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The Lampedusa Studio: A Multimethod Pedagogy for Tackling Compound Sustainability Problems in Architecture, Landscape Architecture, and Urban Design

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Received: 19 April 2020; Accepted: 22 May 2020; Published: 26 May 2020



Abstract: In architecture, landscape architecture, and urban design, entangled multiscale and multidomain, or compound, sustainability problems and associated design requirements are becoming rapidly more demanding, complex, and interdisciplinary due to demographic, social, economic, environmental, and technological changes. This places considerable pressure on developing adequate pedagogical approaches to provide the next generation of architects, landscape architects, and urban designers with the knowledge, approaches, and skills to meet these challenges. This article discusses an attempt to develop an adequate pedagogy for a research-integrated master-level design studio along a multimethod approach. Key concepts, approaches, and methods are discussed, along with selected studio projects and a follow-up master thesis project. The projects are examined in terms of their responses to the themes, concepts, approaches, and methods of the pedagogical approach. Finally, further questions concerning the development of the portrayed pedagogical approach are discussed.

Keywords: architecture; landscape architecture; urban design; compound sustainability problems; pedagogy

1. Introduction

Humanity faces fast unraveling environmental and demographic crises that present entangled multiscale and multidomain, or compound, sustainability problems. Consequentially, the development of response strategies and associated design requirements are becoming increasingly demanding and interdisciplinary. This is due to the complexity of environmental transformation; rapid demographic, social, economic, and technological changes; and fast increasing resource demands. Furthermore, this is due to insufficient consideration of the complex correlations between what are currently predominately treated as domain-specific problems. This concerns the human-dominated and, more specifically, the built environment, including architecture, landscape architecture, and urban design. These cumulative developments make it necessary to develop adequate pedagogies and curricula to train the next generation of architects, landscape architects, and urban designers with the aim to enable them to recognize and meet these challenges and to anticipate their future development.

The problem is exacerbated by modularized curricula and short semester schedules. In this context, the key question is how to develop an adequate pedagogy, especially for master-level architectural design studios, where it is assumed that design synthesis is achieved and sustainability problems are addressed in an adequate manner. This article portrays a multimethod and design and systems thinking-based approach for a specific master-level studio—the Lampedusa Studio—that was developed and run at the chair of Building Technology and Climate Responsive Design at the Technical University Munich. The teaching approach is discussed and illustrated through selected student projects and a follow up master thesis project that employed and elaborated the approach developed for the studio. Finally, the pedagogic approach is evaluated and further development questions are highlighted.

The site for the studio projects is Lampedusa, an Italian Mediterranean island. The island is an exemplary case of resource shortage, impeding environmental degradation, and compound sustainability problems. Lampedusa came to recent attention as a migration hotspot. The island suffers economic and environmental problems and lacks nearly all vital resources, which need to be imported from Sicily and further afield. In order to provide the necessary expert input and insights of those that are directly involved in the context of Lampedusa, the studio secured direct access to environmental agencies and local actors, as well as a broad scope of expert input from architecture, landscape architecture, and urban design fields.

The notion of *performance-oriented architecture*, which foregrounds the interaction between object, systems, and actors, as well as architecture and locally specific environments, served as the theoretical and methodological framework for the studio [1–4]. The premise is that architecture can be in the service of the natural environment and integrate social, cultural, economic, and environmental sustainability criteria so as to tackle compound sustainability problems. Christopher Alexander stated that “the environment must be organized so that its own regeneration and reconstruction does not constantly disrupt its own performance” [5] (p.3). This entails projection of developments over relevant periods of time. In order to deliver a more concretely framed methodological approach, we adopted Pim Martins suggestion for a new research paradigm for sustainability science that includes multiple magnitudes of spatial, temporal, and functional scales; multiple dynamics and actors; and multiple failure modes [6]. At the first run of the studio we were not able to include quantitative evaluation and simulations. We addressed this by asking students for multiple design scenarios to consider and evaluate different outcomes of the proposed schemes.

2. Materials and Methods

As indicated in the introduction, the notion of performance-oriented architecture delivered the conceptual and methodological framework for our pedagogical approach to tackling compound sustainability problems in a master-level architectural design studio. However, this needed to be complemented with a series of disciplinary, pedagogical, conceptual, and methodological aspects. To address this we commenced with Nelson and Stolterman’s notion of design as *inquiry for action* and their elaboration of four distinct types of expertise: routine, adaptive, design, and value expertise [7]. For Nelson and Stolterman, routine expertise is based on the premise that design situations are more or less the same; yet, routine expertise is unsuitable for finding adequate responses to complex and dynamic situations. In this situation, adaptive or reactive expertise is useful, but might not always constitute an adequate long-term approach. Nelson and Stolterman posited that it is often necessary to create change, and that for doing so, design and value expertise are required. Still, they pointed out that routine expertise is commonly emphasized in educational contexts [7]. In order to prevent this shortcoming, we placed emphasis on all four types of expertise and instilled an awareness about the differences between them and their different modes and modalities in the students. In order to shift the context for routine and adaptive expertise, we foregrounded an interdisciplinary approach to establishing adequate starting positions for tackling compound sustainability problems through design. This was enhanced through different modes of analysis. Design expertise was fostered by engaging students in the formulation of design criteria and project briefs and through research-by-design as a

mode of projective inquiry. Value expertise was fostered by a multiscalar and multidomain approach to developing and evaluating future scenarios over a range of spatial and time scales.

A further characteristic of the described pedagogical approach was the linking of design thinking and systems thinking with the aim to address a broad scope of actors and stakeholders. Design thinking contributes a series of methods, including context analysis, defining the problem through problem framing, ideation (divergent and convergent thinking), and abductive reasoning to ill-defined or “wicked” problems [8], such as compound sustainability problems. This includes the ability to identify, analyze, and interrelate relevant criteria. The latter inform and structure the design process [9], and allude to the importance of considering a wide array of criteria when framing a design problem and evaluating design solutions, especially when tackling ill-defined problems. Criteria can act as unifying factors in framing complex design problems [10], especially when it is necessary to transfer core design practices into other problem areas, thus when it is necessary to identify necessary types of expertise to create new frames for multidomain problems. Our pedagogical approach links design thinking to critical systems thinking as a way of comprehending and interacting with system behavior and its complexity and uncertainty across spatial and time scales [11], as well as to tackle the boundary problem with respect to selecting what to include or exclude in design considerations [12]. This was further extended by employing actor-network theory [13] to account for multidirectional dynamic relations and to link objects, systems [14], and a broad range of actors and stakeholders based on a nonhuman perspective [15], thus expanding the remit far beyond human-centric design.

