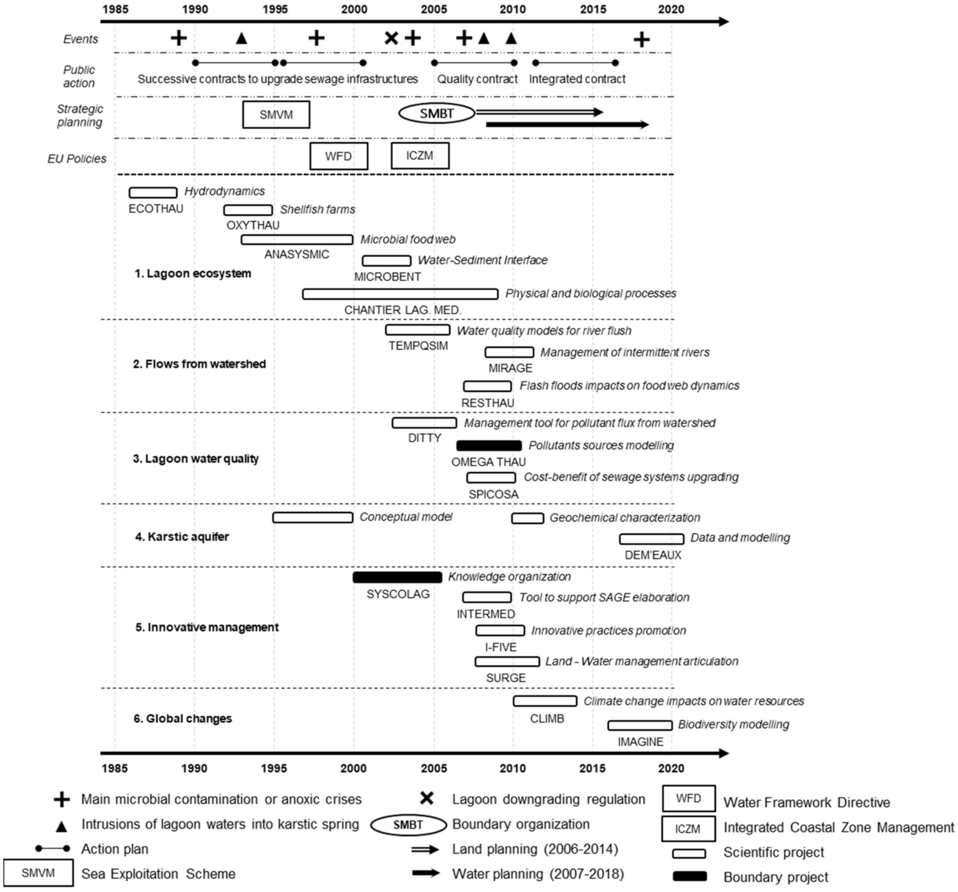

Figure 4. A representation of territorial evolution and the dynamics of research projects on the Thau case study.

The institutional emulation that enforced the establishment of an engineering structure for resource planning (SMBT) initiated a change in collaboration practices between scientists and managers. Indeed, a period of cross-fertilization appears from the creation of the SMBT in 2005, with both researchers and managers contributing to knowledge production and local planning. It suggests the presence of a transition between two regimes, which is corroborated by a quantitative evaluation of knowledge and action (slope variations in Figure 5). To go further in tackling synchronicity, the creation of the SMBT in 2005 will be considered as a transition in the evolution of the system's arrangement, and two distinct periods will be analyzed (before and after 2005).

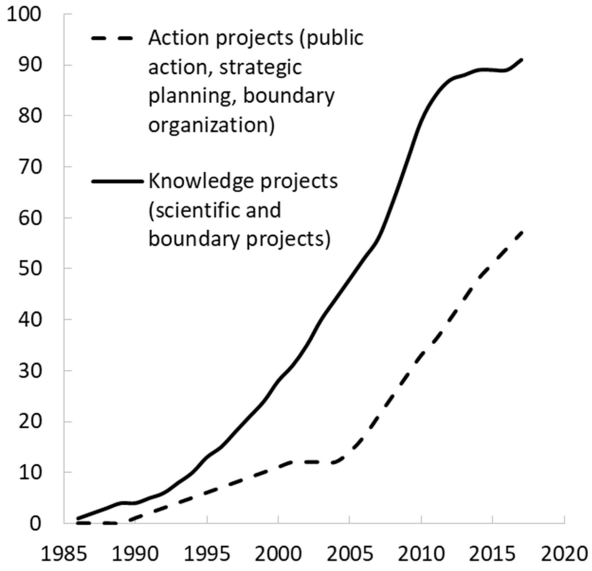

Figure 5. Evolution of the number of years of funded projects through time (cumulated).

3.4. Narrative

The period 1985–2005 can be described by the situational influence of sanitary issues on the scientific questioning and public action. While the socio-economic context pressed the development of sewage infrastructures, the succession of social–ecological crises called for deeper integration between scientific disciplines. Scientific activities, initially focused on different ecological subsystems of the lagoon, operated a gradual transformation through interdisciplinary coupling of modelling approaches. Data aggregation tools certainly played a fundamental role in the interfacing of ecological and economic disciplines. Concerning territorial management, accumulation of evidence about quantitative and qualitative feedback effects of human activities on natural resources helped to perceive the systemic nature of sanitary problems and the need for integrated management (human health, economic activities, and environmental state). However, the lack of an intermediate organization to manage the bay contracts did not facilitate knowledge appropriation and resulted in a relative partitioning of research and development trajectories. Indeed, despite the rapid emergence of explicit willingness for interactions [105], a 2005 survey of scientists and local stakeholders revealed the absence of knowledge capitalization to support policy decision. The boundary project (SYSCOLAG) assumed an early transdisciplinary approach for the experimentation of a knowledge-pooling system to improve the communication between natural and social scientists’ and with territorial managers [106]. The organization of a network of research laboratories with regional organizations supported the funding and coordination of the project, led by a social organization dedicated to coastal management and activities. By the proposition of a breeding ground between research and public action, this multidisciplinary research project set the stage for a collaborative change.

An intermediate public body was introduced in 2005, corresponding to a period of European steering up of integration between sectoral policies (ICZM). Both researchers and stakeholders benefited from the institutional emulation around water management. The SMBT was built on the necessity of a multidisciplinary staff capacity to facilitate communication and turn knowledge into action. During the second period (2005–2017), two types of interactions co-occurred.

First, the SMBT launched and managed the boundary project (OMEGA THAU) in the framework of the quality contract. Its objective was twofold: (1) diagnose the main microbiological contaminations sources to prioritize public investment, and (2) develop an early warning system concerning lagoon contamination [107]. The first step consisted in the transformation of scientific databases into Geographic Information Systems and in the use of simulation techniques to develop applications for the design and assessment of management pathways. The SMBT helped structuring the collaboration between scientists, municipalities and the involvement of private engineering consultants. This interface positioning promoted the building of a system pooling added values competences and transformation of scientific outputs into outcomes. The second step aimed at delivering a forecasting tool to shellfish farmers. However, the development of an early warning system has so far been met with poor success because its projections are subject to as much uncertainty as weather forecasts [108].

Second, the SMBT's commitment to the ICZM principles for the participation of multiple resource users revealed to be an opportunity for social scientists. More specifically, the SMBT's engagement in water and land planning have been supported and analyzed by researchers from the Montpellier academic community. For example, the 2008–2012 period ("Innovative management" x-axe in Figure 4) is marked by various action-oriented projects to track and facilitate the water planning implementation process through innovative governance. Developed with joint scientific board members, these projects were dedicated to interviews with local stakeholders, observations of thematic commissions (e.g., elected officials from local authorities, users and state representatives gathered to elaborate, revise and follow water planning applications), proposal of participatory tools and organization of workshops for a prospective approach. In complement to the projects listed, scientists provided methodological support for the participatory processes of land planning, among which are 3D physical models for the purpose of mediation [97] and inventory of *Zostera* spp. seagrass based on local knowledge [98]. Finally and afterwards, the SYSCOLAG proposal for environmental impacts indicators revealed to be a crucial support in land planning [109].

