

Article

More-Than-Human Perspective in Indigenous Cultures: Holistic Systems Informing Computational Models in Architecture, Urban and Landscape Design towards the Post-Anthropocene Epoch

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Abstract: By studying Aboriginal maps, this speculative research discusses world heritage concepts about land and merges them into western urban contexts. Assumptions concerning spatial allocation and demarcation such as boundaries, divisions and geometric patterns are being contested by ideas pertaining to Indigenous narratives expressing holistic views about community, and the ecosystem as integrated components of broader organisations. First, this paper introduces principles of the Indigenous culture spurring viable land management by shared, equal and inclusive schemes as ones that also respond to global socio-environmental challenges. Alternative strategies are being considered relating to the soft demarcation of distinct areas understood as malleable aggregates merging with each other and with the landscape's topological features, with reference to the Aboriginal culture. The techniques being proposed are further compared with original approaches in architecture and urban design developed since late modernism, challenging enduring practices. Seen next to each other, these models of thought are suggestive of a paradigm shift by which architecture reinforces deeper connections with the intellectual, sociocultural, and natural resources of the greater cosmos. Furthermore, as these ideas are propelled by computing, they lead towards the dynamic linking of analysis with the design results producing all-sustainable structures that are widely applicable, as architecture's contribution to the current socio-scientific discourse on holistic approaches with a more-than-human perspective.

Keywords: Aboriginal mapping; post-Anthropocene; more-than-human; soft boundaries; rewilding; holistic models; ecological urbanism; urban systems; ecosystems; dynamic simulation



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1. Introduction

The Australian continent has been the home of its Peoples since the prehistoric era [1]. Contrary to earlier descriptions presenting Aboriginal life as one essentially based on hunter-gathering, later studies have shown that Aboriginal and Torres Strait Islander Peoples—being a more accurate description of Australia's native population—have developed a rich culture and lifestyle comprised of sophisticated practices on land use, along with hunting, cultural burning, sustainable agriculture, aquaculture, and housing [2,3]. Accordingly, Aboriginal culture, in all its abundance and magnificence, may enrich the contemporary discourse about physical space, with new models of organisation being useful in design cases around the globe in discussing elaborate systems of production and management of Earth's precious resources, especially in the case of the escalating climatic, environmental, and social crises.

Such a background involving many different aspects and groups, along with the deeper concepts and values associated with it, has been portrayed widely in Aboriginal

map paintings. Aboriginal maps incite a more-than-human perspective. They consist of a popular theme across the Australian territory, setting in its pluralism a unique testimony of Aboriginal Peoples' cultural diversity and depth. They are abstract compositions of the landscape, including its natural assets, such as trees, animals, rivers, and valleys, presented alongside community structures and other cultural references. Such an expression is suggestive of human's intimate bonding with specific locations witnessed in all everyday occurrences of Aboriginal life. Conceptually, the Aboriginal map is translated to the smooth distribution of all participating instances and their representation by a homogenous total of dynamic motifs often emerges as aggregates of variously coloured dots. Apparently, such techniques attribute grant value to all contributing elements with regard to parity and recognition, as they belong to a shared place everyone is identified by. The resulting idiom is an organic entity of energy flows, soft transitions, and fusions.

It may be noted, however, that this mapping mode is different to those of western spatial distribution. For example, political maps manifest territorial sovereignty and ownership through geometric boundaries translated to undisputed bordering and clear lot dividing. Strict bordering is a globally accepted practice to demarcate land, employed even to outline areas of natural phenomena. As a consequence, nature's assets and protected zones in Australia and elsewhere are often depicted as bordered and isolated cluster sites too, that is, as if they were clearly marked territories existing separately from the greater activities, the water, other natural reserves, phenomena of diffusion, the wildlife circulation corridors, and the network of places by which they are impacted (see Figure 1). Such techniques do not fully capture the flux and the varying intensities of natural operations, connections, and influences between the local sites and the greater areas. Therefore, the Aboriginal mapping can be suggestive of alternative approaches to urban design and territorial decolonisation, though for now on a speculative basis.

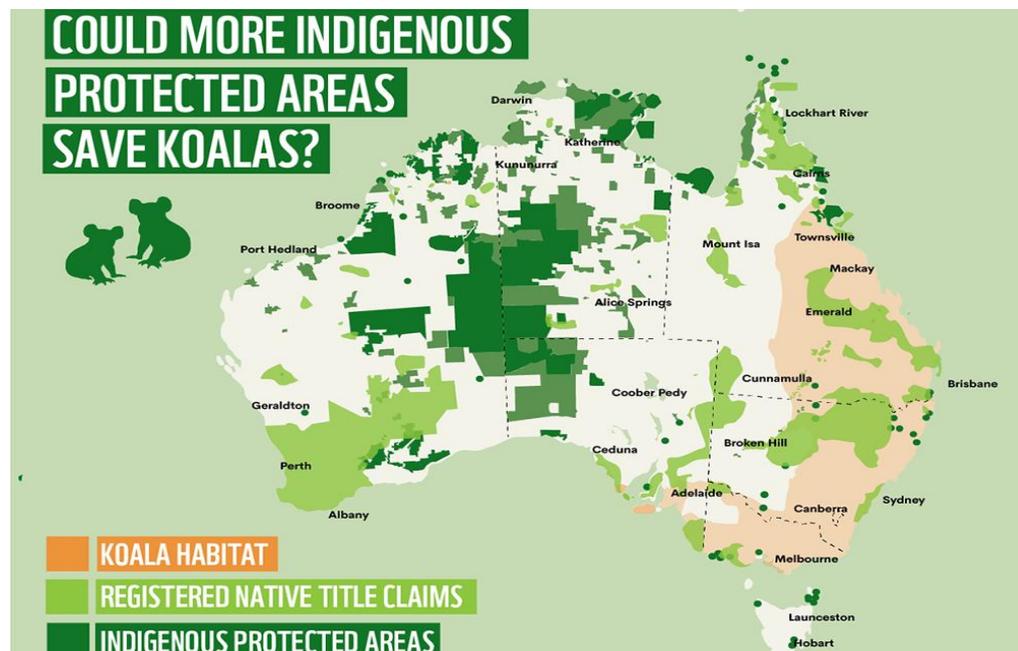


Figure 1. Map of Australia showing the location of Indigenous Protected Areas, existing registered Native Title claims, and viable koala habitats. Aboriginal and Torres Strait Islander people have established and built land and sea management arrangements to care for country and culture upon the successful claim of Native Title. © 2023 WWF-Australia (Map data courtesy of National Native Title Tribunal, Commonwealth of Australia, Department of Agriculture, Water and the Environment, Commonwealth of Australia, Geoscience Australia, Collaborative Australian Protected Areas Database—CAPAD, Commonwealth of Australia and Australian Land Tenure).

The Aboriginal visualisations promote comprehensive schemes for land use, and are strikingly relevant for the treatment of environmental decline and other pursuits of the current world. For example, Aboriginal maps' general ideology and description of elements on equal terms, in relation to one another and with respect to the greater natural structures, may respond to the urges and aspirations of global agendas such as those outlined by the United Nations' Sustainable Development Goals report [4], namely referring to Zero Hunger, Good Health and Well-Being, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life on Land, and Partnerships for the Goals (goals 2, 3, 10, 11, 12, 13, 15, and 17, respectively). Rather than taking a posteriori measurements upon enduring pathogenies without acting upon the causes and the structures that have resulted in their appearance in the first place, Aboriginal mapping is proposed in this case as a pretext that may assist in reconsidering fundamental assumptions about land imbued in western culture, but ones that in the long-term have also begun to show their detrimental impact upon the environment, climate, wildlife, pollution, water quality, and the biosphere, further linked to phenomena of socio-urban stress. As this study suggests, these may be readdressed by rethinking the human/nature co-existential relationship, aiming towards a new kind of synergy, reciprocity, and cointegration of all parts that make the total system [5–7]. The design of physical space favours evolutionary principles connecting natural phenomena as active agents with those of human settlements in a process that may be described as a conditional “rewilding” of the urbanised setting, raising priorities beyond anthropocentric reasoning [8]. Even more, the introduced concepts hint at analogies with advanced rule-based analytical and generative approaches supporting holistic solution schemes held together by underlying living structures and life-creating processes by which a building is linked to its surroundings. Such thoughts have been developed since late modernism [9–12] and were evolved further in the 1990s [13,14], 2000s, and so on as they were enriched with more sustainable views by which to integrate the built environment with experience and the greater milieu [15] (see Figure 2). As this paper proposes, these references with all their differences have set the basis for adaptive development met in more recent generative computational design approaches, where physical space has been considered an effect of fusion, negotiated protocols, and soft programmatic transitioning [16–19]. Consequently, ideas and values expressed in Aboriginal maps are meaningful in the quest for novel urban and landscape design globally, set in response to the present crises and scenarios.