At the start of the semester, students were asked to examine the island of Lampedusa with reference to the Sustainable Development Goals (SDG), laid out by the 2030 Agenda for Sustainable Development [16]. This inquiry focused on four specific aspects:

1. SDG analysis: correlations between individual SDGs to understand the compound nature of sustainability problems and the fact that actions in one SDG will affect other SDGs;
2. Status quo analyses: resources, demography, economy, energy, mobility, infrastructure, geography, ecology, and climate;
3. State of the art: renewable energy, waste management, fresh water production, climate modulation, food production in hot and dry environments;
4. Remote environment strategies for self-sufficiency with examples derived from architectural solutions in extreme environments, with particular focus on ecosystems and multistakeholder and multispecies interaction and integration.

These inquiries served as the knowledge base for the subsequent work. Alongside these inquiries, students were introduced to key concepts and approaches that served as a framework for design responses to compound sustainability problems. These entailed specific subsets of performance-oriented design, including:

1. Hybrid land-use as a way of addressing land fragmentation and segregation of SDGs due to segregation of land-use mosaic;
2. Extended thresholds [17–19] elaborating the interface between buildings and their context as a way of improving key sustainable development performance criteria;
3. Auxiliary architectures [20] and supplementary constructions for the existing built environment as a way of improving key sustainable development performance criteria;
4. Ecological prototypes [21]—specific types of green constructions (GC) that facilitate the integration of the built environment, horticulture and agriculture, and ecosystem services;
5. Outdoor microclimatic modulation as a way of providing suitable environmental conditions for human and nonhuman stakeholders;
6. Multispecies design to foreground key sustainable development performance criteria [16,22] to facilitate an ecosystem-centric approach.

These served as key framing aspects for the addressing compound sustainability problems through design.

A second phase of analyses focused on local conditions in Lampedusa. The characterization of Lampedusa's territory is of fundamental importance to the understanding of the complexity of the situation. Students were asked to identify and map different types of principal land use, including urban, suburban, rural, nature, and water. In Lampedusa, the boundary between these areas are frequently ambiguous due to ongoing and often unregulated transformations. Following the analysis of these different areas, students were asked to select zones between two different land uses or with overlapping land use for their design interventions. This resulted in ten types of land-use interfaces: urban–suburban, urban–rural, urban–nature, urban–water, suburban–rural, suburban–nature, suburban–water, rural–nature, rural–water, and nature–water. The objective was to transcend preconceptions regarding the characterization and division of land use into a priori defined patterns and responses. In this way, one land use can inform another and suggest hybrid solutions to singular land-use regulations, and thus new hybrid responses to compound sustainability problems. Furthermore, this enabled a more differentiated understanding of the causes for land-use patterns and dynamics. Students worked in teams on the analyses of their selected areas.

A visit to Lampedusa served to acquire further insights in the existing conditions through interviews with locals and visitors. A political perspective was obtained through an interview with the mayor Dott. Salvatore Martello, who presented past, present, and future development strategies for Lampedusa. A seminar and interview with representatives of Marevivo, an NGO that is mainly focused on ecological and social aspects related to the sea, served to provide knowledge about current economic resources of Lampedusa in terms of fishing and tourism, as well as related environmental problems. Equipped with the insights resulting from the above described analyses and the definition of specific site-related compound sustainability problems, the projects could commence.

In our pedagogical approach, research by design played a key role as a projective method of inquiry that is gradually becoming an established mode of research in architecture, urban, and landscape design. Lenholzer, Duchart, and van den Brink outlined four modes of research by design-based inquiry, including (post)positivism, constructivism, transformative, and pragmatism [23]. Each ask particular types of questions, while aiming for new design knowledge, research methods, and research evaluation criteria. Our approach placed particular focus on the (post)positivist and the pragmatist modes. The former is characterized by aiming for deductible knowledge and verified theory/design guidelines via design hypothesis testing, while the latter mixes research methods depending on the specific research questions with the aim to derive new practice-oriented knowledge, including new design knowledge [24].

Students worked in teams of two or three on their selected sites and prepared their own problem definition and project brief. This task requires the ability to identify a potential project based on the progression from data to information (formulation of an inquiry) to knowledge (analysis of the inquiry and identifying potential for an intervention), as well as concurrent adaptation and refinement of the project brief during the design phase. In the preparation of the project brief, students were asked to respond to the criteria laid out by Pim Martins in his sustainability science approach [6] by addressing four related aspects:

1. Three relevant spatial scales (wider systemic context of which the selected sites are part (i.e., energy, water, etc.); site scale concerning aspects that are characteristic of the site and its participation in wider systems and that can suggest that the project for the site might have a prototypical role for other similar sites; differentiation of conditions in the selected sites, i.e., microclimatic or terrain differences, differences in use, materiality, exposure, etc.);
2. Three relevant time scales (what is proposed for now; how can what is proposed for now develop in the near future (scenarios); what is the long-term perspective of the project);

3. Three functional scales (what is proposed in a wider systemic scale; what is proposed for the site in terms of scope and specificity of programs, activities, and events; according to which criteria is the program for the site differentiated to meet different already existing latent provisions and in order to inform provisions that need to arise from the proposed architectural, programmatic, and environmental interventions);
4. Human and nonhuman actors and stakeholders in the systems, sites, and projects.

To summarize: the conceptual and methodological framework employed performance-oriented design (through a subset of themes described above) linked with sustainability science, based on a detailed understanding of the SDGs and their interdependence. To relate this to a pedagogical approach, an understanding of different types of expertise was adopted and related to questions and methods of design thinking and critical systems thinking. This foregrounded questions of what to include or exclude from considerations when facing complex design problems. Detailed analyses of the site and the formulation of an initial design brief subsequently facilitated research by design and the development of design proposals involving multiple spatial, temporal, and functional scales; multiple stakeholders; and multiple future scenarios to ensure a robust proposal. The pedagogical approach could then be evaluated in terms of the comprehension and utilization of the individual aspects of the approach by the students, as well as by the design proposal and the level of complexity, robustness, and feasibility of the developed projects vis-à-vis tackling compound sustainability problems.