Finally, the SMBT successfully transformed interactions between researchers and natural resource management and favored the emergence of a new sociotechnical arrangement, enabling feedback loops between the knowledge production and its use in support of public actions. Stakeholders and decision makers directly took part in scientific projects, and researchers contributed to integrated development projects. The Thau case study is representative of a coevolution process where research and management organizations have intertwined dynamics and contribute to improve territorial adaptive capacities. The articulation of social and ecological dynamics was considered an exemplary case study at a regional scale: the lagoon became an object of cooperation changing of Thau's *image* [102] into an inspiring *territoire,* where governance is closely tied to the maintenance of its ecological integrity (learning from practice and research).

4. Discussion

With regard to on-the-ground changes, they may be difficult to relate to specific research activities, but the results show the increase in the complexity of sociopolitical interactions through the evolution of the collaborative process. Many works today are tackling social–ecological outcomes, for example, concerning the Thau image [102], local observatories [110], or ecological impacts on the lagoon ecosystems [111,112]. The following discussion will be centered on the methodological contributions and mention these impacts.

4.1. Thau, a Typical Case Study

The Thau *territoire* presents persistent environmental problems that have been tackled for the last 30 years through technical infrastructures (massive works on waste water collection and treatment). Shellfish farming economic activities pressed for the constant improvement of lagoon water quality. From 2005, the appropriation of land resources by local actors and their engagement in local planning is explained by the creation of a joint engineering planning social infrastructure. Supported by participatory research activities [113], the SMBT triggered an empowerment sequence [114]. In terms of ecological impacts, the decrease in nutrient discharges from the watershed led to the lagoon oligotrophication, with a shift in the eutrophication process during the period 2003–2006 [111].

The lagoon ecosystem is now more resistant to the threat of summer heat waves and anoxic crises [112], but the *territoire* is facing new issues driven by climatic change trends, which is expected to influence the observed recovery process.

Some inspiring multidisciplinary approaches emerges for the study of the ecological restoration trajectory of coastal lagoons [115]. The ecological shift coincides with the change identified in collaboration practices between scientists and managers, revealed by the complexification of trajectories between projects and organizations. Explicative factors of this transformation are multiple, but the allocation of specific human resources devoted to orchestrate capacities is pivotal in the coevolution trajectory [40,41].

Interactive dynamics are being currently triggered by multiple innovations that are linked together [116], which combined have further impacts on the systems configuration [117]. Today, any environmental project on Thau operates within a complex system of interacting actors [39]. For example, a series of scientific studies in relation to the IMAGINE project (cf. Table A1 and Figure 4) explored how to adapt the ecosystem services concepts in territorial planning in a context of ecological transition and climate change adaptation. First, social assessment (participative workshops) aimed the identification of land functions from land categories in order to produce an "ecosystemic services map" [118]. Second, these maps were aggregated by typology of service (like food provision or flood risks) and then used as boundary objects in a workshop with practitioners. It resulted in a transformation of participants' perspective, from a zonal reading with land-use map to a multifunctional understanding [119].

Shared opportunities, joint learning and network embeddedness and awareness drives a gradual transition in collaboration practices, towards a functional interfacing where scientists and managers are partners that negotiate what is feasible, desirable, and acceptable. First, the next action plan lead by the SMBT (2019–2025) has been elaborated by a collective of researchers, stakeholders and decision makers through working groups and calls for contribution. The exchanges with research laboratories reveals the role of scientists within the organization and the support of research activities in management actions. This bottom-up logic helped structure the ideas and identify a list of actions that will be adapted during the course of the plan. The contract will be supported by a regional investment in a territorial platform for innovation, the "Lab'Thau", enabling the SMBT to experiment ecological transition (from problem-oriented to solution-oriented). This approach aims to foster the collaboration between academia, government and private sector [120]. Second, scientific communities are up to structure their efforts with managers through a dedicated research infrastructure to support interdisciplinary communities to share observations and experiment new technics and/or practices. Encouraging collaborative practices, managers' involvement in the long-term social-ecological research observatory elaboration process has been reached through participative workshops. Thau is expected to benefit from these new forms of research platforms situated in pilot *territoires*, with extended partnerships—including "tech" private initiatives—to foster broader impacts.

4.2. Systemic Timeline Multistep Methodology

The STM methodology relies upon a schematic representation of the main ecological conservation projects and their environmental and contextual factors. Regarding co-production principles [10], the building of a boundary object is expected to help organize interactive processes for collective learning, informing both scientists and decision makers about collaborative pathways and their articulation through time. The coevolution perspective facilitates cross-interpretation of trajectories and supports reflection for the implementation and the sustainment of transdisciplinary research.

While its implementation on a *territoire* gives a simplified model of the reality, it grasps a global vision of the dynamics of the collaborative process. Obviously, such hindsight does not account for the intensive and time-consuming translation process, where agency scientists and institutional involvement are precious (Messerli and Messerli 2008, Grove et al. 2016, Miller and Wyborn 2020). Scientific literature also reports the crucial importance of social and interpersonal factors [76], which tend to be overlooked in the STM methodology. However, the methodology is built upon systemic factors for the achievement of knowledge-use-centered approaches, which facilitates effective collaboration across disciplines and actors [121]. Hence, the STM methodology may be regarded as a mechanistic perspective on human relationships, which are implicitly considered as functionally oriented (illustrated by the wheels in Figure 2). Doing so is helpful in a retrospective study because many people that worked a few decades ago have gone (retirement can be associated to a lost in knowledge), and the objective is not to put emphasis on specific personalities, even if some competencies are crucial for collaborative works [122] and sustainability science [123]. Hence, the STM methodology does shed light on facilitating actors and activities to ensure a common understanding of ill-defined problems and the definition of shared objectives [40].

Typical case studies provide critical opportunity to question the multiple forms of boundary works and their transformative functions [41]. For Thau, it results that loops are sufficiently visible to be grasped by the methodology. The next step is to investigate the replicability of the method on other case studies (for example LTER study sites, comparable places). Moreover, the former and current decision makers' perspectives need to be explored, for example, using the synthetic timeline as an object of mediation. Sharing the lessons learned and exchanging constructive arguments [92,94] on the requests formulated by decision makers and their relations with scientists and knowledge would contribute to the attempt of combining research activities and water governance. Connecting with a public policy perspective' [124] and ecological restoration [115] is expected to help relating environmental outcomes to organizational patterns [19].

4.3. Science and Practice Interfacing

Situated practice of research, open to hybrid scientific knowledge and socially accountable, is a lever for sustainability transitions [125]. However, the current model of science is pushing researchers to justify the territorial anchorage of their research projects and provide evidence of broader impacts [39], although beneficial change takes a while and is often difficult to relate to projects (research outcomes need time and public actions have diffuse impacts). This flight to operationalization of knowledge erodes traditional frontiers between actors engaged in environmental projects [113], speeds up and shortens collaborative periods, and finally questions the respective roles of scientists and practitioners [7]. Safeguards certainly contribute to prevent from blurry interactions. For example, in long-term scientific platforms [38], scientists experience a stakeholder' posture through their involvement in collective actions, accepting to reposition themselves and to consider research as a social activity. As observed in competency groups [126], there is a switch from project oriented actions to process oriented activities. It thus puts emphasis on boundary objects, organizations and spaces that support social meeting, exchanges and transformations while ensuring functional and operational interfacing [127].

In the present day, open data and open science are mainstreamed in the will to secure information during the process of a research project. Beyond harmonization issues, it can help keeping track of knowledge production (capitalization issue). With regard to knowledge co-production, the elaboration of an information sharing system can be considered as an integration mechanism in a "complex social process" between researchers and practitioners [121]. In practice, an information system may take advantage of new data streams (remote sensing, local sensors, and social media) to develop community indicator systems. Many related initiatives arise in Thau to exploit data disseminated among different research laboratories, engineering consultants, local communities and nature associations. For example, a shellfish farms observatory aims to optimize cultivation practices and product quality, and another action consists in the capitalization of available hydrogeological data. Still, improving territorial management via information systems is a daunting task [108,110], where overall success is the result of a negotiated iterative strategy.