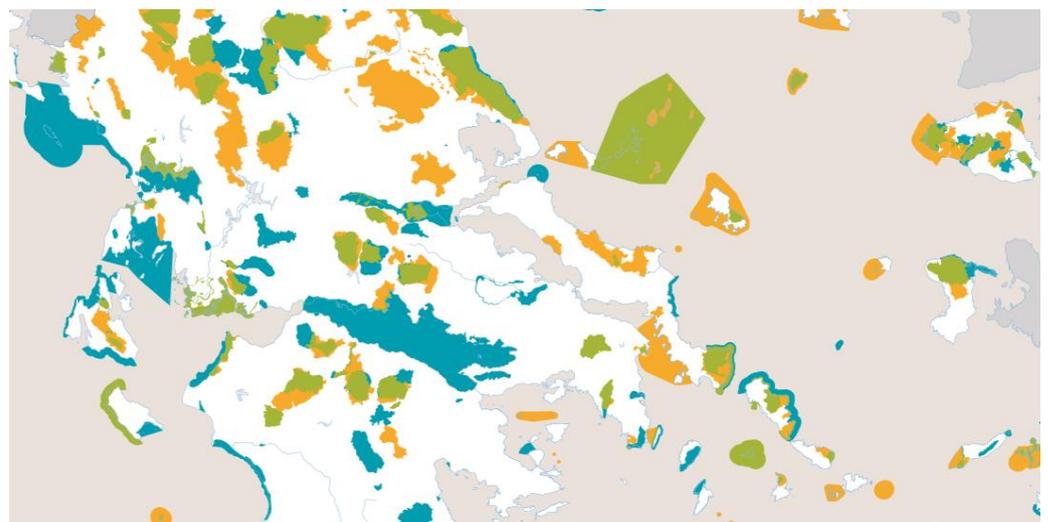


Figure 2. Natura 2000 map of Greece in detail, showing the protected zones dispersed in the greater territory. Ideally, these areas should form a continuous network with smooth transitioning between them to promote interactions, exchanges, and energy flows across the whole region.

In response to the above, this study proposes Aboriginal mapping as an appropriate reference to inform current architectural, urban, and landscape design discourse by cross-disciplinary themes, further supported by computational models and dynamic simulation techniques. Moreover, by exploring the potential of these influences to deal with the persistent challenges of the physical space, architectural knowledge is enriched with the world's cultural legacy and aura. Computational methods and practices of the built environment may assist architecture at large to fully engage with greater sustainability aims and structures directed towards social, climatic, and ecological equilibrium, sought alongside the cycles, the resources, and the operations of the greater 'topos' that its works inevitably incur.

2. Methodology

This study unfolds in the following key moments illustrated in the methodology diagram (see Figure 3) explained below:

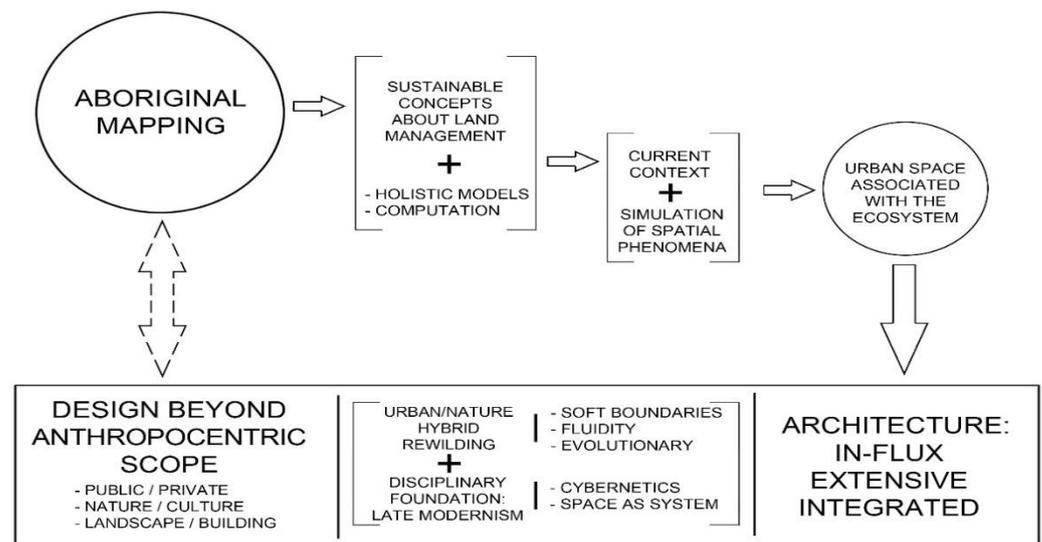


Figure 3. Methodology diagram.

As a start, this paper delves into Aboriginal map painting as an original narrative artform carrying sustainable concepts about land applicable globally in various urbanised contexts. Especially since design has evolved, with the aid of holistic models supported by algorithmic processes, the principles invested in Aboriginal mapping may redirect architecture and urban design into more adaptive modes of social cohabitation, further harmonised with nature's systemic and structural operations directed to energy management, sustainable functioning, and overall balance. Thus, through a brief analysis of Aboriginal mapping, this study acknowledges the profound significance of Indigenous practices around land as a valuable resource—both intellectual and applied—for the world to embrace and to learn from.

In the next step, the references set above are explored with dynamic simulation techniques managing various sorts of data inputs attributed to spatial occurrences. As Aboriginal mapping is transferred into contemporary design contexts, its concepts are suggestive of holistic views about physical space manifested as the hybridisation of the urban activities with nature's performances all merging with the ecosystem. From a technical point, this set of goals is satisfied by a fluid perception of space and shapes identified by their mutual compromises rather than by cartesian defining or rigid linearity. Tentative descriptions and shifting values of the greater socio-cultural and natural setting reflect the behavioural properties of the parts as animated features producing a series of interactions and, accordingly, soft output variations in physical space seen as a time-based effect. The results are suggestive of a multiplicity of associations among the elements of the

human-made environment sought alongside those of the natural system. Physical space is identified as a bottom-up phenomenon resonating with general ecological structures as opposed to permanence or top-down order.

In Section 4, this paper adds further significance to the above approach by grounding it in the core architectural discourse. The main principles of Aboriginal concepts are compared with those set by late modernism's avant-garde. Parallels are drawn between Aboriginal views presented in their maps and emergent formation methods such as associative design strategies, protocols of negotiation, and spontaneous spatial organisation and development. Set in an era influenced by cybernetics, these references echo systemic analogies directed to dynamic data management through simulations and approximated procedures. The principles of late modernism were revisited during the 1990s by raising its affinities with computational thinking, for example, space is understood as a dynamic and evolving field. In that context, computations introduce an exploratory character to design. A variety of inputs are employed along with extensive use of references as a means to inform the model adding more credibility to the design process. This emerging mode of architectural practice is supported by scientific rigour set alongside creative insight to reach comprehensive solutions to problems of higher complexity, often with no prior reference. An alliance between Aboriginal views, late modernism, pioneering works of the 1990s, and advanced computing outlines a new prospect for architecture and urban design to respond to current demands around physical space, such as imbalanced territorial occupancy, environmental misuse, and uncoordinated distribution of natural assets.

In its conclusion, this paper reflects upon how the findings set above may impact common assumptions about architecture at large in its transition towards the post-Anthropocene epoch with a more-than-human perspective. Widely applied precepts related to strict bordering, lot dividing, and security control are sought next to the polarisations they beget, such as those about public/private, nature/culture, and landscape/building. Such dichotomies are thought as being inherent to the western world's perception of spatial occupancy, thus are also unavoidable, still causing unwanted friction and waste on a large scale of raw materials, property and lot allocation, minerals, water, culture, and knowledge, with long-term consequences and a degradation of the urban space, the ecosystem, and society. Concepts expressing a more integrated scope about nature and humans, such as those represented by the Aboriginal culture, may assist creative architectural practices to find solutions to problems witnessed in the anthropocentric world.

3. Significance, Applicability, and Conceptual Principles of Aboriginal Mapping as It Meets Computing

3.1. Significance and Applicability

Analysis and interpretation of Aboriginal map paintings with advanced computing was guided by a quest to create a balance between human-made settlements and the ecosystem. Dynamic simulation was employed to activate concepts about physical space belonging to the Aboriginal tradition, related to organisation, reprioritisation, use of natural instances and materials, as well as of the sociocultural assets associated with it, making an aggregate of heterogeneous references being recruited in the map narratives. Recurring features and themes expressed by soft edges and shape patterns consist of active components about land, its meaning, and the activities it supports. The resulting spatial organisation schemes and the techniques they are produced by it are linked to the worldviews, stories, legends, and ideals by which Aboriginal people have lived together in their natural setting, arguably since the earliest period of humanity. The map insinuates a total system in which each unit lies together with those set next to it. Outlines and forms correspond to the ways in which different instances of matter and energy under certain conditions comprise larger totals. As demonstrated in the respective chapter, the Aboriginal map can be interpreted as a holistic system incorporating tangible and intangible knowledge by employing alternative conceptual principles to bring those elements together. This organisational structure advocates fusion rather than separation of the parts. Its roots may be traced in Aboriginal

cosmology, which includes every component, material and immaterial alike, producing entities through dots, lines, structures, and outlines as an effect of their immediate interaction. Such an idea is reminiscent of nature's greater manifestations creating spatial architectonics in their most generic form [20] (pp. 172–173), that is, being different to any mysterious or greater force, a common doctrine in western theology. As the analysis suggests, Aboriginal mapping sets an alternative understanding of physical space that promotes inclusion and equal participation of the elements it holds in mutual acknowledgement, adaptation, and reciprocity into a smooth whole.