3. Results

The context for the studio work was the Italian island of Lampedusa, which is characterized by explicit resource shortage; stationary and transitory populations (tourists and migrants), with the latter unsettling and transforming traditional land uses and activities; and pronounced environmental problems. Located in the Mediterranean Sea ca. 200 km south of Sicily, Lampedusa is short of drinking water, food supply, building materials, electricity, etc., which need to be imported from Sicily and further afield. The stationary population of ca. 6000 people experiences a lack of educational, social, and healthcare services and employment opportunities. Currently most of the island's economy is based on tourism, with a seasonal flow of ca. 250,000 visitors, and a growing fishing industry. Its semiarid climate is characterized by mild winters with moderate rainfall and hot and dry summers. The current landscape is a result of desertification due to deforestation over centuries, decreasing agricultural activities, land abandonment, and unregulated development and sprawl. The informal urban development led to a fluid landscape, an encounter between humans and natural systems with ephemeral boundaries.

Today, Lampedusa is primarily known as a port of arrival of migrants from Africa into Europe. During our visit to the island in 2018 there was a pause in migrant flow. The migrant hotspot was closed and there were no migrants present on the island. This prevented first-hand experience of the migrant situation and therefore precluded addressing this in an informed way in the studio projects. For this reason, the work focused on socioeconomic and socioenvironmental issues that could be adequately documented. However, most projects considered migrants as part of the transitory population and integrated these in multistakeholder design scenarios.

In the following, we discuss selected projects produced in the studio and one example of a follow-up master thesis project of a student that participated in the studio and was supervised following the same objectives and methods.

3.1. Studio Projects

3.1.1. Project Hybrid Zone

The project "Hybrid Zone" by Natalie Salama, Siwar Eid, and Livia Medici (Figure 1) focused on the interface between suburban settlements and nature, where the boundary between land use is especially fluid and unregulated suburban sprawl is rampant. At this interface there exists still

space for shepherds to let their sheep graze, even though the distance between such areas is increasing and the available areas are decreasing. At the same time, these areas are a refuge for the remaining natural flora and fauna. Further suburban sprawl would lead to the eventual disappearance of this vital resource. The project focused, therefore, on the integration of these types of spaces in guidelines for designing suburban areas. This is based on the recognition that preserving and invigorating ecosystems in suburban environments also benefits human well-being [25]. In order to support these areas and to integrate their interface with suburban areas in suburban development, the project located a range of recreational activities and provisions within these areas. Additionally, the interface would be extended into garden areas within suburban developments and supplemented with large canopies and pergolas, as well as green infrastructure, to enable outdoor activities during the hot season. This also has considerable microclimatic advantages for houses and communal spaces and reinforces pastoral use and promotes small-scale agricultural use in areas that are directly adjacent to suburban developments. The SDGs addressed by this project include good health and well-being, sustainable cities and communities, climate action, and life on land. The specific subsets of performance-oriented design include hybrid land use, auxiliary architectures, microclimatic modulation, and multispecies design. The boundary problem was addressed by redrawing a boundary for land uses that are not typically considered in terms of their interaction, especially in terms of integrated planning and architectural scales. This project fell short in providing different scenarios that elaborate possible degrees of integration of the involved land uses and a larger scale consideration of enabling networks, i.e., for sheep grazing and in terms of biotic corridors. These would constitute useful areas for further research and design inquiry.

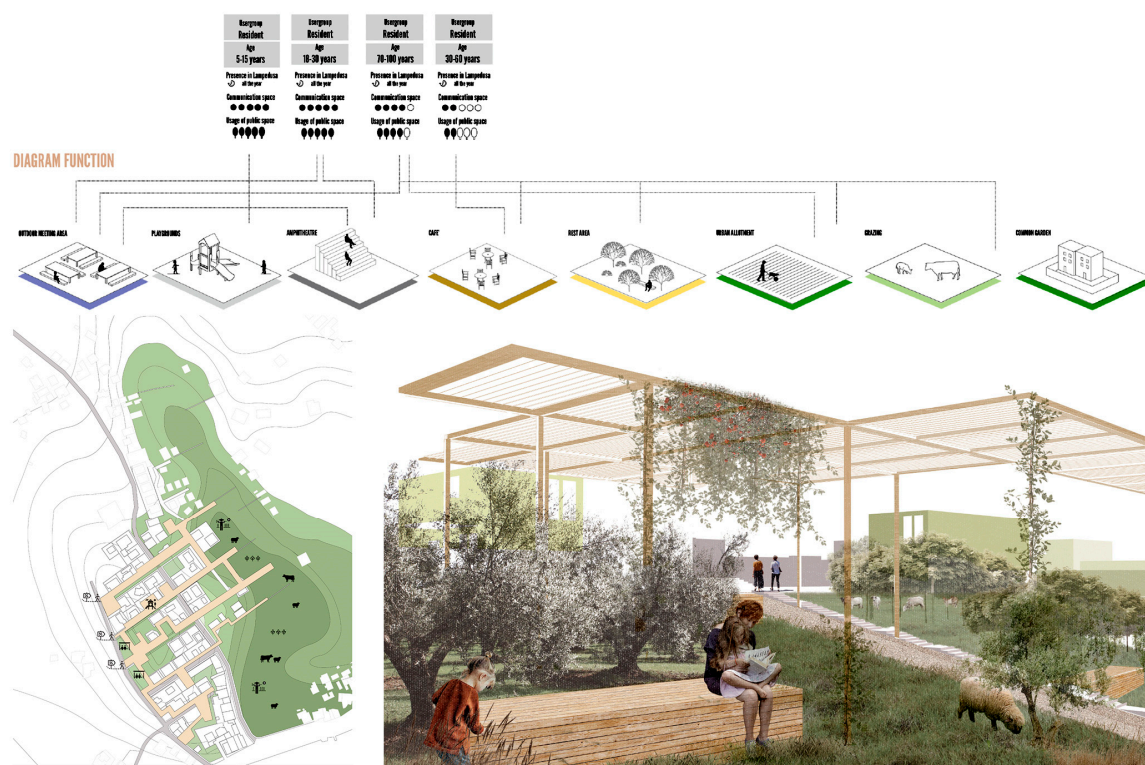


Figure 1. Hybrid Zone: (a) identification of stakeholders and related provisions; (b) site plan of the integrated suburban, pastoral, agricultural, and nature zones referencing stakeholders; (c) rendered view of the transitional space between suburban housing and pastoral, agricultural, and nature zones.