5. Conclusions

While global change issues urge for leveling-up human capacity to organize collectively (long-term vision and uncertainties consideration), cooperation is more and more acknowledged as a key function of any project targeting sustainable management and as the cornerstone for natural resource stewardship. Inherent interactions exist between research and management organizations, but they do not always result in effective collaboration, defining its success in terms of coordination and integration of knowledge and action in diverse forms. A system's perspective on research and development activities helps navigate the diversity of organizations and interactions among them which produce a wide variety of arrangements. Moreover, transdisciplinary collaborations analysis brings a strategic perspective on human–nature interactions and opens new tracks for territorial diagnosis and for supporting action-research governance.

To question coevolution, we propose a descriptive framework of the transdisciplinary process as a local sociotechnical system embedded in a *territoire*, a concept used to grasp perpetual modification of the relations of proximity between the actors of the system and between them and their environment. The spatial and temporal integration of data and knowledge on environmental conservation projects is expected to bring useful support to trace human–nature interactions and to explain levers of change in the co-production process. Based on an efficient and innovative way of investigating the place of long-term research in the adaptation of a *territoire*, the Systemic Timeline Methodology (STM) enriches the sense of place and envisions coevolution trajectories. Its operationalization relies on tracing, illustrating and analyzing the coupled dynamics of research projects and management pathway. It may add reflexivity to local actors about their role in the observed social and ecological evolutions (explicit will or exogenous factor, cross-fertilization process), highlighting the multiple forms of boundary works and their transformative function while helping conserving diversity in the roles of respective organizations.

The STM methodology has been developed for the diagnosis of a case study, and successively applied to the coastal Thau *territoire*, which provides great insights for knowledge and action interfacing. Research and development projects have a long history of coevolution and show high dependency of Thau lagoon's water quality to spatial planning in the catchment. Scientific activities and public actions shaped each other in a continuous process of interaction. Driving factors supporting successful collaboration practices on the Thau case study are numerous and interwoven: societal events, institutional entrepreneurship and scientific trends played a fundamental role in the building of a favorable arrangement, but long-term monitoring, data accessibility and knowledge pooling have benefited from the presence of a boundary organization to create and maintain a co-production space which facilitates the production of transformative knowledge.

Future work perspectives arise for the improvement of the STM methodology: (i) continuation of reflective works about past and on-going collaboration in the Thau *territoire*, (ii) testing its implementation on other cases studies, and (iii) connecting organizational arrangements with environmental outcomes.

Author Contributions: Conceptualization, K.D. and C.W.; methodology, K.D. and C.W.; validation, P.M., F.C. (Flavie Cernesson) and V.D.; investigation, K.D.; writing—original draft preparation, K.D., C.W. and F.C. (François Colin); writing—review and editing, All authors; visualization, K.D.; supervision, C.W.; project administration, C.W.; funding acquisition, C.W. and F.C. (François Colin). All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the I-SITE MUSE (Montpellier University of Excellence) and the WATERS Key Initiative.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful to the consortium of researchers from different joint research units in Montpellier, with special thanks to S. Barone, O. Barreteau, J-P. Chery, N. Devaux, B. Devillers, P. Garin, S. Ghiotti, P. Lemoisson, S. Luque, J-C. Maréchal, P. Monfort, B. Mostajir, E. Pitard, H. Rey-Valette, C. Salles, B. Schatz and M. Teisseire. We are also grateful to SMBT engineers and scientists who gave their operational insights. Finally, the authors would like to gratefully thank O. Barreteau and two anonymous reviewers for their fruitful insights on transdisciplinary research and knowledge co-production.

Appendix A

This appendix presents the listing of research projects inventoried during the data collection step for the Thau case study (Table A1). Note that six research objects (e.g., scientific topics) are attributed to groups of projects: 1. Lagoon ecosystem, 2. Flows from watershed, 3. Lagoon water quality, 4. Karstic aquifer, 5. Innovative management and 6. Global changes.

Table A1. List of research project concerning the Thau *territoire* (Eur. stands for Europe, Nat. for National, Reg. for Regional).

Project Acronym	Duration	Spatial Extent	Research Topic (Object)	Funding Opportunity	Coordinator	Illustrative Reference
ECOTHAU	1986–1989	Lagoon	Ecosystem compartments, hydrodynamic simulation (1.)	PIREN (Nat.)	CNRS	[128]
OXYTHAU	1991–1995	Lagoon	Resource-environment relationship: biogeochemical cycles and shellfish farms (1.)	PNOC (Nat.)	IFREMER	
ANASYSMIC	1993–2000	Lagoon	Microbial food web, picoplankton (1.)	UMR n°5 (Reg.)	IFREMER	
	1995–2000	Karstic aquifer	Hydrogeological functioning (4.)	French administrative department (Reg.)	BRGM	[129]
SYSCOLAG	2000–2006	Lagoon + sea coast	Maritime economy, knowledge identification and indexation (5.)	Government-Region plan	Cépralmar	[106]
MICROBENT	2001–2003	Lagoon	Biogeochemical processes at the water–sediment interface, mobility of metallic contaminants (1.)	PNEC (Nat.)	IFREMER	[130]
Chantier Lagunes Méditerranéennes	1997–2009	Lagoon + watershed	Biological and hydrodynamic models, biogeochemical composition and human activities (1.)	PNOC (Nat.), PNEC (Nat.)	IFREMER	[103,131]
TEMPQSIM	2002–2006	Sub-watershed	Intermittent river: water quality modelling and pollutant exportation (2.)	FP5-EESD (Eur.)	IRD	[132]
DITTY	2003–2006	Intermunicipality	Lagoon microbial contamination, bacterial fluxes reduction measures (3.)	FP5-EESD (Eur.)	Ifremer & CNRS	[133]
SPICOSA	2007–2009	Intermunicipality	Microbial contamination, sewage treatment systems, macroeconomic analysis, governance mechanisms (3.)	FP6-SUSTDEV (Eur.)	IFREMER	[134]
OMEGA THAU	2007–2010	Lagoon + watershed	Management tool, environmental crises, early warning system (3.)	Quality contract (Reg., Nat.)	SMBT & IFREMER	[107]
RESTHAU	2007–2010	Lagoon + watershed	River flash floods, food web dynamics (2.)	EC2CO (Nat.)	CNRS	[135]
Intermed	2007–2010	Intermunicipality	Open infrastructure, consultation, implementation of management plans (5.)	ANR (Nat.)	INRAE	[136]
I-FIVE	2008–2011	Intermunicipality	Instruments and institutions, WFD implementation at local scale (5.)	FP6-ERA-NET IWRM-NET (Eur.)	INRAE	[137]

Table A1. *Cont.*

Project Acronym	Duration	Spatial Extent	Research Topic (Object)	Funding Opportunity	Coordinator	Illustrative Reference
SURGE	2008–2012	Intermunicipality	Companion modelling, workshops with stakeholders, information sharing (5.)	Eaux et Territoires (Nat.)	INRAE	[138]
MIRAGE	2009–2011	Sub-watershed	Water management, WFD and intermittent rivers (2.)	FP7-ENVIRONMENT (Eur.)	Univ. Montpellier	[139]
	2010–2012	Karstic aquifer	Geochemical characterization, quantitative contributions (4.)	French administrative region (Reg.)	BRGM	[140]
CLIMB	2010–2014	Watershed	Water scarcity, climatic projections (6.)	FP7-ENVIRONMENT (Eur.)	Univ. Tours	[141]
IMAGINE	2017–2020	Intermunicipality	Multispecies distribution models, connectivity hotspots (6.)	Biodiversa (Eur.)	INRAE	[118]
DEM'EAUX	2017–2021	Karstic aquifer	Management tool, complex phenomenon (4.)	Government-Region plan	BRGM	Ongoing project