An analogy between the Aboriginal map and architectural and urban design may be drawn, adding more significance to it as a comprehensive means—both an intellectual and a practical one—to respond to contemporary aspirations. Specifically, ideas expressed in Aboriginal maps may be compared with innovative modes of urban development explored since late modernism [9], as adaptations of cybernetics into physical space [21] and then with the advent of computing. Such an alliance may be suggestive of new protocols by which to outline architectural form in a more direct relationship with the restrictions it is created by [17]. The formed analogies may set new references and terminology into architecture and urban design as these evolve rapidly into the present computational era in meeting with current socio-political and environmental agendas.

Hence, Aboriginal mapping is an exemplary case by which to unfold Indigenous culture's all-sustainable values and adapt them selectively and with the assistance of computational models into architecture's discourse, especially on systems of spatial organisation. Aboriginal mapping becomes a vehicle for attributing cultural depth to land management, so that physical space is signified beyond mere measurements. The suggested alliance between the Aboriginal mapping and the code-based features of computational power is offered as a drastic antidote to the standardising character of mainstream trends, often showing little potential for adjustment and alignment with the unique characteristics of different loci. Computation has equipped designers with dynamic tools advocating a stronger relationship between society, the natural setting, and the ecosystem [22]. The polyvalent forces of the greater urban and ecological fabric may be activated and related to each other so that their shared impact is studied even in real-time experiments, suggestive of the genesis and evolution of dynamic settlement patterns as these gradually turn into design schemes. Understanding the act of mapping as a dynamic rather than a descriptive process sets physical space inseparably from land and its physical phenomena, including the geo/biocytes, flora and fauna, and people. As such, space is continuously linked to changing factors, and is therefore a time-bounded and debated concept [16,23,24]. For this purpose, key principles manifested in Aboriginal mapping are expanded with performative modelling techniques to scrutinise architecture and urban design in different contexts and case studies [25]. The proposed analogies present tighter connections between qualitative and quantitative inputs guiding a project's analysis towards synthesis, and in so doing, reinforcing informed predictions, provisions, and solutions.

Consequently, this paper's scope is to connect a set of versatile references and thoughts as they have been reshaped and adapted towards new principles, methods, and actions about architecture outlined by all-sustainable means, in its transitioning towards the post-Anthropocene epoch. The proposed approach is grounded on a holistic understanding of a more-than-human perspective, further activating sociocultural and cross-disciplinary knowledge also with advanced computing to construct alternative pathways to design. In its conception, this paper presents a long-term quest to engage intellectual and technical inputs from sources often outside architecture with the discipline's past and recent theories, that may have only scarcely—if not at all—been linked to each other. It is hoped that such an attitude to open architectural discourse in a broader socio-scientific frame will assist in rethinking the long-lasting assumptions and add consistency and rigor in meeting with global challenges.

3.2. Conceptual Principles

3.2.1. Shared Identities, Land Topology, and Fluidity

In Aboriginal Culture, humans are thought of as part of the land they live in. Aborigines are intimately connected to the landscape and the stories associated with it. An Aboriginal's identity is somewhat pre-constructed, being integrated with the narratives about the geography of a place, which also connects it with all other members within the group as well as with activities of ancestral beings [26]. Land clearly supersedes human ownership. Aborigines own the stories they create and through this they have been linked together with the land, registered as a 'place' in the memory of its peoples. The notion of a place is conceived by incorporating temporal and spatial aspects of Aboriginal mythology. Aboriginal people fill the stories; consequently, every aspect of their existence, including their actions, even their physical bodies, are tied with a place; they do not simply live on the land, they belong to it and are identified by it. Earth, land, and the human body are depicted as "interpenetrating, polymorphic, shifting and metamorphosing sediments of experience that establish a foundational identity" [27] (p. 122). The living body, with its lively actions, changes, moves, and shifts, creates tensions and overlaps with those of the dead body, which is calmer and more tranquil, associated with resting, sleeping, dreaming, and dying, altogether complementing the universe. A desire for fluidity sets the protocol of cohabitation and interaction between humans, animals, plants, minerals, and heavenly bodies, as a primary quality they all share. Aboriginal land includes any material and intellectual constructs associated with Aboriginal peoples, also animal and plant beings, which are common to everyone. Land is composed of bits of material and information forming layers of references, memories, and matter, rendering it a ubiquitous network structure.

The Aboriginal concept of land is invested in the graphic language and techniques of Aboriginal mapping. Mapping sets a graphic system closely associated with the narratives of the country [26]. Other than fulfilling the objectified task of accurately tracing reality, the Aboriginal map is expressive of a highly subjective tone both in the ways it has been produced and by which it is being read. As such, it is more of a topological experience of the stories it refers to, relating to non-representational and non-illustrative movement diagrams [28]. With shape and dot abstraction, information is made operational and instrumental. Data from different sources are shown by diagrams of relations between elements and generative forces, echoing Deleuze and Guattari's view of diagrams as consolidated matter-and-function assemblies [29]. Land, with the semantic values and the living practices it incites, is manifested as a place generator, expressed by iconic elements in countless combinations, producing, signifying, and loading sites with meaning [30]. Mapping produces pulsating instances of balance by simulating a place's dynamics into a semantic total.

3.2.2. Relationscapes and Connectedness

Aboriginal maps present a space as a dynamic phenomenon of movements and flows invested in the shapes and the artistic techniques. Through the act of painting, the artist, either individually or in a group, re-enacts the events. Mapping becomes a choreography of practices, a 'relationscape' that directs the viewer to re-experience sensation in relation to the implied liveliness of an emergent location (see Figure 4). Movements often acquire the form of tracks or songlines that traverse the whole continent [31]. They translate to a flux of intensities about land, as the land beholds experiences, along with the possibilities by which the world might have been created. The complexity of movement leads to the experience of a certain instability that instigates a rethinking of space and time [28]. This results in an ontology of space, time, and beings in constant exchange, according to which everything exists by its relationships with other instances. The body, whether human or of any other significance, acquires its social, political, and existential purpose by its actions in the range of influences and impact with the greater patterns it is immersed into. Every instance contributes to the complex genealogical and spatial structure, adding coherence,

energy, and value to the greater milieu, humans and nature combined. Consequently, an idea of ‘connectedness’ is demonstrated, signifying links among ancestors, people, places, and ceremonies [31], setting a spacetime network of all ancestral beings also with the present. This dynamic structure is replete with associations recorded in the painting’s semantic language, in which the subject of sentences are not things, but references from the centrality of the land in the Aboriginal cosmos. The concepts of ‘relationscape’ and ‘connectedness’ set above are embodied in the map’s visual outputs. Information of diverse quality and origin produces a blending of geospatial, environmental, and socio-cultural knowledge. The landscape becomes the secret source of values, rights, and obligations of Aboriginal culture, which expands between dreams and narratives, and reads both as a map and the technique of its recreation (see Figure 5).



Figure 4. Dick Pantimus Tjupurrula. Water and Wallaby Dreaming, 1981. © Estate of Dick Pantimus Tjupurrula. Licensed by Aboriginal Artists Agency Ltd.

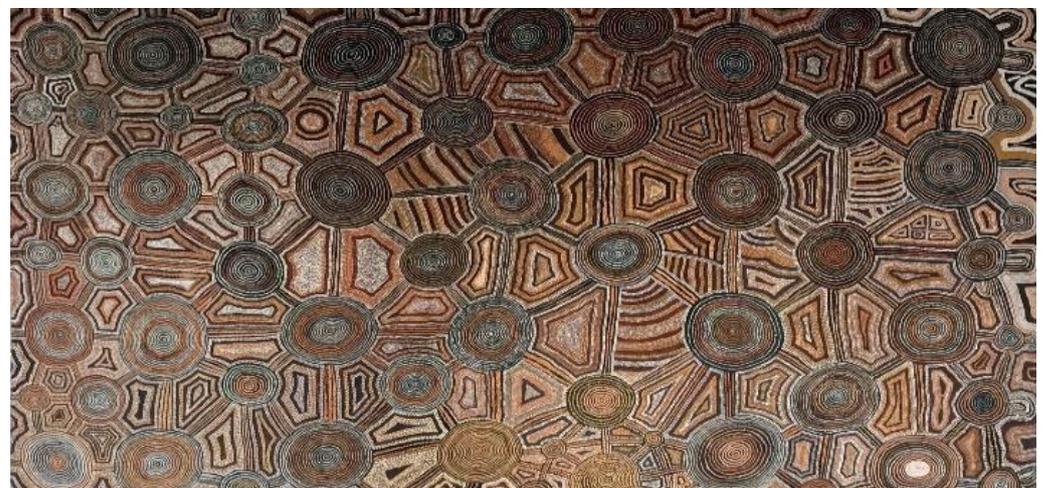


Figure 5. Uta Uta Tjangala. Untitled (Jupiter Well to Tjukula), 1979. © Estate of Uta Uta Tjangala. Licensed by Aboriginal Artists Agency Ltd.

