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Evidence on the efficacy of impacts from real-world experiments in triggering transformative processes is still scarce. This study evaluates multi-actor labs to provide examples of direct impacts of real-world experiments in tackling long-standing, local, sustainability challenges.

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Abstract

Multi-actor labs (MALs), a form of real-world social experiments, were implemented in three coastal-rural regions in France (Charente River Basin), Spain (Mar Menor), and Greece (South-West Messinia) to better assess and tackle coastal-rural interactions that govern local sustainability challenges, such as water use conflicts and biodiversity degradation. The MALs used participative methodologies based on systems thinking and transition management. Stakeholders were continuously engaged in a series of workshops to co-produce knowledge, reach a common understanding of the sustainability challenges and issues at stake, and co-design solutions in the form of a roadmap for sustainable transitions in coastal-rural regions. This paper evaluates MALs to provide examples of successful sustainability transition experiments based on the outputs produced, outcomes achieved, and processes used in the three coastal, rural regions.

Keywords

coastal, co-production of knowledge, multi-actor labs, participatory research, real-world experiments, real-world labs, real-world transformation, rural, sustainability transformation

Rural coastal regions are complex socio-ecological systems confronted with challenges driven by both exogenous and endogenous forces, linked to their coastal and rural identities.

According to the European Union's (EU) long-term vision report (EC 2021) on rural areas, 80% of the EU territory is characterised as rural and is home to 30% of the EU population. These numbers are constantly shrinking, as populations and employment are increasingly concentrated in urban areas, while rural coastal zones are plagued by a form of urban sprawl termed coastalization (Lagarias and Stratigea 2022). These pressures cause dynamic transformations of socio-ecological systems in coastal-rural areas, both in terms of their socio-economic as well as ecological characteristics. Thereby, they affect future perspectives of coastal-rural areas and create challenges for the design of sustainable development policies. Considering the different levels of governance involved and the systemic transitions taking place, coastal-rural areas (defined as a coastal zone, urban or rural, and its rural hinterland) create a forum for socio-ecological transformations which will benefit from the design of integrated place-based strategies that are flexible for adaptation (Martínez-López et al. 2019). To be effective and broadly accepted, these strategies need to be rooted in participatory, multi-actor approaches (in this case, with actors from both rural and coastal sectors) in order to enhance and exploit co-creation even when faced with diverging interests – such as in relation to the management of water resources and the dependent relationships between downstream and upstream activities (Dzwaire et al. 2010). However, a systematic study of the interactions between hinterland rural and coastal activities, whether positive or negative, suffers from the fact that existing research and policy analysis still primarily address these issues from either a coastal- or a rural-based perspective. This results in policies and decisions that are ill-adapted to support effective land-sea integration and synergetic development at the local and regional levels. To address this, multi-actor labs (MALs) were established, as real-world experiments, in Spain (Mar Menor lagoon), Greece (South-West Mes-

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sinia) and France (Charente River Basin), all characterized by complex challenges around water resources management and complex interactions between coastal and inland rural areas. Using systems thinking and participatory approaches, the MALs were aimed to study these coastal-rural dynamics, and support the development of concerted actions across the source-to-sea continuum for a new sustainability model. In this study we use the evaluation framework for sustainability transition experiments proposed by Luederitz et al. (2017) to examine the impacts of the co-design process that was performed in the three MALs. The aim of the paper is to demonstrate how the outputs and related outcomes of the MALs are supporting the transition towards sustainability in coastal-rural regions but even more how the co-design process itself within each MAL has been fundamental in triggering the necessary changes for sustainability transition.

Our project: Methods and procedure

The evaluation framework

Luederitz et al.'s framework (2017) for evaluating the performance of sustainability transition experiments is based on four evaluation dimensions: outputs, outcomes, process, and inputs, using a series of criteria identified as essential characteristics to assess the effects of such transitions (see online supplementary material, 2¹).² This framework was applied to evaluate the performance in terms of sustainability transitions of three MALs implemented in coastal-rural regions, by looking at the results produced, their direct impacts, as well as the co-design method and tools that were used. The evaluation was based on feedback of participants: participants of each MAL (local stakeholders and research scientists involved) were asked to answer a short questionnaire regarding their experience (see online supplementary material, 1¹).