3.1.2. Project Meshing Up Lampedusa

The project “Meshing up Lampedusa” by Katharina Meenenga, Marie van Tricht, and Mattia Zannoni (Figure 2) focused on bioremediation through water collection at the intersection between nature and rural areas. Water scarcity led to desertification and limited agricultural activities on the island. Ancient techniques to collect water were abandoned and partially replaced by infrastructure that was not adequately maintained. The results have been increasing desertification, soil erosion, and decrease of agriculture. The project proposes a strategy to harvest nonrainfall water (fog and dew) through fabric-covered towers and collecting it to initiate local ecology recovery, communal gardening activities as social condensers, and environmental education. Resource management, specifically in relation to water, is a focal area for anthropologists engaging place-based community research and climate change [25]. Anthropologists have long engaged issues of water, especially as the world faces increasing shortages and pollution [26–29]. The project seeks to reinstate abandoned practices of water harvesting and irrigation and combine these with new ways of harvesting water. This serves to bring back agricultural activity and to restart ecosystems and biodiversity based on incremental increase in water harvesting. The selected locations for the proposed water-harvesting structures simultaneously become locations for environmental research and education for local and transient communities, as well as microcommerce in terms of selling local agricultural produce. Tourists, as well as migrants, can engage in this process during their stay on Lampedusa. In this way, participants can obtain knowledge and skills in counteracting desertification and related agricultural- or ecosystem-related services as a way of finding work. These water-harvesting towers and related ecosystems also include other functions to bring people to more remote places on the island and to serve as observation towers. The project comprises different future scenarios based on the resulting amount of water for the purposes outlined by the project. The SDGs addressed by this project include good health and well-being, clean water, sustainable cities and communities, climate action, and life on land. The specific subsets of performance-oriented design include extended thresholds, auxiliary architectures, microclimatic modulation, and multispecies design. As such, the project remains on a speculative level and it would be useful to consider parallel courses in a teaching curriculum that would focus on designing and building full-scale prototypes on site as local laboratories for long-term studies.

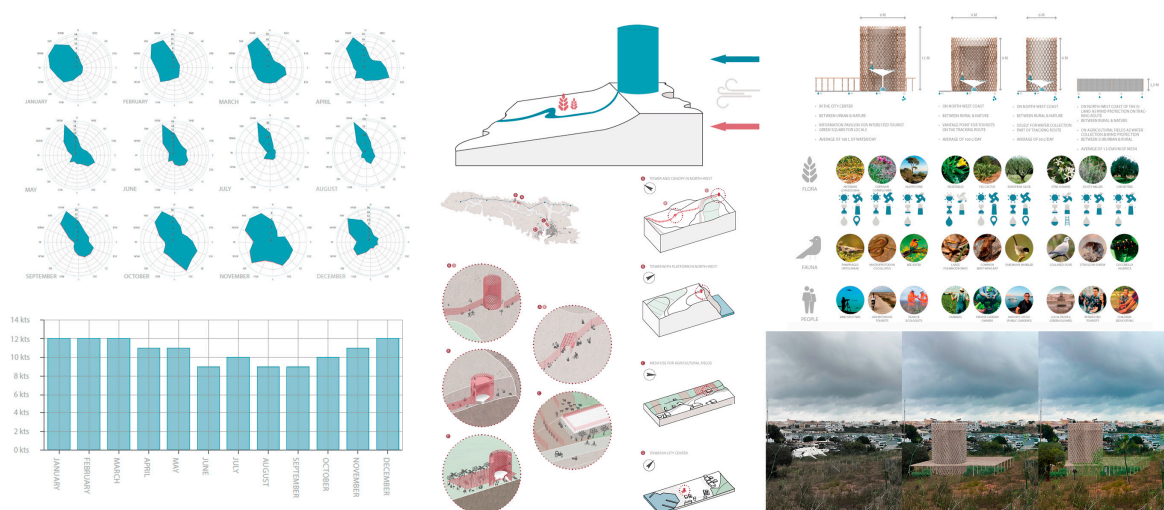


Figure 2. Meshing up Lampedusa: (a) seasonal wind directions and precipitation; (b) strategies for harvesting nonprecipitation water; (c) types of water catchers, human and nonhuman stakeholders, three stage development of sample site.

3.1.3. Project Green Urban Canopy

The project “Green Urban Canopy” by Alice Calini, Sara Hozzankova, and Alina Ovsyannikova (Figure 3) was located at the intersection between urban and rural areas. The project addressed the existing relation between private backyard cultivations in the urbanized areas of the island. This was done by proposing a vision for mitigating extreme microclimatic conditions in urban spaces. As the urban area is the densest and produces large amount of waste, collecting and disposing organic waste was seen as an opportunity for creating a more self-sufficient setting. This entails the residents collecting organic waste, supplemented by the municipality collecting brown organic waste i.e., from public parks and gardens. The organic waste is used for a biocomposting process to produce nutrient soil. The produced soil is used to support green projects, as lack of soil is one of the primary obstacles in creating green spaces in the urban context. In this way the proposed project combined municipal and local population cooperation. The project proposed an urban block scale green canopy structure, akin to a very large pergola with plants growing on it. As such it constitutes an urban scale vision and version of auxiliary architectures. The canopy creates places to meet, involves and fosters community activity, and limits the illegal vertical growth of the city that is driven by unregulated construction. The columns of the canopy double up as a lighting system powered by solar energy and as the main irrigation system to water the plants that inhabit the structure. The latter involves the use of grey water from the urban block that gets recycled and cleaned in the process of use. Residents are encouraged to participate in the organic waste collection. When participating they get soil in exchange for personal use on roof gardens or allotment gardens located on an adjacent abandoned plot. Residents of the buildings can participate in the process by using their roofs to grow the plants that inhabit the canopy structure. The proliferation of covered green spaces provides shaded outdoor spaces that reduce the urban heat island effect in the dense urban environment and provide desired microclimatic conditions. The SDGs addressed by this project include good health and well-being, clean water, affordable and clean energy, sustainable cities and communities, responsible consumption and production, and climate action. The specific subsets of performance-oriented design include extended thresholds, auxiliary architectures, microclimatic modulation, and, to a lesser explored, extent multispecies design. The latter could be further strengthened by considering ecosystem services that can be related to the organic material cycle and the green canopy. A more extensive remapping of the system boundary of the project could have pointed to this aspect at an earlier stage of the project development. This points also towards the need to bring further disciplines into the project when insights emerge and opportunities for design development arise. To have the necessary resources at hand when needed places considerable demand on curricula development but could be addressed through cross-faculty collaboration and parallel interdisciplinary research projects that are thematically aligned with teaching modules.