Moreover, mapping presupposes that one has the experience, knowledge, and responsibility to speak of the land and for its sustenance and transmission of meaning. The land is a property that is common to all, a confusing idea to a western mind at first; however, explained in that land is primarily a concept created and reshaped constantly through spacetime processes, that is, opposite to establishing outlines and ownerships. Having no permanency or fixity, the land is no different to an open field set through extendable strings [31,32]. The curved lines, the shapes, and the colours of the map respond to the dynamic qualities of the portrayed elements. There is often a discrepancy between the actual measurements and the shapes and sizes being shown, since the purpose is not to record a place's geometric features or other quantitative values, but to stir up the bond between it and its occupants; hence, to promote space's qualitative characteristics that add to its identity. As a result of the profound qualities a map carries within it, the act of mapping is endowed only to those who have lived and have connected their lives with that place, so they can testify their experience through the art of painting. The result is a hybrid system rich in meaning, symbolisms, relationships, and connections of cultural and practical information, which engages the land with its people and the natural and other treasures it hosts.

3.2.3. Soft Boundaries

The concepts of relationships and connectedness of Aboriginal maps are manifested very differently compared to typical topographic maps. In an Aboriginal map, they invoke superseding the need to draw strict boundaries. A unit's boundary sets a soft limit that often expands through offsets, repetitions, and diffusions until it meets with other units (see Figure 6). In that case, the boundaries' main function is that they are there to cross [33]. They are permeable, with rites of access being most frequently granted. Consequently, the boundary does not correspond to notions of enclosure [31]. Rather, it is suggestive of a soft membrane that outlines not only a space's limits, but also the kind of space it creates in closer analogy with the natural space produced by a living body and its extensions also in relation to its outer world [20] (pp. 192–193). The boundary becomes an active unifier, a bottom-up demarcation whose presence as well as properties carry deeper sensations and various connections outside Euclidean structures [28]. The wavy feel induces a field that reverberates energy not limited to motionless tracking. At times, the lines extend to the sky, linking the movements, paths, songlines, verses, and legendary stories by an omnipresent order (see Figure 7). Introducing these features into the Aboriginal map system causes a rethink of the boundary as a malleable effect that occurs when two or more instances as soft outlines negotiate their energies by welcoming, interacting, and living together; that is, an emerging result rather than a pre-set condition.



Figure 6. Warlimpirrnga Tjapaltjarri, Marrawa, Tjukurrpa Palurukutu, Kutjupawana Palyantjanya. Same Stories, A New Way, 2009. © Warlimpirrnga Tjapaltjarri. Licensed by Aboriginal Artists Agency Ltd.

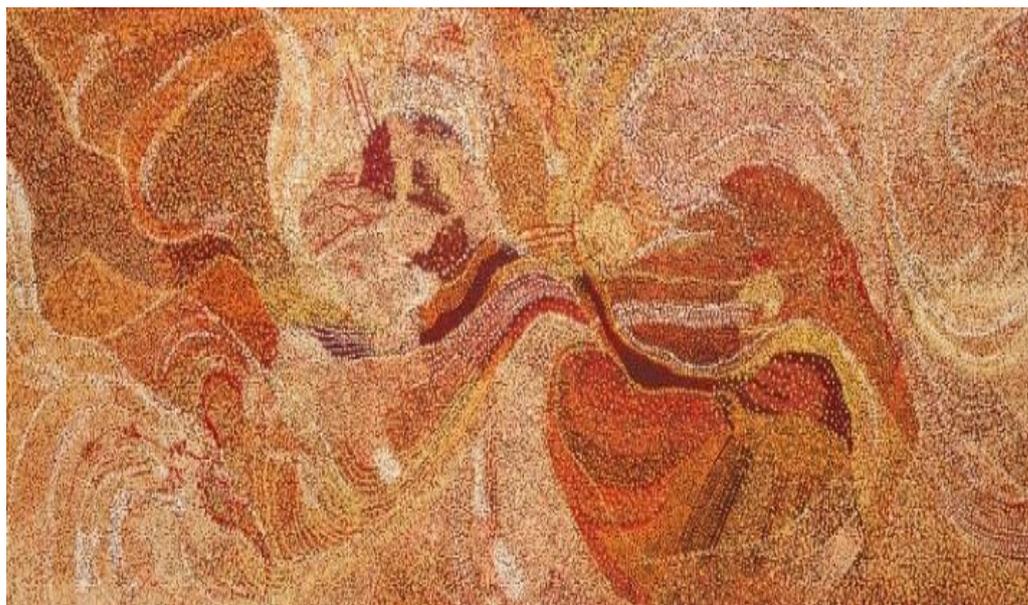


Figure 7. Nyunmiti Burton. Ngayuku Ngura—My Country, 2014. Mollie Gowing Acquisition fund for Contemporary Aboriginal art © Licensed by Art Gallery NSW.

3.3. Data Approximations

3.3.1. From Dot-Painted Shapes to Dynamic Particle Simulations

For the next phase, the goal was to explore computational techniques by expanding those of Aboriginal mapping into the digital working environment. Evoking the fluid character of aboriginal maps, a shape is defined as a fusion of singular elements. The selected software was Autodesk Maya due to its inbuilt parametric capabilities; it does not require extra plug-ins and offers the designer a more direct relationship with the rule-based inputs and the geometries being created [34] (p. 10). As the software is applied, it allows the creation of shapes as aggregates of animated particles and their manipulation by adjusting the value of forces, intensities, emission rates, lifespan, and behavioural properties, such as movement, collisions, bounciness, stickiness, and colour. Thus, it is possible to form bodies and solids by repeating particles and actions as living things always in movement and as ones that can also be parts of larger collectives.

Similarly, the outline is also an emerging quality of the aggregate particles. The shapes and volumes are varied with different sizes, linking the microscopic scale to a planetary galaxy system (see Figure 8). Forms become dynamic, ever-changing, and self-feeding instances, brought together through internal and external forces of relationality and connectivity. These interactions produce palpable densities of patterns, inciting different narratives as they relate to fields of action by which a form acquires its significance.

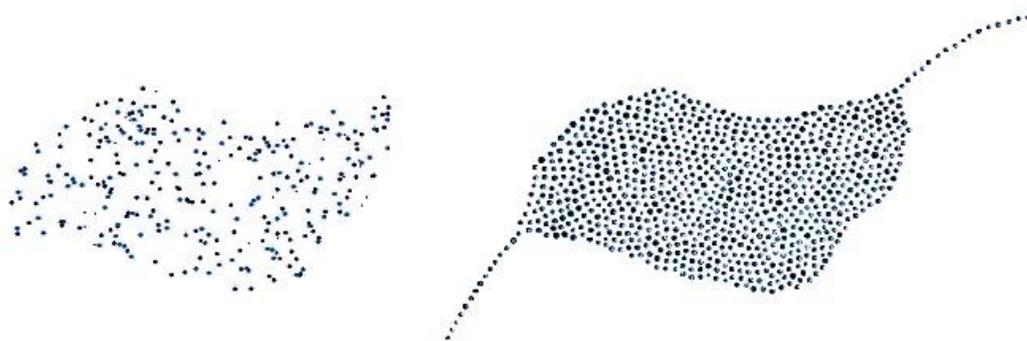


Figure 8. Jenny Johnstone. Water molecules producing shape and form, 2020.

For this study, the concepts set above were translated to basic systemic operations about physical space and then run in the simulation software. The focus was directed mainly to the urban environment, seeking what form could be and how it could be animated and behave as different urban energies interact, giving shape to it [35]. Hence, the term ‘urban energies’ may signify any sort of urban activity. In an urban context, these may include human and natural processes adapted to their setting and the greater landscape, not to be confused however with energy sources such as electricity, solar energy, oil, or gas.

After activating these energies, the next task was to create digital simulation models to examine their influences as they trigger spatial phenomena. In that case, the model is rather reflective of a computational systemic approach, being more rule-based, generative, and formational than representational, and is suggestive of dynamic landscape experiments studying natural topographies [34] (p. 15). As demonstrated in earlier simulation models of landscape design, rule-based approaches lead to understanding modelling as a process that focuses on behaviours and interactions, rather than formal explorations linked to compositional aims, and are therefore more suitable to work with the dynamic and unstable forces of the landscape [35,36]. Simply put, the idea is to ‘grow’ shapes and then volumes as spatial areas, made from energies represented by dot particles and interacting with each other to produce landform mapping results in two and three dimensions. Echoing evolutionary principles, these enabling strategies function more as agents, processes, active interferences, and ever-emerging networks of potential [5]. For this purpose, the particles are grouped and merged so that it is possible to experiment with relationships and connections between entities as in the Aboriginal paintings. The Aboriginal concepts of relationships and connectedness are transferred into the present setting by defining functions of mutual causality among single particles and particle flows. These energy interactions are sought in the most basic form, so that particles emit particles as they move towards, are attracted by, and collide with others, for example, similar to a fire that intensifies when it meets fuel. These effects also determine a particle’s lifespan. A particle’s energy affects something else, while it also collides with other ones. Actions and reactions among particles produce explosions presented with various colours (see Figure 9).