References

1. Coutellec, L.; Schmid, A.-F. La difficile construction d'un commun dans les sciences. Crise pandémique et éthique de la recherche. *Nat. Sci. Soc.* **2020**, *28*, 214–215. [CrossRef]
2. Folke, C.; Polasky, S.; Rockström, J.; Galaz, V.; Westley, F.; Lamont, M.; Scheffer, M.; Österblom, H.; Carpenter, S.R.; Chapin, F.S.; et al. Our Future in the Anthropocene Biosphere. *Ambio* **2021**, *50*, 834–869. [CrossRef]
3. Larrue, C. Recherche et politiques publiques environnementales: Vers un modèle d'interactions. *Nat. Sci. Soc.* **2017**, *25*, S12–S17. [CrossRef]
4. Lyall, C.; Bruce, A.; Tait, J.; Meagher, L. *Interdisciplinary Research Journeys: Practical Strategies for Capturing Creativity*; Bloomsbury Academic: London, UK, 2011; ISBN 978-1-84966-013-6.
5. Jollivet, M. Une recherche ouverte sur l'action publique. *Nat. Sci. Soc.* **2017**, *25*, S21–S28. [CrossRef]
6. Klein, J.T. Sustainability and Collaboration: Crossdisciplinary and Cross-Sector Horizons. *Sustainability* **2020**, *12*, 1515. [CrossRef]
7. Knapp, C.N.; Reid, R.S.; Fernández-Giménez, M.E.; Klein, J.A.; Galvin, K.A. Placing Transdisciplinarity in Context: A Review of Approaches to Connect Scholars, Society and Action. *Sustainability* **2019**, *11*, 4899. [CrossRef]
8. Max-Neef, M.A. Foundations of Transdisciplinarity. *Ecol. Econ.* **2005**, *53*, 5–16. [CrossRef]
9. Hadorn, G.H.; Hoffmann-Riem, H.; Biber-Klemm, S.; Grossenbacher-Mansuy, W.; Joye, D.; Pohl, C.; Wiesmann, U.; Zemp, E. (Eds.) *Handbook of Transdisciplinary Research*; Springer: Dordrecht, The Netherlands, 2008; ISBN 978-1-4020-6698-6.
10. Norström, A.V.; Cvitanovic, C.; Löf, M.F.; West, S.; Wyborn, C.; Balvanera, P.; Bednarek, A.T.; Bennett, E.M.; Biggs, R.; de Bremond, A.; et al. Principles for Knowledge Co-Production in Sustainability Research. *Nat. Sustain.* **2020**, *3*, 182–190. [CrossRef]
11. Zscheischler, J.; Rogga, S.; Busse, M. The Adoption and Implementation of Transdisciplinary Research in the Field of Land-Use Science—A Comparative Case Study. *Sustainability* **2017**, *9*, 1926. [CrossRef]
12. Thondhlana, G.; Mubaya, C.P.; McClure, A.; Amaka-Otchere, A.B.K.; Ruwanza, S. Facilitating Urban Sustainability through Transdisciplinary (TD) Research: Lessons from Ghana, South Africa, and Zimbabwe. *Sustainability* **2021**, *13*, 6205. [CrossRef]
13. Hassing, J.; Unesco. World Water Assessment Programme (United Nations). In *Integrated Water Resources Management in Action: Dialogue Paper*; UNESCO: Paris, France, 2009; ISBN 978-92-3-104114-3.
14. Linton, J.; Budds, J. The Hydrosocial Cycle: Defining and Mobilizing a Relational-Dialectical Approach to Water. *Geoforum* **2014**, *57*, 170–180. [CrossRef]
15. Massuel, S.; Riaux, J.; Molle, F.; Kuper, M.; Ogilvie, A.; Collard, A.-L.; Leduc, C.; Barreteau, O. Inspiring a Broader Socio-Hydrological Negotiation Approach With Interdisciplinary Field-Based Experience. *Water Resour. Res.* **2018**, *54*, 2510–2522. [CrossRef]
16. Abbott, B.W.; Bishop, K.; Zarnetske, J.P.; Minaudo, C.; Chapin, F.S.; Krause, S.; Hannah, D.M.; Conner, L.; Ellison, D.; Godsey, S.E.; et al. Human Domination of the Global Water Cycle Absent from Depictions and Perceptions. *Nat. Geosci.* **2019**, *12*, 533–540. [CrossRef]
17. Boelens, R.; Hoogesteger, J.; Swyngedouw, E.; Vos, J.; Wester, P. Hydrosocial Territories: A Political Ecology Perspective. *Water Int.* **2016**, *41*, 1–14. [CrossRef]
18. Barone, S. SCoT est-il plus SAGE ? Gestion de l'eau et aménagement du territoire en France depuis la loi du 21 avril 2004. *Vertigo* **2012**, *12*, 17. [CrossRef]
19. Baudoin, L.; Arenas, D. From Raindrops to a Common Stream: Using the Social-Ecological Systems Framework for Research on Sustainable Water Management. *Organ. Environ.* **2020**, *33*, 126–148. [CrossRef]