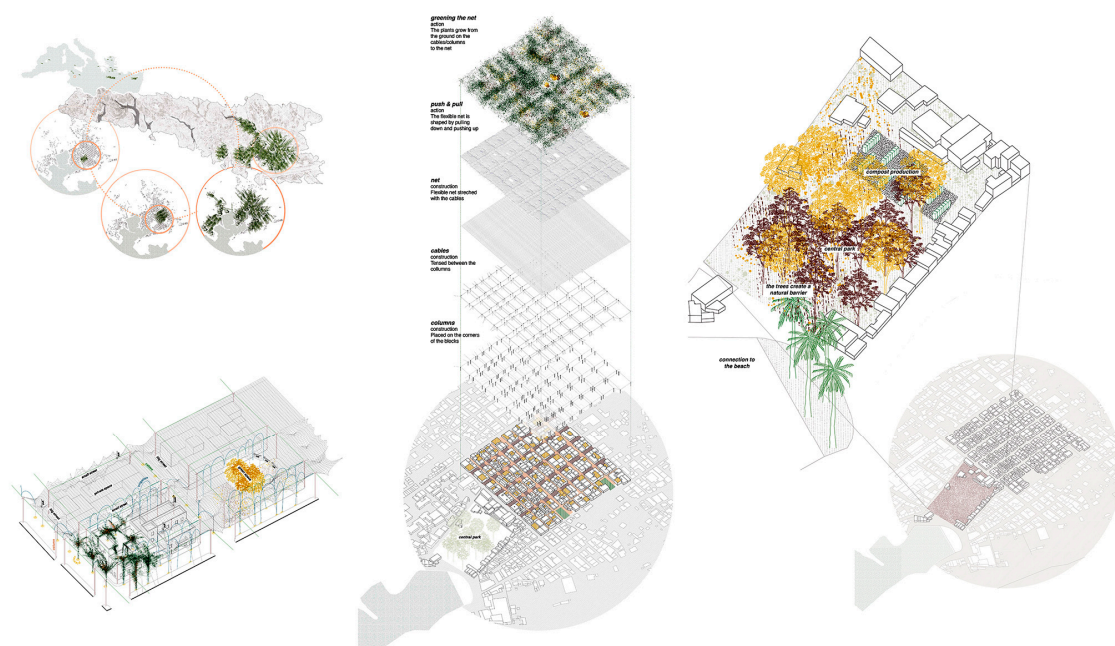


Figure 3. Green Urban Canopy: (a) staged development across spatial and temporal scales, axonometric view of a city block with canopy; (b) exploded axonometric view of canopy development across the town center; (c) development of a brown field site and abandoned green sites for revegetation and biocompost collection and processing.

3.1.4. Project Green Forum

The project “Green Forum” by Doron Revach, Krystn Rilloraza, and Anna Volinia (Figure 4) was located in the intersection between urban and nature. Primarily, the project consisted of a new small-scale institution for environmental education. The site was an abandoned green space, a “third landscape” abandoned by humans and left to landscape evolution [30]. Clément pointed out the importance of acting with the existing ecosystem instead of against it when engaging with the third landscape. The project took up this proposition by way of an incremental approach to building up the ecosystem as a first step on the site and a first phase in environmental education of local pupils and interested citizens. This would be followed by a gradual build-up of constructions on site that either work with the existing terrain, such as implementing an amphitheater, or by way of temporary constructions, including a kitchen and educational pavilions, which would be tied together into a coherent whole by a permanent large green canopy that supports the local ecosystem and modulates the microclimate accordingly. The SDGs addressed by this project include good health and well-being, quality education, clean water, sustainable cities and communities, responsible consumption and production, and climate action. The specific subsets of performance-oriented design include extended thresholds, auxiliary architectures, microclimatic modulation, and multispecies design. The latter could be further strengthened by considering ecosystem services that can be related to the organic material cycle and the green canopy. Again, a more extensive remapping of the system boundary of the project could have pointed to this aspect at an earlier stage of the project development.

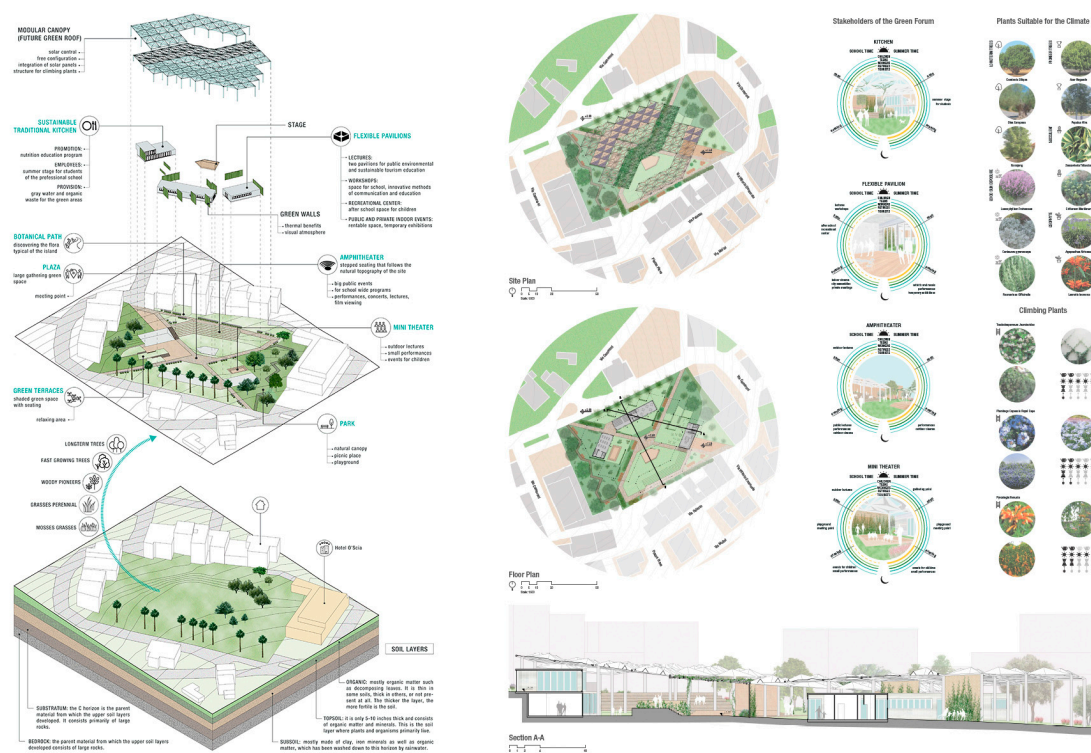


Figure 4. Green Forum: (a) exploded axonometric view of the development of the brown field site; (b) plan views, program and provision distribution, and stakeholder identification; (c) section through the site showing the architecture and vegetation interfaces.