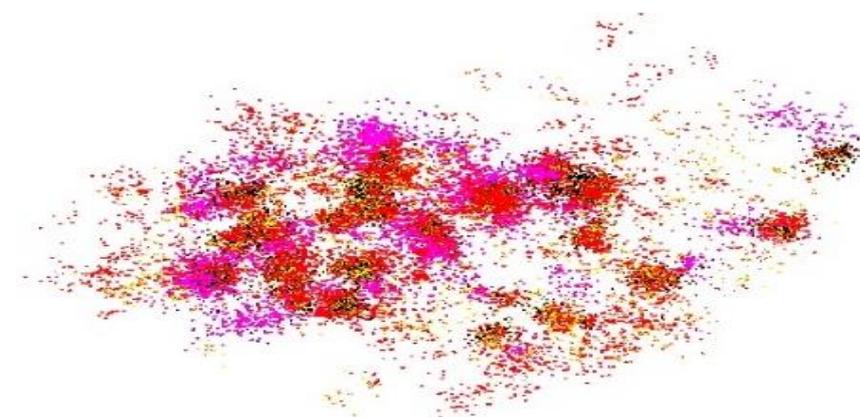


Figure 9. Jenny Johnstone. Fuel explosions producing fire concentrations, 2020.

In another iteration, the particle aggregates produce energy patterns as force field areas characterised by constant activity and positive (when attracting) or negative (when repelling) values. The aim was to approximate the shape and growth of green network forms. Green is attracted to oxygen or carbon concentration in fertile soil, whereas in their absence it is repelled. The formed soft patterns are semi-adjusted and partially created, and from this, protocols of permeability and exchange are set among energies, particles, shapes, forms, and positive and negative forces. Apart from greenery (see Figure 10), the process may be adapted to other open system structures too, supporting concomitant phenomena, layered narratives, and hybrid typologies as activity programs mingle with natural operations in mixed urban/landscape scenarios.

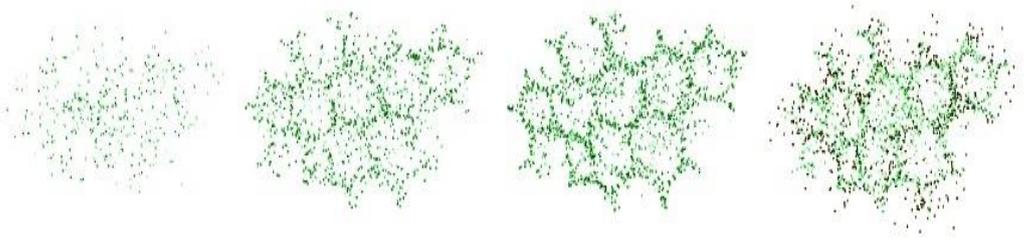


Figure 10. Jenny Johnstone. Green network forming, which could be oxygen or carbon, 2020.

3.3.2. Experiments with Hybrid Urban/Natural Schemes: A Case Study

The process set above indicates a shift in focus by which space is understood as a dynamic system causing synergies among multiple elements, human-made and nature combined. These may vary significantly, so that human activity may be studied alongside animals, plants, and marine life, who share the same territory to equally claim a spot in the new hybrid urban/natural setting as active parts of the ecosystem (see Figure 11). The discussed scheme is suggestive of an unplanned order that links versatile information, producing a fluid perception of space in relation to energies and time-dependent factors. Space becomes an emergent phenomenon of collaborations, energy exchanges, compromises, and negotiations among various participants. The formed relationships, shapes, and territorial occupancies present continual transformations as they resist formal fixity, geometric delineation, closure, and representation [5]. The analysis and processing of space through interactions of pulsating elements and debated values rather describes it as a mixture of zones defined by cohabitation, mutuality, and fusion. Spatial experience becomes an outcome of connections and blends due to soft boundaries trespassing artificial limits and guided by the bio/geomorphic characteristics of the greater milieu. These dynamic features further promote programmatic variety through spontaneity, undesigned activities, unexpected coincidences, and cross-layered associations of different instances sharing the same land and enriching experiences beyond prescribed routines.

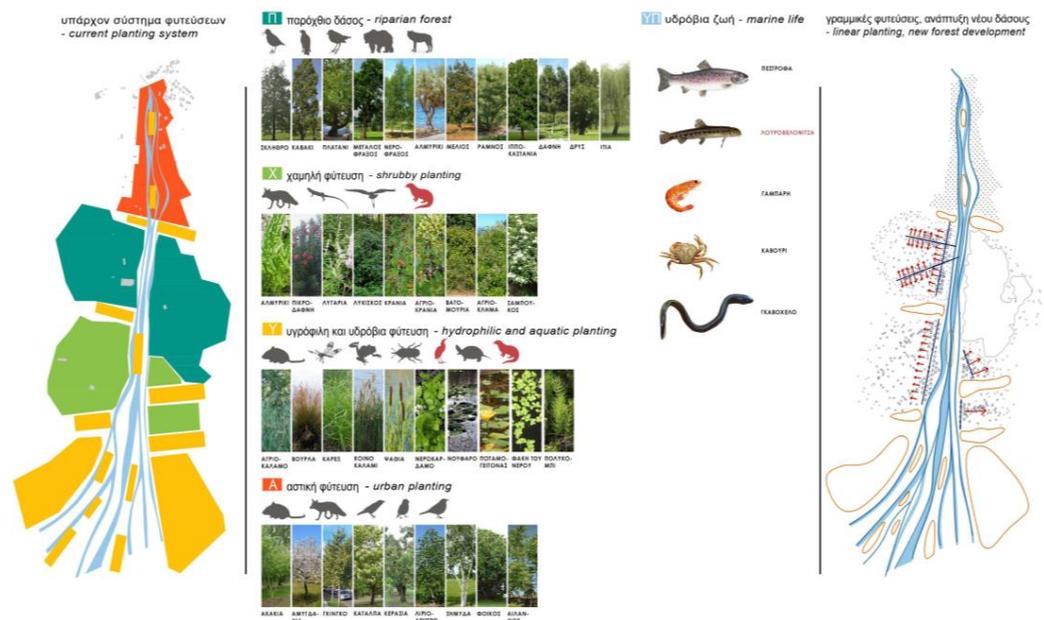


Figure 11. Sophia Kalakou, Maria Patmanidou, Carolos Galanos, Lena Sionti, and Yannis Zavoleas. Crossings of natural phenomena guiding hybrid urban/natural development strategies through dynamic mapping (right). Advanced urban design studio, University of Ioannina, 2022.

The above principles describe the aims for the design research project “Urban Safari 38.83, 20.70” by Eleni Kanellopoulou [37]. The task at hand was to consider new possibili-

ties for the urban environment where its structures reinforce the operations of a natural ecosystem (see Figure 12). The old town on Lefkada Island was selected as an appropriate location, given its special character attributed to the natural surroundings. The old town is close to a lagoon lake. Due to uncoordinated touristic development, public space inadequacy, and narrow street infrastructure, the area suffers from congestion, especially during the summer months.