20. Swyngedouw, E. The Political Economy and Political Ecology of the Hydro-Social Cycle. *J. Contemp. Water Res. Educ.* **2009**, *142*, 56–60. [CrossRef]
21. Miller, T.R.; Baird, T.D.; Littlefield, C.M.; Kofinas, G.; Chapin, F.S., III; Redman, C.L. Epistemological Pluralism: Reorganizing Interdisciplinary Research. *Ecol. Soc.* **2008**, *13*, art46. [CrossRef]
22. Frodeman, R. *Sustainable Knowledge*; Palgrave Macmillan UK: London, UK, 2014; ISBN 978-1-349-45405-1.
23. Liehr, S.; Röhrig, J.; Mehring, M.; Kluge, T. How the Social-Ecological Systems Concept Can Guide Transdisciplinary Research and Implementation: Addressing Water Challenges in Central Northern Namibia. *Sustainability* **2017**, *9*, 1109. [CrossRef]
24. Schlüter, M.; Müller, B.; Frank, K. The Potential of Models and Modeling for Social-Ecological Systems Research: The Reference Frame ModSES. *Ecol. Soc.* **2019**, *24*, art31. [CrossRef]
25. Berkes, F.; Folke, C.; Colding, J. (Eds.) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 1998; ISBN 978-0-521-59140-9.
26. Colding, J.; Barthel, S. Exploring the Social-Ecological Systems Discourse 20 Years Later. *Ecol. Soc.* **2019**, *24*, art2. [CrossRef]
27. Chapin, F.S.; Carpenter, S.R.; Kofinas, G.P.; Folke, C.; Abel, N.; Clark, W.C.; Olsson, P.; Smith, D.M.S.; Walker, B.; Young, O.R.; et al. Ecosystem Stewardship: Sustainability Strategies for a Rapidly Changing Planet. *Trends Ecol. Evol.* **2010**, *25*, 241–249. [CrossRef]
28. Peçanha Enqvist, J.; West, S.; Masterson, V.A.; Haider, L.J.; Svedin, U.; Tengö, M. Stewardship as a Boundary Object for Sustainability Research: Linking Care, Knowledge and Agency. *Landsc. Urban Plan.* **2018**, *179*, 17–37. [CrossRef]
29. West, S.; van Kerkhoff, L.; Wagenaar, H. Beyond "Linking Knowledge and Action": Towards a Practice-Based Approach to Transdisciplinary Sustainability Interventions. *Policy Studies* **2019**, *40*, 534–555. [CrossRef]
30. Holling, C.S. (Ed.) *Adaptive Environmental Assessment and Management*; International series on applied systems analysis; International Institute for Applied Systems Analysis; Wiley: Laxenburg, Austria; Chichester, UK; New York, NY, USA, 1978; ISBN 978-0-471-99632-3.
31. Lee, K. Appraising Adaptive Management. In *Biological Diversity*; Buck, L., Geisler, C., Schelhas, J., Wollenberg, E., Eds.; CRC Press: Boca Raton, FL, USA, 2001; pp. 3–26. ISBN 978-0-8493-0020-2.
32. Kiteme, B.P.; Wiesmann, U. Sustainable River Basin Management in Kenya: Balancing Needs and Requirements. In *Handbook of Transdisciplinary Research*; Hadorn, G.H., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., Zemp, E., Eds.; Springer: Dordrecht, The Netherlands, 2008; pp. 63–78. ISBN 978-1-4020-6698-6.
33. Callahan, J.T. Long-Term Ecological Research. *BioScience* **1984**, *34*, 363–367. [CrossRef]
34. Leveque, C.; Pave, A.; Abbadie, L.; Weill, A.; Vivien, F. Les zones ateliers, des dispositifs pour la recherche sur l'environnement et les anthroposystèmes: Une action du programme "Environnement, vie et sociétés" du CNRS. *Nat. Sci. Soc.* **2000**, *8*, 43–52. [CrossRef]
35. Ohl, C.; Johst, K.; Meyerhoff, J.; Beckenkamp, M.; Grüsgen, V.; Drechsler, M. Long-Term Socio-Ecological Research (LTSER) for Biodiversity Protection—A Complex Systems Approach for the Study of Dynamic Human–Nature Interactions. *Ecol. Complex.* **2010**, *7*, 170–178. [CrossRef]
36. Krohn, W. Learning from Case Studies. In *Handbook of Transdisciplinary Research*; Hadorn, G.H., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., Zemp, E., Eds.; Springer: Dordrecht, The Netherlands, 2008; pp. 369–383. ISBN 978-1-4020-6698-6.
37. Collins, S.L.; Carpenter, S.R.; Swinton, S.M.; Orenstein, D.E.; Childers, D.L.; Gragson, T.L.; Grimm, N.B.; Grove, J.M.; Harlan, S.L.; Kaye, J.P.; et al. An Integrated Conceptual Framework for Long-term Social–Ecological Research. *Front. Ecol. Environ.* **2011**, *9*, 351–357. [CrossRef]
38. Bretagnolle, V.; Benoit, M.; Bonnefond, M.; Breton, V.; Church, J.M.; Gaba, S.; Gilbert, D.; Gillet, F.; Glatron, S.; Guerbois, C.; et al. Action-Orientated Research and Framework: Insights from the French Long-Term Social-Ecological Research Network. *Ecol. Soc.* **2019**, *24*, art10. [CrossRef]
39. Belcher, B.M.; Claus, R.; Davel, R.; Ramirez, L.F. Linking Transdisciplinary Research Characteristics and Quality to Effectiveness: A Comparative Analysis of Five Research-for-Development Projects. *Environ. Sci. Policy* **2019**, *101*, 192–203. [CrossRef]
40. Palmer, M.A.; Kramer, J.G.; Boyd, J.; Hawthorne, D. Practices for Facilitating Interdisciplinary Synthetic Research: The National Socio-Environmental Synthesis Center (SESYNC). *Curr. Opin. Environ. Sustain.* **2016**, *19*, 111–122. [CrossRef]
41. Bremer, S.; Meisch, S. Co-Production in Climate Change Research: Reviewing Different Perspectives: Co-Production in Climate Change Research. *WIREs Clim. Chang.* **2017**, *8*, e482. [CrossRef]
42. Kooiman, J. Social-Political Governance: Overview, Reflections and Design. *Public Manag. Int. J. Res. Theory* **1999**, *1*, 67–92. [CrossRef]
43. Hassenforder, E.; Barone, S. Institutional Arrangements for Water Governance. *Int. J. Water Resour. Dev.* **2019**, *35*, 783–807. [CrossRef]
44. Di Méo, G.; Pitte, J.-R. *Géographie Sociale et Territoires*; Nathan Université: Paris, France, 2001; ISBN 978-2-09-191203-5.
45. Raffestin, C. Space, Territory, and Territoriality. *Environ. Plan. D* **2012**, *30*, 121–141. [CrossRef]
46. Gignoux, J.; Davies, I.D.; Flint, S.R.; Zucker, J.-D. The Ecosystem in Practice: Interest and Problems of an Old Definition for Constructing Ecological Models. *Ecosystems* **2011**, *14*, 1039–1054. [CrossRef]
47. Sayer, J.; Sunderland, T.; Ghazoul, J.; Pfund, J.-L.; Sheil, D.; Meijaard, E.; Venter, M.; Boedhihartono, A.K.; Day, M.; Garcia, C.; et al. Ten Principles for a Landscape Approach to Reconciling Agriculture, Conservation, and Other Competing Land Uses. *Proc. Natl. Acad. Sci. USA* **2013**, *110*, 8349–8356. [CrossRef]