The case study areas

This study focuses on MALs implemented in three European coastal-rural regions (see details of case studies in online supplementary material, 3¹) which differ in their socio-environmental context, demographic structure, degree of urbanization and economic development. Yet, they face common sustainability issues around the use of the water resources such as increased pollution, limited availability, impacts on biodiversity, and conflict over water use. South-West Messinia is an example of an interlinked coastal-inland area in the Eastern Mediterranean region. Agriculture and coastal tourism are the two major economic activities. Besides the presence of olive groves, the land cover consists of a variety of Mediterranean habitats included in a *Natura 2000* area and important cultural sites. Social dialogue is quite underdeveloped, and people have limited engagement in decision making. The Charente river basin is predominantly rural with agriculture being the main hinterland activity, while there is major urbanization on the coast. There is a contrast between the densely populated coastal fringe and the rural territory with a low pop-

ulation density, and there is a high concern about diffuse pollution of surface waters and its impact on coastal activities. The Mar Menor coastal lagoon in South-East Spain is characterized by multiple environmental, social-cultural and economic interests, often competing for scarce resources, water being the most important. The lagoon is strongly influenced by interactions between inland agriculture on one hand, and coastal tourism and fisheries affecting natural ecological values and socioeconomic sustainability on the other.

Multi-actor labs

MALs combine elements of urban transition labs and evolutionary learning labs (McCrorry et al. 2020), utilizing systems thinking (Meadows 2008, Bosch et al. 2007). They are underpinned by transition management, a participatory governance approach using co-creation processes aimed at creating space for new paradigms, innovative practices and visionary ideas, to address local sustainability issues from the perspective of radical long-term change (Roorda et al. 2014, Loorbach 2007). Transition management enables consideration of the diversity of perspectives presented in the context of the MALs, while managing divergent opinions in response to sustainability challenges, thereby arriving at a direction for change (Smith and al. 2005). The aim of the MALs was first to better understand and assess coastal-rural interactions that govern local sustainability challenges (e.g., water use conflicts, biodiversity degradation). Second, they were designed to develop solutions tackling the key local challenges, triggering coastal-rural synergies across actors and sectors. Within this setting, stakeholders were iteratively engaged over the course of four and a half years, through a series of workshops (nine per MAL), regular meetings and interviews. Over 200 stakeholders were involved (80 in Greece, 54 in France, 60 in Spain), representing key economic sectors in each area (e.g., tourism, agriculture and agro-industry, aquaculture/fisheries) as well as local authorities, universities and NGOs³. The first round of workshops focused on individual sectors (six per MAL), followed by three multi-sectoral workshops per MAL (table 1).

The process: Co-identifying problems, co-designing solutions

During the first round of workshops participants explored the relevant land-sea interactions from a sectoral coastal or rural hinterland perspective, taking into consideration the motivations and barriers for collaboration as well as inter-sectoral synergies. In addition, they considered positive and negative externalities, using a systems thinking exercise (Tiller et al. 2021). They developed sectoral mental maps, consisting of graphical representations of key relationships between problems, solutions and opportunities as they perceived them. These mental maps (online supplement, 4.2, 4.3¹) were then combined, based on common variables, into one single map, representing the system as a whole.

1 Online supplementary material: <https://doi.org/10.14512/gaia.33.S1.9.suppl>.

2 Christ et al. (2024, in this issue) also use this framework.

3 For details on the stakeholder engagement, see online supplement, 4¹.

TABLE 1: The process: activities performed, methods used, and goals envisioned in each of the three multi-actor laboratories (MALs).

ACTIVITIES	METHODS	GOALS
first round of workshops (6 sectoral, 3 from coastal sectors, 3 from rural sectors)	participatory system mapping (Tiller et al. 2021, Barbrook-Johnson and Penn 2022)	<ul style="list-style-type: none"> ■ engage rural and coastal sectors ■ group problem understanding focusing on challenges, opportunities, obstacles and solutions ■ map the cause-effect relationships in the context of land-sea interactions from each sectors perspective
in-between workshops	team seminar for the creation of qualitative system model	create combined qualitative model of the social-ecological land-sea interactions identified in the sectoral mental maps
second round of workshops (multi-sectoral)	<ul style="list-style-type: none"> ■ participatory modelling exercises (Tiller et al. 2021) ■ transition management: visioning (Roorda et al. 2014) 	<ul style="list-style-type: none"> ■ validate the combined qualitative models ■ definition of a shared view of the land-sea system; identify leverage points ■ co-development of a shared vision
in-between workshops	individual interviews	discuss actions and potential business solutions with sector representatives
third round of workshops (multi-sectoral)	backcasting (Jackson 2013)	co-develop the coastal-rural roadmap: identify short-, mid- and long-term actions to reach the vision