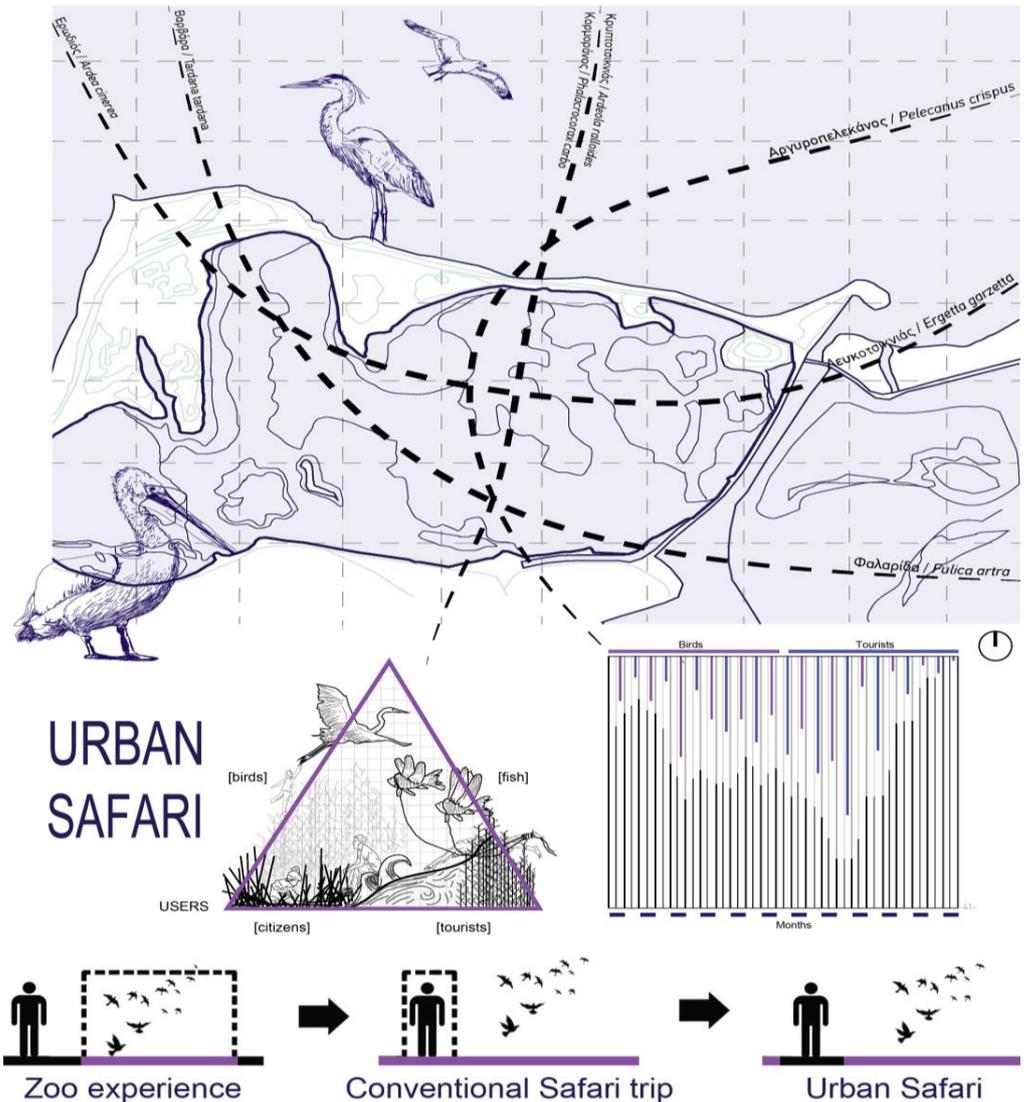


Figure 12. Eleni Kanellopoulou with Karolos Galanos (supervisor), 2022. Urban Safari 38.83, 20.70. Department of Architecture, University of Ioannina. Analysis setting the project's main aims and concept. Reproduced with the permission of Kanellopoulou.

The project examines urban development alongside the potential for a new kind of symbiosis between humans and nature. As a result of its unique landscape, the island has potential in this direction, and is suitable for activities related to the avifauna, birdwatching, and fishing, especially along the coastline and the surrounding wetland areas. Major attention has been given in this analysis to the population flows, the variability and the migration of birds, and also the air and the sea water tides (see Figure 13). These elements have been used as active agents to inform evolutionary modes of public space in the close suburbs, in contrast to the old town network which remains static and dense.

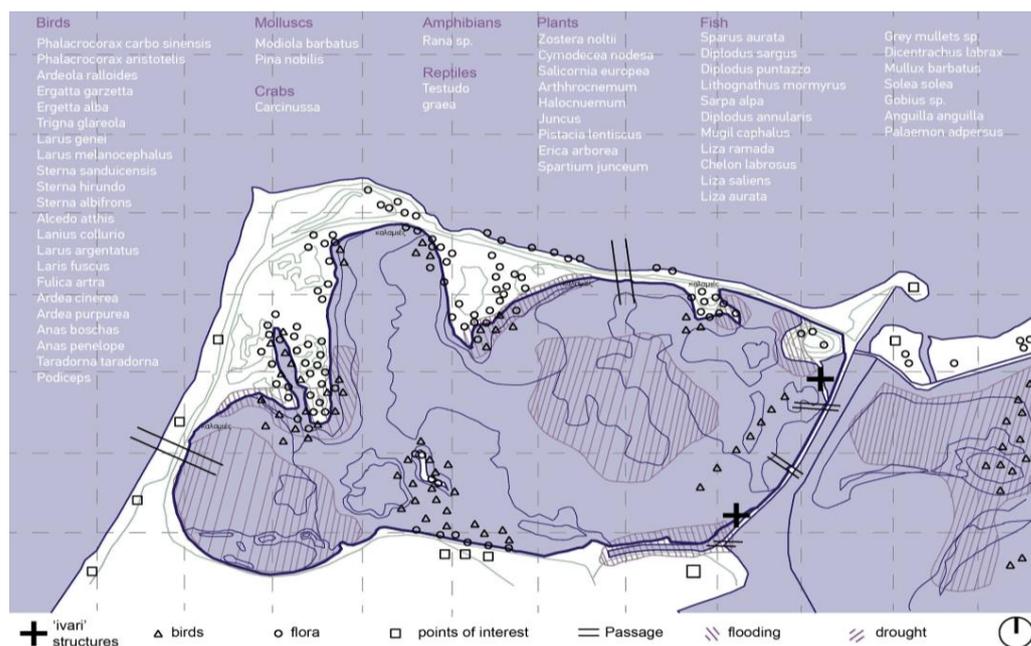


Figure 13. Eleni Kanellopoulou with Karolos Galanos (supervisor), 2022, Urban Safari 38.83, 20.70, Department of Architecture, University of Ioannina. Biodiversity map of the greater lagoon lake area showing species' variety in relation to the sea tide during the year, which changes due to drought and rainfall periods. Reproduced with the permission of Kanellopoulou.

The idea was to introduce spaces of recreation and relief to decongest the current urban system, producing new mixtures of artificial and natural settings while reinforcing biodiversity by integrating it with the greater structures. To avoid any of the drawbacks of enduring modes of practice, the project has sought new ways to address human aims in parallel with nature's dynamics. The proposed schemes would have to be fully capable of self-regeneration over time by engaging with environmental phenomena and forces [37]. The concept was to develop a system whose performance would alleviate any of the long-term consequences of hardship and/or detrimental treatment. This approach outlines a strategy to reactivate the ecosystem's vital functions over a certain period, rather than a finite design scheme that would supposedly restore nature by bringing it back to an earlier and healthier state [38]. By following these priorities, 'Urban Safari' proposes an alternative model of urban planning progressively filtered by decisions on the architectural scale, to enhance the relationship between humans and the ecosystem by also bridging local activity with the greater landscape. The architect was guided by the intention of offering dynamic forms of coexistence between humans and nature; nevertheless, nature may, to some extent, reclaim the land it once occupied, a stance that is suggestive of a more responsible and nature-aware urban living condition. The human-made environment will merge with the natural one into a hybrid structure made for the adoption of flora and fauna through selective interactions with humans.

Moreover, the Urban Safari's aims were adapted so that they may be relevant to realistic scenarios. The analysis was directed towards bringing culturally loaded ideas and ecological structures into the present. These include traditional fishing methods based on lightweight bamboo structures called "ivari", along with techniques by which to grow new islands naturally; that is, through the gradual accumulation of debris, sand, soil, gravels, and rocks (see Figure 14). The program includes additional activities aimed at locals, visitors, and especially children, such as a flea market, areas to interact with natural life in its proper setting, and museums to educate people on biodiversity and ecology matters. The 'whole' forms a soft layout that may expand and be transformed for future needs (see Figure 15).

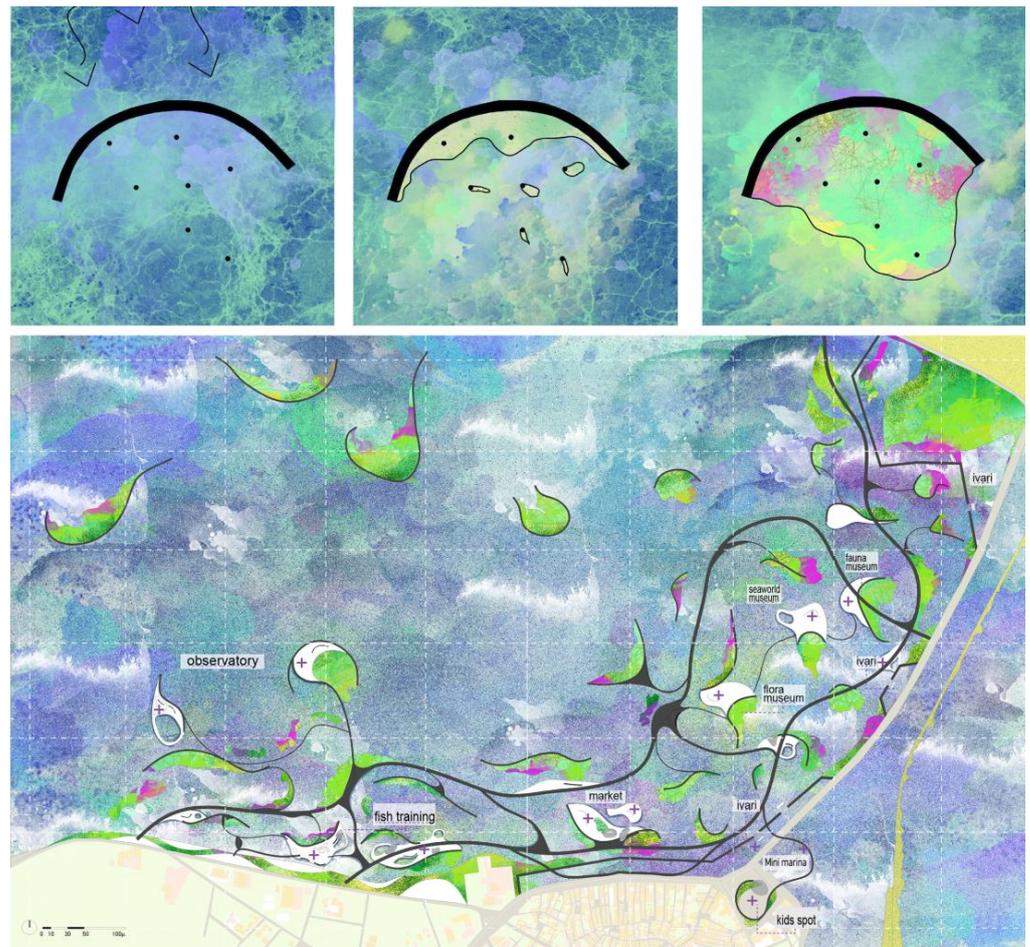


Figure 14. Eleni Kanellopoulou with Karolos Galanos (supervisor), 2022, Urban Safari 38.83, 20.70, Department of Architecture, University of Ioannina. General map proposal. Reproduced with the permission of Kanellopoulou.