3.1.5. Project M-Filter

The project “M-Filter” by Virginia Boldrini, Yonne-Luca Hack, and Krzysztof Kuczynski (Figure 5) proposed a modular architecture for waste collection and recycling as an information point, small research lab, and educational information point. Initially located in the main harbor in Lampedusa, the architectural elements can be relocated together or in part to different sites on the island, addressing locally specific waste combinations and recycling strategies over time according to different land use-related waste conditions. The project made initially specific provisions for the collection of plastic waste from the sea and on land to address the current problem of increasing plastic pollution and its impact on marine life. Local fisherman would be encouraged to collect plastic waste from the sea by way of a compensation and subsidy scheme. This part of the project was informed by interviews with researchers of the NGO Marevivo. Furthermore, the project proposed a microeconomy with workplaces for locals based on waste collection, waste-related research, and waste recycling. This would, in the long-term, entail that much less waste needs to be transported off island by ship to distant waste-management locations. The SDGs addressed by this project include good health and well-being, quality education, clean water, sustainable cities and communities, and responsible consumption and production. The specific subsets of performance-oriented design include extended thresholds, and microclimatic modulation. The project could have explored more deeply the various suggested scenarios related to different waste and recycling problems in different locations on the island. Moreover, the questions concerning (urban) metabolism and material consumption on the scale of the entire island could have been developed to provide a higher level plan and indicators for the placement and focal aspects of local interventions. For this, the system boundary map would have to be utilized as a multiscale tool.

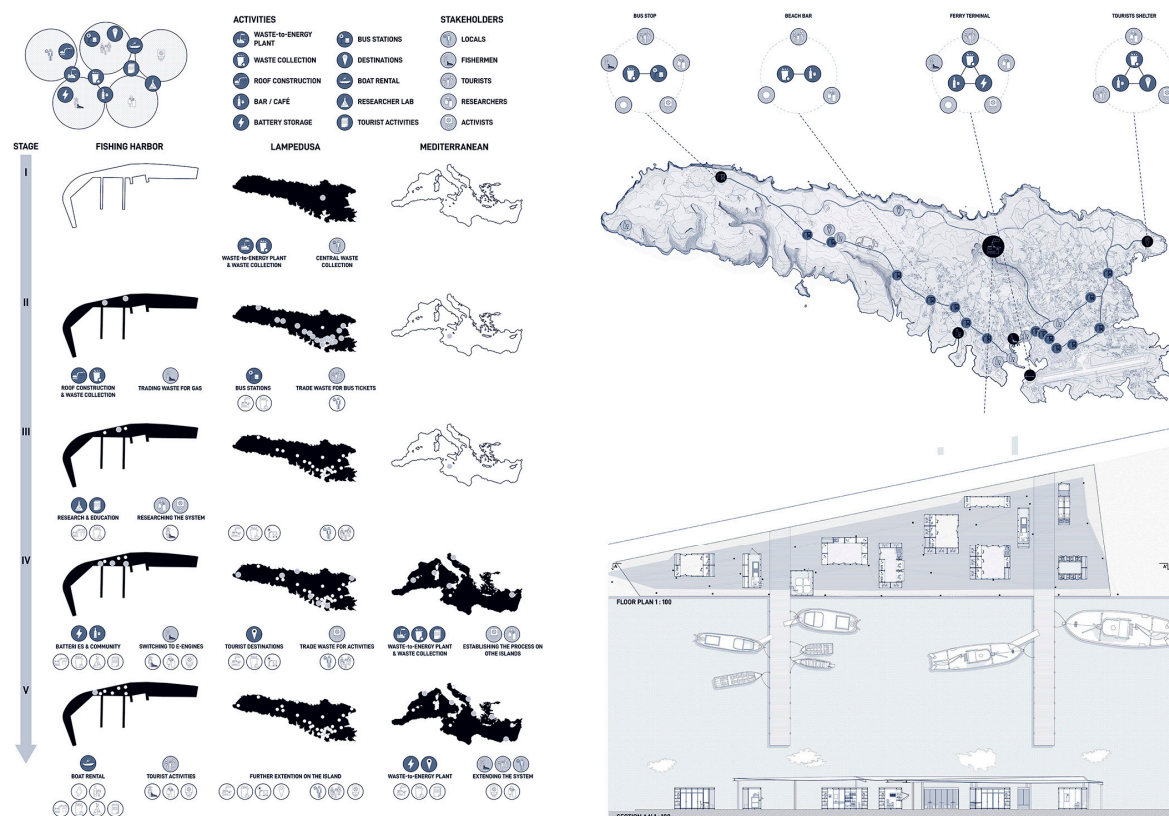


Figure 5. M-Filter: (a) chart of activities and stakeholders and development scenarios over time; (b) activity and stakeholder configurations for different locations on the island; (c) intervention in the main harbor of the island.

3.2. Master Thesis

The master thesis project by Alina Ovsyannikova (Figures 6 and 7), who participated as a master student in the Lampedusa Studio, focused on the Lake Baikal region. The project commenced with an extensive and detailed analytical mapping exercise [31] to identify problems and key stakeholders around the largest freshwater lake by volume in the world, which features a unique ecosystem. The analysis focused on community composition, spread, conditions, and needs around the lake. Circa 100,000 people live on the coast of Lake Baikal and the population is continually decreasing. There exist ca. 80 settlements around the lake. Most of them have under 1000 inhabitants. These communities are poorly connected by water and many cannot be accessed by land. In addition, the winter climate is harsh and the lake freezes over from January to May. The project proposed an all year boat connection to particularly difficult to reach communities and to gather smaller communities together into larger ones to have more advantages of new infrastructure. The boat connection would also serve for waste collection and delivery of much-needed resources. By involving the tourist population that is present, and that can be increased, the financing of the boat connection can benefit significantly and new jobs can emerge even in more remote locations. In addition to the infrastructural scheme, the project proposed a new hybrid building for each connected location that serves as a boat-stop, waiting room, and space for communal use during the seasons, including a small café. At the same time the building would serve as a greenhouse to facilitate communal farming of vegetables and fruits, especially for consumption during the cold season. As such, these small buildings would serve as meeting points and social condensers for these small and remote communities. These can largely be built from local materials, except for the transparent cladding material, thus keeping the initial costs as low as possible. The SDGs addressed by this project include no poverty, reduced inequality, sustainable communities, and responsible consumption and production. What is interesting to see is

that the experience of the Lampedusa studio reduced the inhibition on the side of the student to take on a very complex project of a large scale and scale range, without readily available information or a project brief. The tool of extensively mapping the context to derive an informed system boundary for a project, supplemented by the SDGs as an additional means, made it possible to think of different scale-specific interventions that could have prototypical characteristics that could be made locally specific due to local conditions and related scenarios.