48. Shanahan, E.A.; Jones, M.D.; Mcbeth, M.K.; Radaelli, C.M. The Narrative Policy Framework. In *Theories of the Policy Process*, 4th ed.; Weible, C.M., Sabatier, P.A., Eds.; Routledge: New York, NY, USA; Westview Press: Boulder, CO, USA, 2018; pp. 173–213. ISBN 978-0-429-49428-4.
49. Barreteau, O.; Giband, D.; Schoon, M.; Cerceau, J.; DeClerck, F.; Ghiotti, S.; James, T.; Masterson, V.A.; Mathevet, R.; Rode, S.; et al. Bringing Together Social-Ecological System and Territoire Concepts to Explore Nature-Society Dynamics. *Ecol. Soc.* **2016**, *21*, art42. [CrossRef]
50. Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; da Fonseca, G.A.B.; Kent, J. Biodiversity Hotspots for Conservation Priorities. *Nature* **2000**, *403*, 853–858. [CrossRef] [PubMed]
51. Tierno de Figueroa, J.M.; López-Rodríguez, M.J.; Fenoglio, S.; Sánchez-Castillo, P.; Fochetti, R. Freshwater Biodiversity in the Rivers of the Mediterranean Basin. *Hydrobiologia* **2013**, *719*, 137–186. [CrossRef]
52. Tuel, A.; Eltahir, E.A.B. Why Is the Mediterranean a Climate Change Hot Spot? *J. Clim.* **2020**, *33*, 5829–5843. [CrossRef]
53. Bermond, I. L'aqueduc de l'agglomération antique de Balaruc-les-Bains (Hérault): Aqueducs de la Gaule méditerranéenne. *Galia* **2005**, *62*, 35–48. [CrossRef]
54. Ludovic, C.; Gilles, L.; Fabien, M. Captage et distribution des eaux de la source d'Issanka, 150 ans d'évolution et d'adaptation des infrastructures de la commune de Sète. *Revue d'Histoire et d'Archéologie de Sète et de sa Région* **2018**, *42–43*, 17.
55. Dupaquier, C.; Desbrosse, A.; Maurel, P.; Ruoso, L.-E.; Plant, R.; Roussillon, J.-P. Apports de l'imagerie Pléiades à la Gestion Intégrée des Zones Côtières—Application au territoire de Thau. *RFPT* **2014**, *208*, 45–50. [CrossRef]
56. Gangnery, A.; Bacher, C.; Buestel, D. Assessing the Production and the Impact of Cultivated Oysters in the Thau Lagoon (Mediterranee, France) with a Population Dynamics Model. *Can. J. Fish. Aquat. Sci.* **2001**, *58*, 1012–1020. [CrossRef]
57. Buclet, N.; Donsimoni, M. Dossier « L'économie circulaire: Modes de gouvernance et développement territorial »—Métabolisme territorial et capabilités: Une articulation entre enjeux économiques et écologiques. *Nat. Sci. Soc.* **2020**, *28*, 118–130. [CrossRef]
58. Baron, N. Politique publique du littoral et recherche finalisée: Des pratiques et concepts en co-évolution. *Nat. Sci. Soc.* **2017**, *25*, S36–S41. [CrossRef]
59. Anderies, J.M.; Barreteau, O.; Brady, U. Refining the Robustness of Social-Ecological Systems Framework for Comparative Analysis of Coastal System Adaptation to Global Change. *Reg. Environ. Chang.* **2019**, *19*, 1891–1908. [CrossRef]
60. McPhearson, T.; Pickett, S.T.A.; Grimm, N.B.; Niemelä, J.; Alberti, M.; Elmqvist, T.; Weber, C.; Haase, D.; Breuste, J.; Qureshi, S. Advancing Urban Ecology toward a Science of Cities. *BioScience* **2016**, *66*, 198–212. [CrossRef]
61. Blundo Canto, G.; Barret, D.; Faure, G.; Hainzelin, E.; Monier, C.; Triomphe, B. *ImpreS Ex Ante. An Approach for Building Ex Ante Impact Pathways*; Cirad: Paris, France, 2018; ISBN 978-2-87614-738-6.
62. Pendleton, L.; Evans, K.; Visbeck, M. Opinion: We Need a Global Movement to Transform Ocean Science for a Better World. *Proc. Natl. Acad. Sci. USA* **2020**, *117*, 9652–9655. [CrossRef]
63. Gibbons, M.; Limoges, C.; Nowotny, H.; Schwartzman, S.; Scott, P.; Trow, M. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*; Sage Publications, Inc.: Thousand Oaks, CA, USA, 1994; p. 179. ISBN 0-8039-7793-X.
64. Grove, J.M.; Childers, D.L.; Galvin, M.; Hines, S.; Muñoz-erickson, T.; Svendsen, E.S. Linking Science and Decision Making to Promote an Ecology for the City: Practices and Opportunities. *Ecosyst. Health Sustain.* **2016**, *2*, e01239. [CrossRef]
65. Djenontin, I.N.S.; Meadow, A.M. The Art of Co-Production of Knowledge in Environmental Sciences and Management: Lessons from International Practice. *Environ. Manag.* **2018**, *61*, 885–903. [CrossRef]
66. Harvey, B.; Cochrane, L.; Van Epp, M. Charting Knowledge Co-production Pathways in Climate and Development. *Environ. Policy Gov.* **2019**, *29*, 107–117. [CrossRef]
67. Tejada, G.; Cracco, M.; Bouleau, C.R.; Bolay, J.-C.; Hostettler, S. Testing Analytical Frameworks in Transdisciplinary Research for Sustainable Development. *Sustainability* **2019**, *11*, 4343. [CrossRef]
68. Boon, W.P.C.; Hessels, L.K.; Horlings, E. Knowledge Co-Production in Protective Spaces: Case Studies of Two Climate Adaptation Projects. *Reg. Environ. Chang.* **2019**, *19*, 1935–1947. [CrossRef]
69. Cash, D.W.; Clark, W.C.; Alcock, F.; Dickson, N.M.; Eckley, N.; Guston, D.H.; Jäger, J.; Mitchell, R.B. Knowledge Systems for Sustainable Development. *Proc. Natl. Acad. Sci. USA* **2003**, *100*, 8086–8091. [CrossRef]
70. Frantzeskaki, N.; Rok, A. Co-Producing Urban Sustainability Transitions Knowledge with Community, Policy and Science. *Environ. Innov. Soc. Transit.* **2018**, *29*, 47–51. [CrossRef]
71. Dilling, L.; Lemos, M.C. Creating Usable Science: Opportunities and Constraints for Climate Knowledge Use and Their Implications for Science Policy. *Glob. Environ. Chang.* **2011**, *21*, 680–689. [CrossRef]
72. Brand, F.S.; Jax, K. Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object. *Ecol. Soc.* **2007**, *12*, art23. [CrossRef]
73. Feldhoff; Stockmann; Fanderl; Gahle; Graf; Leger; Sonnberger Bridging Theories and Practices: Boundary Objects and Constellation Analysis as Vehicles for Interdisciplinary Knowledge Integration. *Sustainability* **2019**, *11*, 5357. [CrossRef]
74. Lyall, C.; Fletcher, I. Experiments in Interdisciplinary Capacity-Building: The Successes and Challenges of Large-Scale Interdisciplinary Investments. *Sci. Public Policy* **2013**, *40*, 1–7. [CrossRef]
75. Lyall, C.; Bruce, A.; Marsden, W.; Meagher, L. The Role of Funding Agencies in Creating Interdisciplinary Knowledge. *Sci. Public Policy* **2013**, *40*, 62–71. [CrossRef]
76. Roux, D.J.; Rogers, K.H.; Biggs, H.C.; Ashton, P.J.; Sergeant, A. Bridging the Science-Management Divide: Moving from Unidirectional Knowledge Transfer to Knowledge Interfacing and Sharing. *Ecol. Soc.* **2006**, *11*, art4. [CrossRef]

77. Barreteau, O.; Bots, P.W.G.; Daniell, K.A. A Framework for Clarifying Participation in Participatory Research to Prevent Its Rejection for the Wrong Reasons. *Ecol. Soc.* **2010**, *15*, art1. [CrossRef]
78. Tsoukias, A.; Montibeller, G.; Lucertini, G.; Belton, V. Policy Analytics: An Agenda for Research and Practice. *EURO J. Decis. Processes* **2013**, *1*, 115–134. [CrossRef]
79. Bouleau, G. The Co-Production of Science and Waterscapes: The Case of the Seine and the Rhône Rivers, France. *Geoforum* **2014**, *57*, 248–257. [CrossRef]
80. Miller, C.A.; Wyborn, C. Co-Production in Global Sustainability: Histories and Theories. *Environ. Sci. Policy* **2020**, *113*, 88–95. [CrossRef]
81. Ramankutty, N.; Coomes, O.T. Land-Use Regime Shifts: An Analytical Framework and Agenda for Future Land-Use Research. *Ecol. Soc.* **2016**, *21*, art1. [CrossRef]
82. Geels, F.W. Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study. *Res. Policy* **2002**, *31*, 1257–1274. [CrossRef]
83. Fuenfschilling, L.; Binz, C. Global Socio-Technical Regimes. *Res. Policy* **2018**, *47*, 735–749. [CrossRef]
84. Elissalde, B. Géographie, temps et changement spatial. *Spgeo* **2000**, *29*, 224–236. [CrossRef]
85. Wise, R.M.; Fazey, I.; Stafford Smith, M.; Park, S.E.; Eakin, H.C.; Archer Van Garderen, E.R.M.; Campbell, B. Reconceptualising Adaptation to Climate Change as Part of Pathways of Change and Response. *Glob. Environ. Chang.* **2014**, *28*, 325–336. [CrossRef]
86. Kofinas, G.P. Adaptive Co-management in Social-Ecological Governance. In *Principles of Ecosystem Stewardship*; Folke, C., Kofinas, G.P., Chapin, F.S., Eds.; Springer New York: New York, NY, USA, 2009; pp. 77–101. ISBN 978-0-387-73032-5.
87. Plummer, R.; Crona, B.; Armitage, D.R.; Olsson, P.; Tengö, M.; Yudina, O. Adaptive Comanagement: A Systematic Review and Analysis. *Ecol. Soc.* **2012**, *17*, art11. [CrossRef]
88. Giacona, F.; Martin, B.; Eckert, N.; Desarthe, J. Une méthodologie de la modélisation en géohistoire: De la chronologie (spatialisée) des événements au fonctionnement du système par la mise en correspondance spatiale et temporelle. *Physio Geo* **2019**, *14*, 171–199. [CrossRef]
89. Piovan, S.E. *The Geohistorical Approach Methods and Applications*; Springer: Cham, Switzerland, 2020; ISBN 978-3-030-42439-8.
90. Mathevet, R.; Peluso, N.L.; Couespel, A.; Robbins, P. Using Historical Political Ecology to Understand the Present: Water, Reeds, and Biodiversity in the Camargue Biosphere Reserve, Southern France. *Ecol. Soc.* **2015**, *20*, art17. [CrossRef]
91. Dufour, S.; Piégay, H. From the Myth of a Lost Paradise to Targeted River Restoration: Forget Natural References and Focus on Human Benefits. *River Res. Appl.* **2009**, *25*, 568–581. [CrossRef]
92. Bergeret, A.; Delannoy, J.-J.; George-Marcelpoil, E.; Piazza-Morel, D.; Berthier-Foglar, S.; Bonnemains, A.; Bourdeau, P.; Duval, M.; François, H.; Girard, S.; et al. L'outil-Frise, Dispositif D'étude Interdisciplinaire du Changement Territorial. *EspacesTemps.net* 2015. Available online: https://www.espacestemps.net/articles/loutil-frise-dispositif-detude-interdisciplinaire-du-changement-territorial (accessed on 28 July 2021).
93. Spiegelberger, T.; Bergeret, A.; Crouzat, É.; Tschanz, L.; Piazza-Morel, D.; Brun, J.-J.; Baud, D.; Lavorel, S. Construction interdisciplinaire d'une trajectoire socio-écologique de vulnérabilité à l'exemple du territoire des Quatre Montagnes (Isère, France) de 1950 à 2016. *Revue de Géographie Alpine* **2018**. [CrossRef]
94. Arnaud, F.; Roux-Michollet, D.; Antonio, A.; Carrel, G.; Comby, E.; Durey, L.; Franquet, E.; Graillot, D.; Grelot, F.; Lamouroux, N.; et al. Croiser Les Disciplines et Partager La Connaissance Produite Dans Un Observatoire: Élaboration d'une Frise Chrono-Systémique Pour l'OHM Vallée Du Rhône. In Proceedings of the SAGEO'2018—Conférence Internationale Francophone Spatial Analysis and GEOmatics, Montpellier, France, 6 November 2018.
95. Ostrom, E. A Diagnostic Approach for Going beyond Panaceas. *Proc. Natl. Acad. Sci. USA* **2007**, *104*, 15181–15187. [CrossRef] [PubMed]
96. Zazueta, A.E.; Garcia, J.R. Multiple actors and confounding factors: Evaluating impact in complex social-ecological systems. In *Evaluating Environment in International Development*; Routledge: New York, NY, USA, 2014; p. 18. ISBN 978-1-315-81402-5.
97. Maurel, P. Signes, Données et Représentations Spatiales: Des Eléments de Sens Dans L'élaboration d'un Projet de Territoire Intercommunal: Application au Territoire de Thau. Sciences de L'environnement. Ph.D. Thesis, Université du Sud Toulon Var, Toulon, France, 2012.
98. Plant, R.; Maurel, P.; Barreteau, O.; Bertacchini, Y. The Role of Territorial Intelligence: The Case of the Thau Territory, Southern France. In *River Basin Management in the Twenty-First Century*; CRC Press: Boca Raton, FL, USA, 2014; pp. 446–466. ISBN 978-1-4665-7962-0.
99. Recommendation of the European Parliament and of the Council of 30 May 2002 Concerning the Implementation of Integrated Coastal Zone Management in Europe (2002/413/EC). *Off. J. Eur. Communities* **2002**, *51*, OJ L148. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002H0413 (accessed on 28 July 2021).
100. Loiseau, E.; Roux, P.; Junqua, G.; Maurel, P.; Bellon-Maurel, V. Implementation of an Adapted LCA Framework to Environmental Assessment of a Territory: Important Learning Points from a French Mediterranean Case Study. *J. Clean. Prod.* **2014**, *80*, 17–29. [CrossRef]
101. Kergosien, E.; Laval, B.; Roche, M.; Teisseire, M. Are Opinions Expressed in Land-Use Planning Documents? *Int. J. Geogr. Inf. Sci.* **2014**, *28*, 739–762. [CrossRef]
102. Barone, S. Building a Narrative on Environmental Policy Success. Reflections from a Watershed Management Experience. *Crit. Policy Stud.* **2018**, *12*, 135–148. [CrossRef]