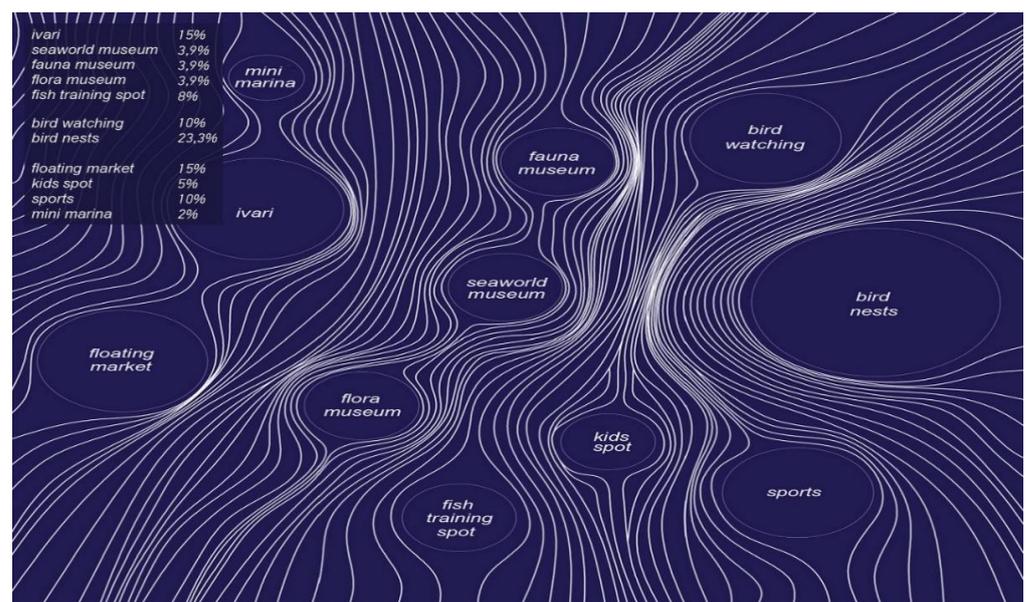


Figure 15. Eleni Kanellopoulou with Karolos Galanos (supervisor), 2022, Urban Safari 38.83, 20.70, Department of Architecture, University of Ioannina. Soft programmatic development. Reproduced with the permission of Kanellopoulou.

3.3.3. Designing beyond Anthropocentric Scope: Conditional Rewilding

The aim was to design evolutionary schemes that follow nature's performative features, by also treating wildlife equally to humans, as a form of an invitation to return the symbiotic ecosystems to their natural form. The objective was to construct enabling relationships between the freedoms of life in terms of unpredictability, contingency, and change [5]. In that sense, the project unfolded by displaying an orientation toward evolutionary, time-based processes, and dynamic forms that take on a genuine self-organising life of their own [39]. In the meantime, the analogue and generative diagrams would have to be combined.

The above strategy is suggestive of a prelude to what is otherwise identified as a conditional "rewilding" of traditional architectural space. "Rewilding" indicates a process where nature transforms and mutates itself dynamically without any human assistance or other intervention, making it a self-sustaining, resilient ecosystem [7]. Thus, the term "rewilding" is employed in architectural discourse to discuss the built environment as an extension of the nature, with a more-than-human perspective. This signifies a reversal concerning urbanisation and urban sprawl, as it is a phenomenon exclusively managed by nature in its own dynamic way to surpass the human-designated outlines and to reoccupy parts of the urban tissue [8,40]. Nature's reclaiming of land is orchestrated by nature itself, and involves alternative operations leading to wildlife expansion. This may be feasible, as the design is planned to grant nature some autonomy over certain zone areas to perform its own activities, eventually causing the local ecosystem to thrive. Consequently, rewilding connotes a shift in priorities and aims in architecture, directed to the return and long-term survival of the ecosystem, especially in cases where human settlements have taken over.

As a strategy, rewilding introduces land use practices and management that could lead to a more habitable and welcoming epoch for natural species as well as for humans on Earth. This can be implemented by taking advantage of digital technologies. It may indicate a rather 'untamed' but still effective understanding about physical spaces as a dynamic phenomenon that refers to modes of cohabitation between human and nature, where new living conditions along with those concerning production, work, and development are fully aligned with the greater environmental and biological cycles. Furthermore, this set of aims reflects a post-anthropocentric approach to architectural activity, where coordinated technical and natural practices produce sustainable spaces and organic habitats as extensions of natural structures. This result may be managed by connecting dynamically progressing spatial elements with semi-guided natural operations following complex agendas to reunite wildlife with cultural experience. Apart from the necessary skills on how the different elements may be related to each other, the approach requires cross-disciplinary datasets and extended collaborations among the specialisations involved [5].

Whether concerning a contemporary design project such as the "Urban Safari" or the culturally loaded depictions of extended landscape territories in Aboriginal maps, the goal here presents a deliberate effort to alleviate any of the long-term impacts of human activity upon the ecosystem and to include it in the greater natural schemes (see Figure 16). The task is directed towards making the best use of the participating elements, as they are related to each other through associative techniques and time-based predictions. As the above description is consolidated into a methodological approach, the design outlines a process that is initially grounded on extended information inputs, then translated to infrastructure and built materials, which is suggestive of a nature-guided development of a design scheme, whose implementation continues even after it is delivered to its occupants. As the project is materialised and lives on into the future, it will progressively merge with the greater ecology, its cycles, material features, and life forms.



Figure 16. Eleni Kanellopoulou with Karolos Galanos (supervisor), 2022, Urban Safari 38.83, 20.70, Department of Architecture, University of Ioannina. Architecture beyond anthropocentric scope, as a hybrid between nature and humans. Reproduced with the permission of Kanellopoulou.

4. Discussion

So far, this study has compared examples from multiple backgrounds to discuss information describing dynamic phenomena in measured mapping systems. Such a task has been propelled by the aim to integrate nature and evolved principles and performance into architecture and urban design. The Aboriginal paradigm was selected as a point of reference that is rich in connotations and potential to inform contemporary design thinking. In this respect, it has further been linked with more recent design explorations that make use of computational and other experimental means, suggesting that the holistic structures guiding natural operations may assist towards greater sustainability goals in the built environment. The updated approach essentially deals with the totality of instances in society, culture, nature, and the landscape whose influences may be used in a trial-and-error approach as qualitative and quantitative inputs to influence the design outcome. As the process shifts from the analogue to the computational interface, data from various origin are mapped as energies that respond to debated features and hypothetical narratives, and their impact can be thoroughly studied through iterative manipulations and critical adjustments. Such a use of the digital platform outlines a promising scope to support experimental design thinking and tentative decisions during the initial stages of analysis and ideation. The data approximations of these experiments incite the design of a generative, although

not fully automated, character, as a sort of collaboration between the system and the designer [19,41,42]. Any of the intermediate findings may refer back to the datasets, adding some reliability but without claiming full authority concerning decisions. The process is incited by a special kind of computation-driven intuition, where creative thinking happens as a result of tentative applications of the software being pushed beyond its designated scope [19,43]. A critical lesson of Aboriginal mapping is thus that knowledge of diverse characters and sources should retain an open character throughout the process. The steps are led by the designer's skills, sensitivity, introspection, experience, personal taste, and talent, as opposed to straightforward questions or definitive answers. Consequently, the holistic, symbolic, ambiguous, and even transcendental character of Aboriginal maps repositions the processes of analysis and synthesis about physical space towards non-deterministic modes of systemic management.

In an attempt to bridge the discourse on Aboriginal mapping with contemporary architecture, an analogy has been noted between Aborigines' understanding of physical space as an expression of energy flow and open systems studied in the post-war era, and later with a resurging interest in the late 1990s. These historical references explored space as a system in ways that have arguably prepared the current forms of computational analysis. In the 1960s, with the late modernism avant-garde movement, Team 10's focus was to restore the connection between urban space and complex social structures [9]. Their goal was to propose handling energies in mutual exchange, a lifelong process that would continue after the project was materialised. The building was not an isolated object set by rigid boundaries and within fixed regions; rather, it was viewed as a system structure that interacted with its occupants and also with the environment, holding other systems while being part of larger entities organically linked to each other [44].