Then, multi-sectoral workshops were used to validate the single mental map, ensuring a common understanding of the system and problems at stake. This formed the basis of subsequent activities including envisioning a feasible, desirable future, as a critical step to transition towards sustainability (Bennett et al. 2021). Round 3 was dedicated to the co-design of a roadmap, acting as a sustainable transition pathway towards this desirable future. The common visions co-developed across sectors and stakeholder groups gave the goal and objectives to be achieved, where current land-sea challenges would have been solved; while the roadmaps, which revolved around subthemes/sectors, described essential actions/interventions in the short, mid and long term. A backcasting exercise (online supplement, 4.4⁴) was used to guide stakeholders in the development process from the envisioned future, retracing required steps and actions back to the present.

Results

The MALs enabled 1. the creation of a participatory system dynamic model including the collective knowledge and understanding of the problems, causes and solutions, across sectors from source to sea, and 2. the co-design of a roadmap for establishing a sustainable transition path towards a desirable future. The roadmaps were the final outputs of the stakeholder engagement process, providing cross-sectoral territorial strategies and policy recommendations for cross-sectoral sustainable development of coastal and rural socio-ecosystems.

The roadmaps

Despite different local contexts, stakeholders within all the MALs did not primarily envision an increase in the sustainability of their coastal-rural hinterland region through smaller changes in sectoral activities, but rather through a larger transformational

change of the dominant sectors (agriculture and tourism) towards new model paradigms and practices (table 2, p. 60). In France, the future territory was envisioned to become more sustainable through an increased collaboration between stakeholders across sectors of the land-sea continuum with an emphasis on increased dialogue between the farming sector (inland) and the oyster industry (in the coastal zone). In Greece, the central idea of the vision was to achieve the brand name of *Sustainable Messinia* that would attract tourists' interest beyond the sun-sea model.⁴ This will allow the local community to be engaged broadly across all sectors and activities, and gain increased recognition for sustainable olive products of high quality. Similarly, in Spain stakeholders envisioned a well-developed sustainable inland and coastal tourism sector in combination with a sustainable agriculture sector that produces high quality products for local and international markets. Thus, the roadmaps converged primarily around the tourism and agriculture sectors to 1. support their transition towards sustainability, reinforced by measures to create new forms of territorial governance integrating all sectors from the land-sea continuum; and to 2. facilitate the emergence of a true integrated management of the water resources, from source to sea.

It is still early to offer a comparative analysis of tangible impacts of the roadmaps as a sustainability transition tool. Nonetheless impacts of the key actions included in the roadmaps have been identified (table 2), with a strong focus on achieving a sustainable management of the water resource, as it remains the utmost challenge, holding the key to sustainability in coastal-rural regions. These expected impacts have been largely acknowledged by stakeholders across sectors, confirming the relevance of proposed solutions for tackling environmental and socio-econom-

⁴ Noll et al. (2024, in this issue) discuss comparable problems and efforts on the Greek island of Samothraki.

TABLE 2: The roadmaps' actions to be implemented in Greece (GR), France (FR) and Spain (ES), as well as expected impacts.