103. Tournoud, M.-G.; Payraudeau, S.; Cernesson, F.; Salles, C. Origins and Quantification of Nitrogen Inputs into a Coastal Lagoon: Application to the Thau Lagoon (France). *Ecol. Model.* **2006**, *193*, 19–33. [CrossRef]
104. Perrin, J.-L.; Tournoud, M.-G. Hydrological Processes Controlling Flow Generation in a Small Mediterranean Catchment under Karstic Influence. *Hydrol. Sci. J.* **2009**, *54*, 1125–1140. [CrossRef]
105. Deslous-Paoli, J.-M. *Proposition de Programme. Atelier: Lagunes Méditerranéennes. Programme: Mise en Valeur des Lagunes Méditerranéennes*; France. 1996. Available online: https://archimer.ifremer.fr/doc/00341/45245/ (accessed on 28 July 2021).
106. Mazouni, N.; Loubersac, L.; Rey-Valette, H.; Libourel, T.; Maurel, P.; Desconnets, J.-C. Syscolag: A Transdisciplinary and Multi-Stakeholder Approach towards Integrated Coastal Area Management. An Experiment in Languedoc-Roussillon (France). *Vie et Milieu* **2006**, *56*, 265–274.
107. Brocard, G.; Derolez, V.; Serais, O.; Fiandrino, A.; Lequette, C.; Marty, D. Omega Thau: Mesurer pour modéliser: Vers la gestion anticipée des pollutions microbiologiques du bassin de Thau. *TSM* **2010**, 95–104. [CrossRef]
108. Paget, N.; Bonté, B.; Barreteau, O.; Pigozzi, G.; Maurel, P. An In-Silico Analysis of Information Sharing Systems for Adaptable Resources Management: A Case Study of Oyster Farmers. *SESMO* **2019**, *1*, 16166. [CrossRef]
109. Valette, H.R.; Damart, S.; Roussel, S. A Multicriteria Participation-Based Methodology for Selecting Sustainable Development Indicators: An Incentive Tool for Concerted Decision Making beyond the Diagnosis Framework. *IJSD* **2007**, *10*, 122. [CrossRef]
110. Lemoisson, P.; Tonneau, J.-P.; Maurel, P. L'intelligence territoriale dans le bassin de Thau: Un observatoire pour penser et piloter l'action. In *Partenariats Pour le Développement Territorial*; Editions Quæ: Versailles, France, 2015; pp. 59–73. ISBN 978-2-7592-2408-1.
111. Derolez, V.; Soudant, D.; Malet, N.; Chiantella, C.; Richard, M.; Abadie, E.; Aliaume, C.; Bec, B. Two Decades of Oligotrophication: Evidence for a Phytoplankton Community Shift in the Coastal Lagoon of Thau (Mediterranean Sea, France). *Estuar. Coast. Shelf Sci.* **2020**, *241*, 106810. [CrossRef]
112. Derolez, V.; Malet, N.; Fiandrino, A.; Lagarde, F.; Richard, M.; Ouisse, V.; Bec, B.; Aliaume, C. Fifty Years of Ecological Changes: Regime Shifts and Drivers in a Coastal Mediterranean Lagoon during Oligotrophication. *Sci. Total. Environ.* **2020**, *732*, 139292. [CrossRef] [PubMed]
113. O'Brien, L.; Marzano, M.; White, R.M. "Participatory Interdisciplinarity": Towards the Integration of Disciplinary Diversity with Stakeholder Engagement for New Models of Knowledge Production. *Sci. Public Policy* **2013**, *40*, 51–61. [CrossRef]
114. Maurel, P.; Plant, R.; Barreteau, O.; Bertacchini, Y. Beyond IWRM: Developing territorial intelligence at the local scales. In *River Basin Management in the Twenty-First Century: People and Place*; CRC Press (Taylor & Francis): Boca Raton, FL, USA, 2014; pp. 22–41.
115. De Wit, R.; Leruste, A.; Le Fur, I.; Sy, M.M.; Bec, B.; Ouisse, V.; Derolez, V.; Rey-Valette, H. A Multidisciplinary Approach for Restoration Ecology of Shallow Coastal Lagoons, a Case Study in South France. *Front. Ecol. Evol.* **2020**, *8*, 108. [CrossRef]
116. Schut, M.; van Paassen, A.; Leeuwis, C.; Klerkx, L. Towards Dynamic Research Configurations: A Framework for Reflection on the Contribution of Research to Policy and Innovation Processes. *Sci. Public Policy* **2014**, *41*, 207–218. [CrossRef]
117. Geels, F.W.; Sovacool, B.K.; Schwanen, T.; Sorrell, S. Sociotechnical Transitions for Deep Decarbonization. *Science* **2017**, *357*, 1242–1244. [CrossRef] [PubMed]
118. Billaud, O.; Soubeyrand, M.; Luque, S.; Lenormand, M. Comprehensive Decision-Strategy Space Exploration for Efficient Territorial Planning Strategies. *Comput. Environ. Urban Syst.* **2020**, *83*, 101516. [CrossRef]
119. Rey-Valette, H.; Maurel, P.; Jabbour, C.; Cousin, C.; Luque, S.; Billaud, O.; Salles, J.M. Apport de l'information Géospatiale Dans Les Décisions d'aménagement Du Territoire: Une Expérimentation à Partir de Cartes d'occupation Du Sol à Très Haute Résolution Spatiale, et de Cartes de Services Écosystémiques. *Dév. Durable Territ.* **2020**, *11*, 17778. [CrossRef]
120. Ranga, M.; Etzkowitz, H. Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Ind. High. Educ.* **2013**, *27*, 237–262. [CrossRef]
121. Stepanova, O.; Polk, M.; Saldert, H. Understanding Mechanisms of Conflict Resolution beyond Collaboration: An Interdisciplinary Typology of Knowledge Types and Their Integration in Practice. *Sustain. Sci.* **2020**, *15*, 263–279. [CrossRef]
122. Hall, K.L.; Vogel, A.L.; Huang, G.C.; Serrano, K.J.; Rice, E.L.; Tsakraklides, S.P.; Fiore, S.M. The Science of Team Science: A Review of the Empirical Evidence and Research Gaps on Collaboration in Science. *Am. Psychol.* **2018**, *73*, 532–548. [CrossRef]
123. Haider, L.J.; Hentati-Sundberg, J.; Giusti, M.; Goodness, J.; Hamann, M.; Masterson, V.A.; Meacham, M.; Merrie, A.; Ospina, D.; Schill, C.; et al. The Undisciplinary Journey: Early-Career Perspectives in Sustainability Science. *Sustain Sci* **2018**, *13*, 191–204. [CrossRef] [PubMed]
124. Pluchinotta, I.; Kazakçi, A.O.; Giordano, R.; Tsoukiàs, A. Design Theory for Generating Alternatives in Public Decision Making Processes. *Group Decis. Negot.* **2019**, *28*, 341–375. [CrossRef]
125. Popa, F.; Guillermin, M.; Dedeurwaerdere, T. A Pragmatist Approach to Transdisciplinarity in Sustainability Research: From Complex Systems Theory to Reflexive Science. *Futures* **2015**, *65*, 45–56. [CrossRef]
126. Landström, C.; Whatmore, S.J.; Lane, S.N.; Odoni, N.A.; Ward, N.; Bradley, S. Coproducing Flood Risk Knowledge: Redistributing Expertise in Critical 'Participatory Modelling. ' *Environ. Plan. A* **2011**, *43*, 1617–1633. [CrossRef]
127. Arpin, I.; Ronsin, G.; Aubertie, S.; Collin, A.; Landrieu, G.; Le Bastard, A.-M. La transdisciplinarité en pratique. Les collaborations entre chercheurs et gestionnaires d'espaces naturels protégés. *Nat. Sci. Soc.* **2019**, *27*, 205–211. [CrossRef]
128. Troussellier, M.; Deslous-Paoli, J.-M. La Lagune de Thau: Un Site Atelier Pour l'acquisition, l'intégration et La Valorisation Des Connaissances. *Oceanis* **2001**, *27*, 257–289.