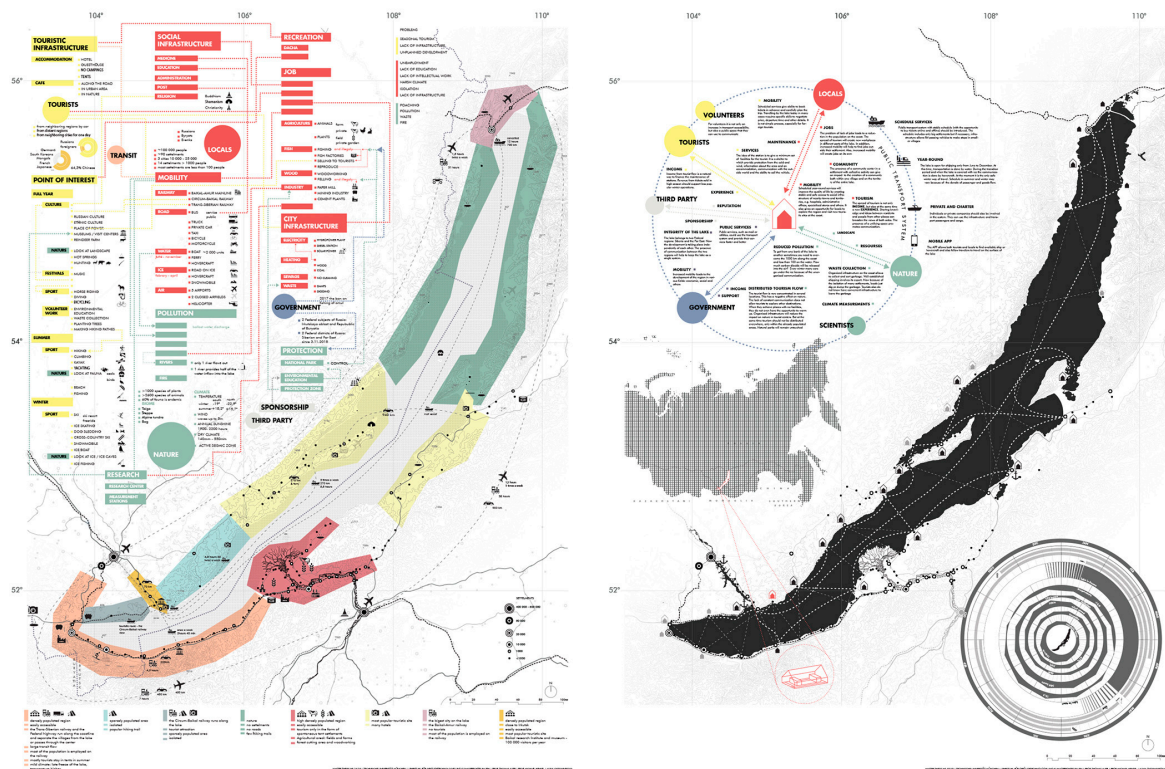


Figure 6. Lake Baikal development plan: (a) summary of extensive site analysis and stakeholder identification and correlations; (b) stakeholder correlation development and related infrastructural plan for a new boat service on Lake Baikal.

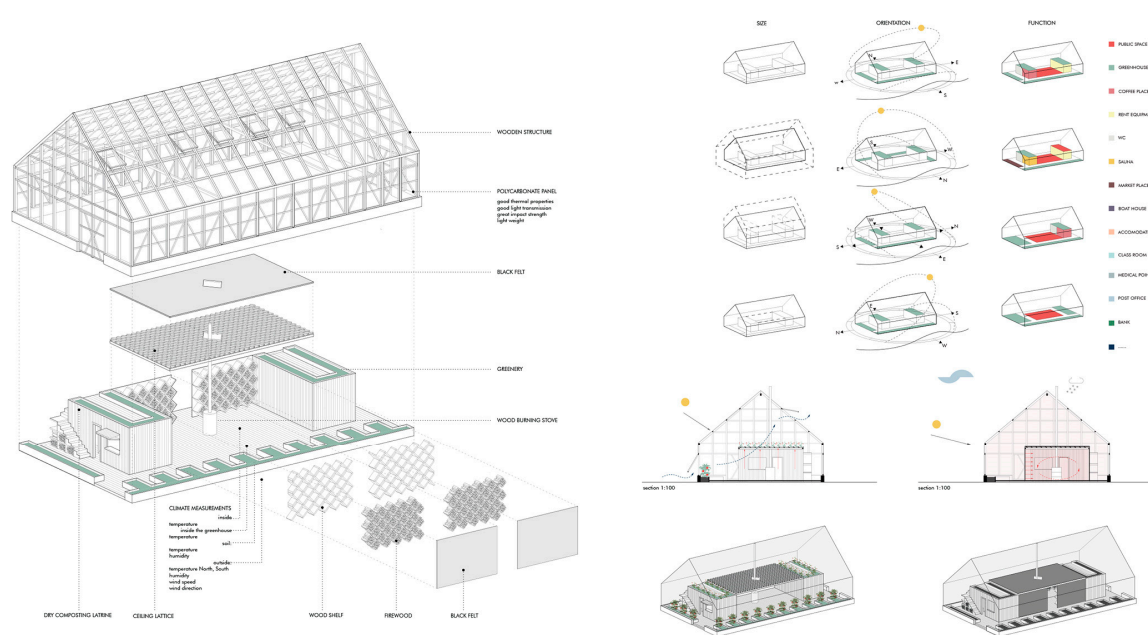


Figure 7. Lake Baikal development plan: (a) exploded axonometric view of a prototypical communal building made largely from locally sourced materials; (b) location and stakeholder configuration specific use scenarios of the communal building.