KEY ACTIONS		EXPECTED IMPACTS
agriculture	<ul style="list-style-type: none"> ■ promote crop diversification (FR) ■ introduce extensive and organic farming (GR-FR-ES) ■ provide a short supply chain (GR-FR-ES) ■ create local quality labels (GR-FR-ES) ■ support young farmers' installation (FR) ■ strengthen farmers' co-operative/cluster (GR) 	<ul style="list-style-type: none"> ■ emergence of sustainable farming models ■ reduced pressure on water resource ■ improved water quality and quantity of inflow to the coast
tourism	<ul style="list-style-type: none"> ■ foster diversification of tourism activities (cultural heritage, nature, and sports) (GR-ES) ■ favour local entrepreneurship and local community involvement (GR-FR-ES) ■ develop agro-tourism initiatives (GR-FR-ES) ■ promote local quality products (GR-FR-ES) ■ valorise unique territorial identity from land to sea (GR-FR) 	<ul style="list-style-type: none"> ■ enhanced resilience of the sector ■ reduced environmental impacts ■ economic benefits spread towards rural hinterland ■ synergies between agriculture and tourism sectors within the coastal-rural landscape ■ increased hinterland attractiveness
governance	create a regional cross-sectoral management body (GR-FR-ES)	<ul style="list-style-type: none"> ■ holistic water management ■ cross-sectoral science-policy-society dialogue, collaboration, knowledge transfer, shared understanding
water management	<ul style="list-style-type: none"> ■ develop sea water desalination (ES) ■ adopt adaptive water quality indicators (GR-FR) ■ have simpler multi-scale integrated policies (FR) ■ better control water uses (GR-FR-ES) 	good environmental status of water resource

ic issues in each MAL. It is worth noting that out of 16 key actions, one half are shared across the three regions, only five are case study specific, arguing for an ambitious and sustainable rural development policy at European level.

Indeed, the analysis of the roadmaps and MALs outputs allowed the development of generic policy recommendations for EU rural development, considering that many of the roadmap actions cannot be implemented without strong EU policy support. First and foremost, a sustainable and harmonized development across coastal-rural regions is achievable only with an ambitious Common Agriculture Policy which prioritises sustainable agricultural practices. In addition, a coherent, enforced regulatory framework and new governance models integrating land-sea continuity are necessary, based on collaboration and partnerships across rural and coastal sectors and administrations.

Finally, the development of the roadmaps resulted in securing new funding⁵, in two out of three case studies, to support the implementation of the roadmaps' actions, and to enable the monitoring and evaluation of the impacts.

Co-production of knowledge and outputs

It is generally agreed among all MALs that the production of the roadmaps would not have been possible if a common understanding and sharing of knowledge and perceptions had not been established through the iterative interactions between stakeholders and researchers. Following this process, the MALs went through all the knowledge types described by Luderitz et al. (2017)

(descriptive, anticipatory, and finally transformational knowledge). This created a co-learning and knowledge sharing space that generated more constructive dialogues in all three MALs. In France, initial tensions arose between water resource managers, shellfish farmers and farmers. However, everyone's positions evolved towards a more constructive dialogue, leading to the emergence of a consensus on the need to change both structural dialogue and local policies. More precisely, local stakeholders came to recognize the need for a paradigm shift, framing land-sea interactions and management as a "territorial continuum" to tackle the MAL's key sustainability issues (i.e., water resource management, sustainable coastal and rural development). Similarly, in Spain, the initial disagreement on the main problems and key solutions was partly solved over the duration of the project through qualitative and quantitative co-production of knowledge, and confidence building between representatives from different stakeholder groups. The participatory modelling and co-design process resulted in the identification and recognition of a wide range of variables that are crucial drivers within the Mar Menor-Campo de Cartagena socio-ecological system (e.g., social welfare, ecotourism, governance, climate change, soil erosion, social cohesion, tourism seasonality), increasing the general understanding of the critical interactions among all sectors involved (e.g., between unsustainable farming practices inland and a bad environmental status of the coastal lagoon). In Greece, participants reported that it was significant that actors from the agricultural and tourism sectors communicated with one another to identify emergent issues of common interest; building on the sector-specific expertises and insights enabled to determine how these issues could be approached from

⁵ National recovery plan of the Spanish government for the Mar Menor lagoon; PRIMA SALAMED project in Greece.

a different perspective. Overall, the processes clearly contributed to a common understanding of sustainability issues and aspirations for the future.