The aforementioned analogy, with late modernist thinking, can be traced to the creative and artistic spirit of that era. For example, the architecturally trained artist Barry Le Va employed similar techniques in studying the dynamic features of a space through particle flow. In a series of sprightly images, sketches, animations, and large-scale models he often laid on the floor, the artist mapped different materials and instances in energy exchanges [45]. These works that the artist described and exhibited as "Distributions," "Dematerialisations", and "Accumulated Vision", were defined as "relationships of points and configurations to each other" [46]. As a recurring theme, Le Va presented seemingly scattered elements with varying density, random consistency, and chaotic order [47]. Around the same period, cybernetics also lent its terminology to the evaluation of a physical space, the qualities of which would emerge as different energies and instances of the urban milieu interacted and then translated to time-related design strategies. The inputs were not limited to human-related components, so the outputs were informed by larger systems as associations among agents set as dynamic constraints [21,48]. As it turns out, the late modernist period was marked by a persistent quest to readdress the significance of space as a dynamic concept. Whether architectural, urban, artistic, or even networked, in its various manifestations space was a debated entity whose significance was attributed to the interaction of multiple systems and subsystems. Space was a result of flows; meanwhile, the related discourse would deviate from a focus on form and aesthetics to lean towards operational research on a system's capacity to metabolise its assets and to efficiently reallocate its energy resources. Related studies in the same period emphasised on the mechanisms of adaptive organisation producing variations in numerous configurations [11,24], better responding to mixed social and programmatic scenarios.

These ideas were revisited in the 1990s, this time supported by an aim to reinforce architecture's instrumentality as a material practice that engages physical space with the complexity of experience, with reference to its traditional alliance with territorial organisation and functionality [14]. The focus diverted from the production of buildings as finite objects to a new understanding of space and form as dynamic entities with varying densities and qualities. Likewise, notions such as forces, fields, and evolutionary patterns were employed to describe urban phenomena and the shared influences of space's contextual

factors, making its design a bottom-up process unfolding by generative instructions as opposed to a top-down method [18,19,48] (see Figure 17).

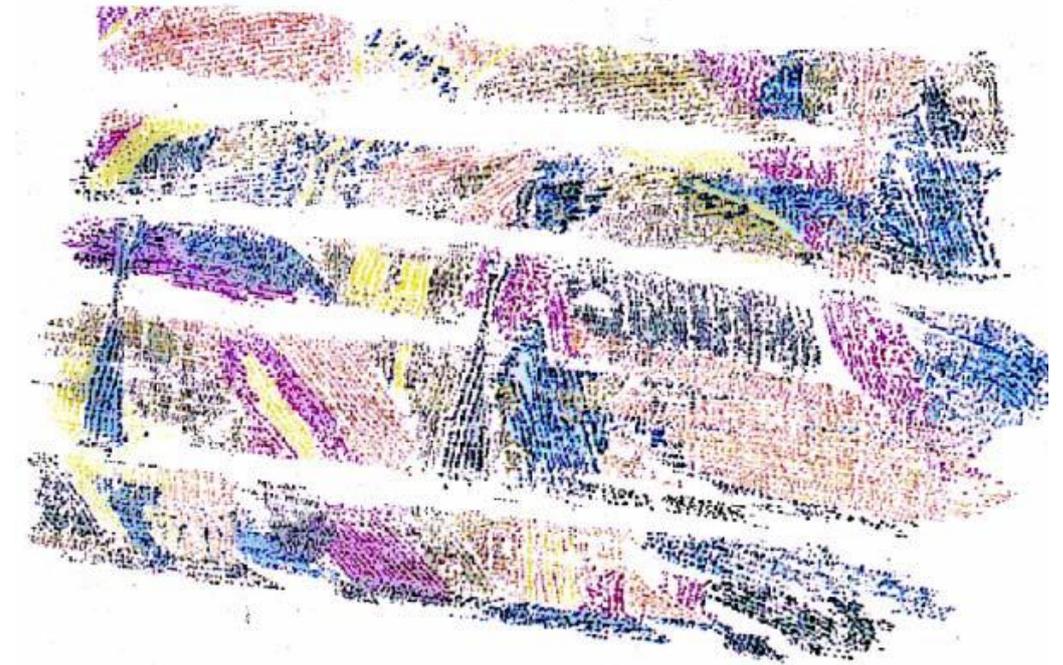


Figure 17. OCEAN Johan Bettum, Kim Baumann Larsen, Birger Sevaldson, 1998. “The Colour Graft.” Source material for a long series of experiments. The information derived from this source material evolved through several projects: Synthetic Landscape 1997, Synthetic Pavilion 1999, and Ambient Amplifiers 2000. The concept inspired the development of the digital techniques in OCEAN NORTH [19] (p. 147). Reproduced with the permission of Sevaldson.

More recently, with advanced computations, it has been possible to interpret and activate dynamic phenomena and extensive data maps in augmented system patterns. The fundamental tenets of systemic thinking set earlier have resulted in new methods for reconceptualising urban environments as socio-ecological compounds guiding design decisions. New human–nature sustainable relationships are integrated into biophilic patterns applicable to regenerative and adaptive design and planning practices [15]. Cross-disciplinary applications and the related software technologies support advanced processes of analysis and composition. The formed comprehensive structures are capable of carrying extended datasets, machine learning procedures, cloud platforms, and browser-friendly infrastructures, facilitating participatory and collaborative ways of working throughout the architecture, engineering, and construction industries [49]. Data interactions are explored through persistent analysis, modelling, and experimental techniques, then applied to particles and other soft topological instances to produce rough diagrammatic outputs. Hence, computations allow the management of exchanges, movements, fusions, and resistances of the urban system in unity with the energies and cycles of the urban scape and the greater ecology.

New relational forms of urbanism are sought, to refer to adaptation and change surpassing limitations related to grand masterplan schemes. Global recurring crises have prompted the architectural profession towards bold scientific crossings to meet with an ever evolving and unpredictable future [50,51]. Architecture and urban design are increasingly conditioned by fluctuating inputs and local/global associative systems. Thus, it is necessary to replace uncoordinated working patterns with controlled procedures that manage connectivity across heterogenous platforms. Ongoing research on new design methods have proposed new hybridised theories and approaches affecting analysis, critical reasoning, production, and delivery, surpassing former barriers of the fixity of architecture’s language

and representational means. An aim for a real-time update of solutions through real-time data feeds aligns with architecture and urban design's goals to find innovative construction methods, the success or failure of which is dependent upon extensive coordination and alignment with the discipline's upgraded role. These new set of challenges have been present for a long time, forcing architects and urban designers to reconsider their ideologies and practices by mixing them with outside resources and by turning to forgotten or threatened cultures as potential references for novel design propositions.

5. Conclusions

This speculative study started by revisiting Aboriginal map paintings, and then employed computations to activate traditional concepts about land and adapt them to current architectural and urban design thinking. The enduring principles of Indigenous cultures, reflecting an integrated scope with long-term benefits for social and environmental sustainability, were transferred to design and were further explored with dynamic simulation models, reflecting a more-than-human perspective. Additionally, comparing these references with pioneering ideas on systemic thinking during late modernism and the 1990s has prompted architecture and urban design to restate its aims to be in alignment with current priorities.

Following the trajectory outlined above, this paper focused on Indigenous themes expressed in Aboriginal maps, showing pieces of land as porous areas represented by curved lines and dot aggregates in varying densities. These mappings, rich in artistry and meaning, have caused the introduction of elaborate spatial concepts related to relationships, connectedness, and malleable boundaries. Using this knowledge in analyses and experimentation with advanced computational tools has reinforced the significance of architectural and urban space as a dynamic phenomenon whose qualities, organisation, and management abide by the evolutionary principles of the ecosystem. Accordingly, design research may pursue comprehensive answers wherein the human-made setting is reunited with the greater ecology. Contextual data along with aggregates of instances, soft shapes, and fluid forms, as system parts following generative processes, support extensive strategies and holistic schemes. These insightful references are suggestive of new design methods that make full use of the capabilities of the computational workflow to promote architectural and urban space compatibility with the natural milieu. The priorities and goals of spatial design are updated to meet scenarios in the post-Anthropocene epoch, supporting urban/nature hybrids on the ecosystem's terms. Such a turn signifies the prospect of the discipline's future and also questions dichotomies of physical space such as public/private, nature/culture, and landscape/building rooted in western thought. Consequently, architecture and urban design are faced with the challenge of moving beyond past anthropocentric agendas, embracing processes of rewilding into design by granting nature the freedom to thrive and to reclaim currently urbanised areas.

The scope of this work was to update architecture's understanding of space by delving into the potential for cointegration between ecosystems, socio-spatial structures, and cultural references with the aid of advanced computing. Traditional and non-western thought have incited alternative ways to respond to current aims and often dead-ends in architectural space, especially in cases of urban and socio-environmental decay. The ideas presented by the Aboriginal paradigm have caused a rethink of the spatial organisation through dynamic system patterns and hybrid typological variations, along with new evolutionary processes, collaborations, and modes of production with cross-disciplinary impact and appeal. As these studies are supported by computational power, new knowledge and ideas are being created concerning the influences, the performances, and the behaviours of urbanised space, the landscape, and nature's performances. Ideally, the proposed model would engage the design process with the ecosystem, the energy resources, and the space's geopolitical and socio-cultural features, forming a network of activities, roles, compromises, forces, and loads as the sum of architecture's animated components. This whole system presents architecture and urban design with the opportunity to redefine the code consis-

tency of the human-made environment to forge a new contract for planetary health [52] in better alignment with Earth’s cycles regarding the upcoming changes in global condition.

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Data Availability Statement: The images of Aboriginal artworks presented in this study are openly available at this website <https://www.artgallery.nsw.gov.au/> to use for research, study and other related exceptions as defined by section 40 of the Copyright Act 1968 (as amended) without applying for specific permission.

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