4. Discussion

The above-described projects demonstrate possible outcomes facilitated by the portrayed pedagogical approach. While the projects can serve as a way of validating the pedagogical approach, it is necessary to point out that as of yet not enough work has been produced to draw overarching conclusions. Nevertheless, it is useful to undertake a preliminary evaluation based on common features and shortcomings of the work to uncover possible areas of further development of the pedagogical approach.

The projects all comprised of systemic interventions facilitated or augmented by architectural provisions. All projects involved a range of socioeconomic and socioenvironmental sustainability aspects that responded to a number of selected SDGs. Here, it is of interest to review the selection of SDGs in order to understand whether these were mainly motivated by context analysis or general preferences by the students. In various conversations with the students, it became clear that certain SDGs are closer, and some are further away, from the thematic familiarity of architecture, landscape architecture, and urban design students. However, with increasing confidence, some of the SDGs that were perceived by the students as more complex (i.e., no poverty, reduced inequality, etc.) were taken on, as the master thesis project demonstrates.

Furthermore, all projects addressed multiple spatial, temporal, and functional scales and dynamics, as well as a broad range of actors, including local and transient populations. Aspects of resource and waste management were shared by all projects, often in conjunction with experiential or educational provisions, as well as aspects of community building. Some projects envisioned larger-scale institutions or constructions as the start or outcome of the project. However, the majority of projects took an explicit bottom-up approach, together with criteria for assessing impact over time and the means for adapting the approach to emerging conditions and circumstances. In this context, projecting different possible future scenarios played a key role. It was this directed, yet open-ended and scenario-based, characteristic that enabled robustness via adaptability of the projects.

What is also of interest is that students invariably proposed combinations between practices, systems, and objects relative to projected scenarios and intended stakeholders. This marks a distinct departure from the primarily object-focused design of architecture in which sustainability problems

are segregated and narrow in range. As such, this ran counter to the common approach of keeping studio work manageable for students by way of adhering to established notions as to what architecture is and what architecture does. It is of interest to see how a more ambitious approach to embracing complexity also shifts the understanding of what can be architecture and what architecture can be.

In general, the work gives evidence that students develop awareness in utilizing routine, adaptive, design, and value expertise where needed in the development of a project.

What fell clearly short is the question of validation of the possible impact of proposals. It could be of interest to run this type of studio over consecutive semesters, such that returning students can engage in the production of location-specific full-scale prototypes or develop ways of simulating possible outcomes. Thus far, simulations have reduced currency in dealing with compound sustainability problems as simulations frequently are reduced to a lesser number of parameters or limited-use scenarios. Nevertheless, simulations play a role in assessing and developing partial aspects of compound sustainability problems. Furthermore, developments are under way in which simulation methods and tools are considered in terms of their correlation and interoperability in the context of multiscale and multidomain methods and tools. This will be a game-changer in modelling environments from an integrative and interdisciplinary perspective.

Integrating big data and data-driven design [32,33] into the approach will further contribute to its development, but also raise the challenge for the students and the teachers. This may necessitate working in larger teams on projects to spread and incorporate knowledge and skills at a manageable level. In this context, data-driven design will play a big role in the future. As a first try of acquiring and involving site-specific quantitative data, the studio conducted a Climatewalk in Lampedusa. The Climatewalk experiment [34] was designed to measure environmental factors and human thermal behavior in urban spaces by relating individual and subjective responses to environmental condition adaptations. The objective of the experiment was to provide thermal understanding of the responses of pedestrians when walking in outdoor environments using a geo-referenced method for monitoring and mapping of the microclimate and a longitudinal survey to obtain the thermal responses of pedestrians in order to improving the climatic knowledge of the urban context. Urban environments generate microclimates that elicit thermal experiences in the pedestrian that are vastly more complex than they would be under steady-state microclimatic exposures. Including microclimate more explicitly, both in terms of qualitative and quantitative understanding, would serve to formulate proposals that recognize microclimate as a determining result of the complex relationship between architecture, climate, and society. We carried out Climatewalks in Lampedusa to enable the students to obtain a better understanding of the specific ranges of microclimatic conditions in the open public spaces and the landscape of the island. This effort will need to be strengthened and become part of a succinct data-integrated and data-driven design approach to compound sustainability problems.

5. Conclusions

The studio employed a multimethod mode of inquiry, and especially research by design, in seeking to tackle compound sustainability problems in architecture, landscape architecture, and urban design. The key question was how to address the increasing gap between limitations in teaching approaches, time, and resources in master-level education arising from modularized curricula and short semester schedules in relation to increasingly complex sustainability requirements.

Short semester and master thesis schedules continue to pose a substantial problem for in-depth study, even if the tasks can be spread across teams of students. For this reason, it would be useful to parallel the studio activities with linked research studios and interdisciplinary seminars that enable further in-depth study of selected aspects, and to link the master-level teaching with PhD-level research to enable intense periods of research for master-level students, as well as to enable PhD students to obtain experience in research group leading and a production of empirical knowledge.

Finally, it is necessary to realize that questions of ethics and empathy play an essential role in addressing multiactor and multistakeholder compound sustainability problems. This can be linked to

the question of empathy in specific approaches in design thinking and raises questions concerning choice of guiding ethics, related principles, and rights that require consideration in relation to the themes presented and tackled in the portrayed pedagogical approach.

A lot more work is needed to tackle the question of data, ethics, and empathy. In the creative disciplines, design studios and research by design are beginning to be valuable assets in this endeavor.

Author Contributions: Conceptualization, M.H., D.S., and D.S.H.; methodology, M.H., D.S., and D.S.H.; writing—original draft preparation, M.H., D.S., and D.S.H.; writing—review and editing, T.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: We express our gratitude to the Technical University Munich for providing the AWS Visiting Professorship 2018 for Michael U. Hensel. Furthermore, we extend our gratitude to the Marevivo Association, especially to its President Rosalba Giugni, and to Gabriele Giugni and Fabio Galluzzo for their support; the mayor of Lampedusa, Salvatore Martello, for narrating past, present, and future aspirations of Lampedusa; Francesco Guzzardi, journalist and writer, for information about the island and its inhabitants; and to our teaching colleague David Selje for inspiring collaboration.

Conflicts of Interest: The authors declare no conflict of interest.

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