Impacts on local governance arrangements

In the Spanish MAL, stakeholders identified the participatory process as having contributed a lot to the strengthening of stakeholder networks. The use of a blog⁶ proved to be a valuable means to achieve increased acceptance and socio-ecological stewardship, by providing a platform to share experiences, solutions and project progress. The blog opened the project to a wider network of actors, thus supporting transparency and building of confidence in the roadmap actions. In Greece, the MAL succeeded in triggering transformative change (see online supplementary material, 2¹) with regard to the ability to cooperate under open and participatory governance arrangements. At the end of the process, key stakeholder representatives felt that they had gained a better systemic understanding of cross-sectoral linkages, and that their trust had grown (quote from one stakeholder: “I now better understand the needs and problems of the region that the institution I represent is active in”). During the first MAL workshop, many of the participants were sceptical about the process and whether there was any point in engaging in discussions on key decisions which were already perceived as a forgone conclusion. Therefore, several stakeholders were only interested in debating challenges and weaknesses rather than solutions. However, during the last MAL workshop (three years after the first workshop) participants were primarily focused on discussing the positive aspects of the roadmap implementation, with one of them stating “Look at what we have achieved during these last four years – all of us sitting at the same table discussing the future of the area; something we never thought would be possible.” The stakeholder engagement during the MAL has coalesced into a desire to maintain the momentum within the group, materialized in stakeholders’ participation in newly funded projects, and consolidated in the cross-sectoral governance process initiated.

Discussion: Multi-actor labs as an impactful real-world experiment approach

Outputs and outcomes

The use of MALs proved to be an effective approach in contributing to local capacity building and creating a systemic understanding of the problems, causes and solutions identified and prioritized by stakeholders within all the regions.

By generating a shared territorial diagnostic and an agreement on a pathway towards sustainability across sectors and stakeholder groups, the MALs increased the capacity of those involved to reflect on present and future paths, make informed decisions and anticipate trade-offs, thus being able to better navigate the complexity of coastal rural systems (Bennett et al. 2021).

Although there are still significant differences of interest between stakeholder groups, the co-design process has helped to

strengthen the enabling environment for the implementation of the solutions that were proposed within the roadmaps. The MALs provided new opportunities for exchange and cooperation between stakeholders and stakeholder groups, thus creating opportunities to discuss potential solutions to emerging problems across sectors. These activities have increased the visibility of the MAL participants amongst their peers and other stakeholder groups, including policy makers, but also their relationships to one another, even contributing to the reconciliation of conflicting parties (Lehtiniemi and Paloniemi 2023). As a result, the potential influence of the MALs’ stakeholders on the decision-making processes in and for the regions has been growing.

However, as argued by Carter and Vernier (submitted), whether multi-actor approaches and experimental projects can initiate change towards transition is yet to be seen, as experiments run the risk of only remaining within the framework of the research project, without significant influence on external stakeholder groups and society at large. Indeed, to govern the continuum, actors have to move towards a form of collective management, different from the existing sector-based and private-oriented model. The redefinition of actor interests within the MALs confirmed longstanding claims of institutional and public policy analyses (Dryzek 2002) stating that actor interests are not materially “given” but are socially and politically constructed in the course of deliberation.

Process

The MALs, as real-world experiments using participatory workshops and a system approach (Tiller et al. 2021), enabled systemic change by most importantly having an immediate impact on local stakeholders’ governance arrangements (see online supplementary material, 2¹), by building capacity through the development of dialogue across sectors (Saunders 2009), and by enhancing trust among actors (Williams and Robinson 2020).

The systemic stepwise process of “defining the problem – envisioning – roadmapping” was fundamental to help reaching consensus and find common grounds across stakeholders regarding a transition towards environmental and socioeconomic sustainability (Van der Brugge and Rotmans 2007, Boix-Fayos et al. 2023). It initiated transformative processes aimed at reconfiguring societal systems to better address societal needs through system thinking by 1. identifying the needs for fundamental shifts of structures in each local system, 2. developing new mindsets and practices based on cross-sectoral collaboration, 3. engaging multiple actors from many different domains and scales in problem-solving oriented activities (Bosch et al. 2007, Geel and Schot 2007, Roorda and Akisnete 2013). The iterative nature of the process continuously challenged the participants to re-assess the design and proposed solutions, and particularly to assess how changes in the system would affect other sectors in a bid to foster a mutual understanding of system interactions. The participatory approach was particularly robust in facilitating a holistic

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⁶ <https://marmenorcoastal.blog>

understanding amongst stakeholders and scientists of 1. the complex social and physical processes and interactions, and 2. the interconnections between sectors. It also enabled the development of common visions for sustainable development. In addition, the participatory systems approach was fundamental in the co-design of the roadmaps and helped to prioritize solutions and desired impacts. The MALs provided the opportunity for the scientific community to engage with relevant stakeholders and better understand the social issues that hinder the pursuit of sustainability goals; and the stakeholders developed a systemic perspective, resulting in a better comprehension and acceptance of the required transformative change of practices within traditional sectors if territorial sustainability should be achieved.