129. Aquilina, L.; Ladouche, B.; Doerfliger, N.; Seidel, J.L.; Bakalowicz, M.; Dupuy, C.; Le Strat, P. Origin, Evolution and Residence Time of Saline Thermal Fluids (Balaruc Springs, Southern France): Implications for Fluid Transfer across the Continental Shelf. *Chem. Geol.* **2002**, *192*, 1–21. [CrossRef]
130. Rabouille, C.; Amouroux, D.; Anschutz, P.; Jouanneau, J.-M.; Gilbert, F.; Cossa, D.; Prevot, F. Biogeochemical and Contaminant Cycling in Sediments from a Human-Impacted Coastal Lagoon—Introduction and Summary. *Estuar. Coast. Shelf Sci.* **2007**, *72*, 387–392. [CrossRef]
131. Plus, M. Modelling of Oxygen and Nitrogen Cycling as a Function of Macrophyte Community in the Thau Lagoon. *Cont. Shelf Res.* **2003**, *23*, 1877–1898. [CrossRef]
132. Obermann, M.; Froebrich, J.; Perrin, J.-L.; Tournoud, M.-G. Impact of Significant Floods on the Annual Load in an Agricultural Catchment in the Mediterranean. *J. Hydrol.* **2007**, *334*, 99–108. [CrossRef]
133. Loubersac, L.; Do Chi, T.; Fiandrino, A.; Jouan, M.; Derolez, V.; Lemsanni, A.; Rey-Valette, H. Microbial Contamination and Management Scenarios in a Mediterranean Coastal Lagoon (Etang de Thau, France): Application of a Decision Support System within the Integrated Coastal Zone Management Context. *Transit. Waters Monogr.* **2007**, *1*, 107–127.
134. Pérez Agúndez, J.A.; Yimam, E.; Raux, P.; Rey-Valette, H.; Girard, S. Modeling Economic Vulnerability: As Applied to Microbiological Contamination on the Thau Lagoon Shellfish Farming Industry. *Mar. Policy* **2014**, *46*, 143–151. [CrossRef]
135. Fouilland, E.; Trottet, A.; Bancon-Montigny, C.; Bouvy, M.; Le Floc'h, E.; Gonzalez, J.-L.; Hatey, E.; Mas, S.; Mostajir, B.; Nouguier, J.; et al. Impact of a River Flash Flood on Microbial Carbon and Nitrogen Production in a Mediterranean Lagoon (Thau Lagoon, France). *Estuar. Coast. Shelf Sci.* **2012**, *113*, 192–204. [CrossRef]
136. Richard-Ferroudji, A. *Equiper Un Groupe de Travail Pour Coécrire l'état Des Lieux d'un SAGE: WikiThau*; Compte-Rendu Expérimentation-N°1 Intermed Accompagnement; SAGE Thau: Montpellier, France, 2009. Available online: http://intermed.lirmm.fr/ANR_Intermed_2009_Resultats_wiki_Thau.pdf (accessed on 28 July 2021).
137. Bouleau, G.; Barone, S.; Maurel, P.; Richard, A.; Abrami, G.; Cernesson, F.; Richard, S. *I-FIVE: Innovative Instruments and Institutions in Implementing the Water Framework Directive. French Case Study Report: Implementing the WFD on the Thau Basin*; IWRM.net. 2009, p. 83. Available online: https://xueshu.baidu.com/usercenter/paper/show?paperid=06a8a1bd7203d97da150a378fe59a814&site=xueshu_se (accessed on 28 July 2021).
138. Richard-Ferroudji, A.; Barreteau, O. *SURGE: Solidarité Urbain-Rural Pour La Gestion de L'eau*; Programme de Recherche Eau et Territoires; IRSTEA: Montpellier, France, 2012.
139. Perrin, J.-L.; Salles, C.; Bancon-Montigny, C.; Raïs, N.; Chahinian, N.; Dowse, L.; Rodier, C.; Tournoud, M.-G. Comparison of Index Systems for Rating Water Quality in Intermittent Rivers. *Environ. Monit. Assess.* **2018**, *190*, 70. [CrossRef] [PubMed]
140. Ladouche, B.; Millot, R.; Guerrot, C.; Lamotte, C. Caractérisation géochimique de l'aquifère hydrothermal de Balaruc-les-Bains lors d'un épisode d'inversac. In Proceedings of the Dix-Huitièmes Journées Techniques du Comité Français d'Hydrogéologie de l'Association Internationale des Hydrogéologues. "Ressources et Gestion des Aquifères Littoraux. Cassis 2012", Cassis, France, 15 March 2012; pp. 141–149.
141. Herrmann, F.; Baghdadi, N.; Blaschek, M.; Deidda, R.; Duttmann, R.; La Jeunesse, I.; Sellami, H.; Vereecken, H.; Wendland, F. Simulation of Future Groundwater Recharge Using a Climate Model Ensemble and SAR-Image Based Soil Parameter Distributions—A Case Study in an Intensively-Used Mediterranean Catchment. *Sci. Total. Environ.* **2016**, *543*, 889–905. [CrossRef] [PubMed]