Due to the fact that the MALs acted as collaborative innovation environments, they played a crucial role in fostering trust among participants. The MALs provided a dynamic platform where local stakeholders worked together to collectively contribute to the sustainable development of their region. Trust was built through transparent and open communication, mutual respect and shared goals. Participants felt empowered by being included in the process and by the fact that their voices and concerns were genuinely considered. The iterations and feedback cycles allowed participants to see tangible progress and to experience the impact of their contributions, reinforcing their trust in the process and in each other. This inclusivity and the opportunity to co-design solutions lead to a sense of ownership and responsibility, further strengthening trust, which is fundamental in sustaining effective innovation ecosystems (Steinbruch et al. 2022). Nevertheless stakeholders can remain skeptical as to whether their suggestions and proposals will influence future policies, particularly when the outputs of a process have not been officially endorsed by the relevant authorities. Although the science-driven processes for the co-design of sustainability transitions have an important positive impact on shared problem understanding, social networks, trust and governance aspects, it remains a major challenge to connect them with policy making by responsible authorities. Finally, while the emphasis on co-design and integrated approaches combining different sectors was greatly valued, the process was at times perceived as too theoretical and research-oriented. While it was beyond the scope and capability of the research project, nonetheless stakeholders would have appreciated more immediate actions within the MAL processes. Ultimately, as a tool, MALs are easily transferable and scalable although they necessitate adequate resources to sustain the stakeholder engagement over time, and skilled facilitators to guide the co-creation process.

Conclusion

Through the lens of Luederitz et al.'s (2017) framework, this paper evaluated the effectiveness of three MALs, implemented in European coastal-rural regions, as sustainability transition experiments, by assessing the outputs, outcomes and processes.

The study shows that using MALs as platforms for sustainability transition kick-started system change at the local level in these specific regions. Although it is too early to identify the mid-to-long-term potential for MALs to drive a sustainable transition of local systems, as an immediate impact they allowed for the development of a new cross-sectoral territorial dialogue thanks to the participatory system approach, which lay the foundations of 1. proposals for radical yet evidence-based solutions in the roadmaps, co-constructed and validated with local stakeholders, aiming to support a transformation of the socio-ecological systems currently in place; and 2. a forum for initiatives that attracted interest from local and regional authorities and thereby received additional funding to move towards the implementation phase of the roadmaps. The outputs of the MALs were comparable and the results transferable across socio-geographical regions and political contexts. The results of the study indicate that the transition towards sustainable coastal-rural territories calls, above all, for a change of systems and practices within the agriculture and tourism sectors. The projects also enabled researchers to draw generic policy recommendations for European coastal-rural regions, targeting water and agriculture policies. The roadmaps underline the necessity of a new territorial dialogue based on cooperation and partnership across sectors from source to sea, which should support an integrated coastal-rural territorial management with the sustainable management of the water resource as a priority.

The use of system thinking (participatory system mapping) and transition management approach (envisioning a radically sustainable future, co-designing of roadmaps using backcasting) made it possible to elicit shared knowledge paths and a better understanding of complex systems from science-society perspectives in iterative, interactive and reflexive ways, while providing territorial strategies for the sustainability transition. This also helped to build awareness of system interdependencies, such as the interrelations between coastal and rural hinterland activities, among the involved stakeholders. In addition, participants were able to develop trust and a shared understanding of sectoral challenges, across the rural hinterland and the coastal zones, thus reducing conflicts and positively impacting local governance arrangements. The process, with its bottom-up approach and local ownership of the co-created ideas, ensures social and sectoral acceptance of the solutions proposed as well as higher probability of stakeholder uptake and implementation by policy makers.

A second evaluation using the same framework in five years' time is recommended to reassess and validate the initial conclusions drawn in the present paper.

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