FORT ECOLOGIES AND THE PLANETARY TERRARIUM

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Terrariums are fragments of the world that are able to depict complexity, synthesizing a few of its elements or features: they reproduce specific environmental conditions in a sort of micro-wunderkammer with an enclosed atmosphere, usually characterized by an object-like scale. Components are usually obtained through a solid supporting base – on which different mineral and soil strata are layered upon – and by a glass case, whose walls define the inner environment and surrounding this aerial counterpart. But besides their pure material configuration, the design of the terrarium is essentially based on the interplay between mineral-animal-botanical features and on a continuous exchange between inorganic and organic matter, animated and unanimated (Morton 2013). In fact, etymologically, terrarium comes from the Latin word *terra* plus *-arium,* referring to what comes from or belongs to the land. Terrariums introduce, act and keep unfolding a specific ecological behavior based on a closed-cycle set of processes condensed onto their scale, and they could surprisingly offer an ecological perspective for inhabiting the world in architectural and landscape terms. Indeed, if we consider a terrarium in performative terms (not focusing on dimensions but only on its characteristics) we see how some of its behaviors can be retraced in architectural objects and elements encompassing different landscape dimensions, acting on geographic – or even planetary – scale. Thus, the terrarium is not intended as a passive-receptive box but as an operative concept that can help to re-conceptualize architecture's role inside a dynamic and environmental condition, inscribing its functioning within an expanded planetary (Brenner and Schmid 2013) and ecological notion and responsibility (Colomina and Wigley 2017), revealing the need and opportunity for a disciplinary expansion. With this outlook in mind, an old mountain military heritage could represent the example of an extraordinary century-long unconscious experiment of interaction between nature, design and their intertwined components.

In the eastern Italian Alps, the boundary once separating Italy from the Austro-Hungarian empire where WWI took place – with its archaeology of traces and material presences of military landscape – could be regarded as an emerging hyperobject (Morton 2013). Modifying the mountains, opening new roads, building defensive structures, concrete forts, and hundreds of kilometers of trenches, it was able to encompass opposite geological times and factors and fuse together artificial and natural features (Leoni 2015) in a sort of alternative mountain range. In particular, abandoned WWI forts of the Trentino-Alto Adige alpine region have, over time, constituted platforms for encoun-

Fig 01 Geographical localization of WWI forts in Trentino by Livia Sassudelli, realized for the exhibition “Paesaggi Forti”, 2022. Key: X: main existing forts and remains of military structures; +: disappeared forts and military structures.

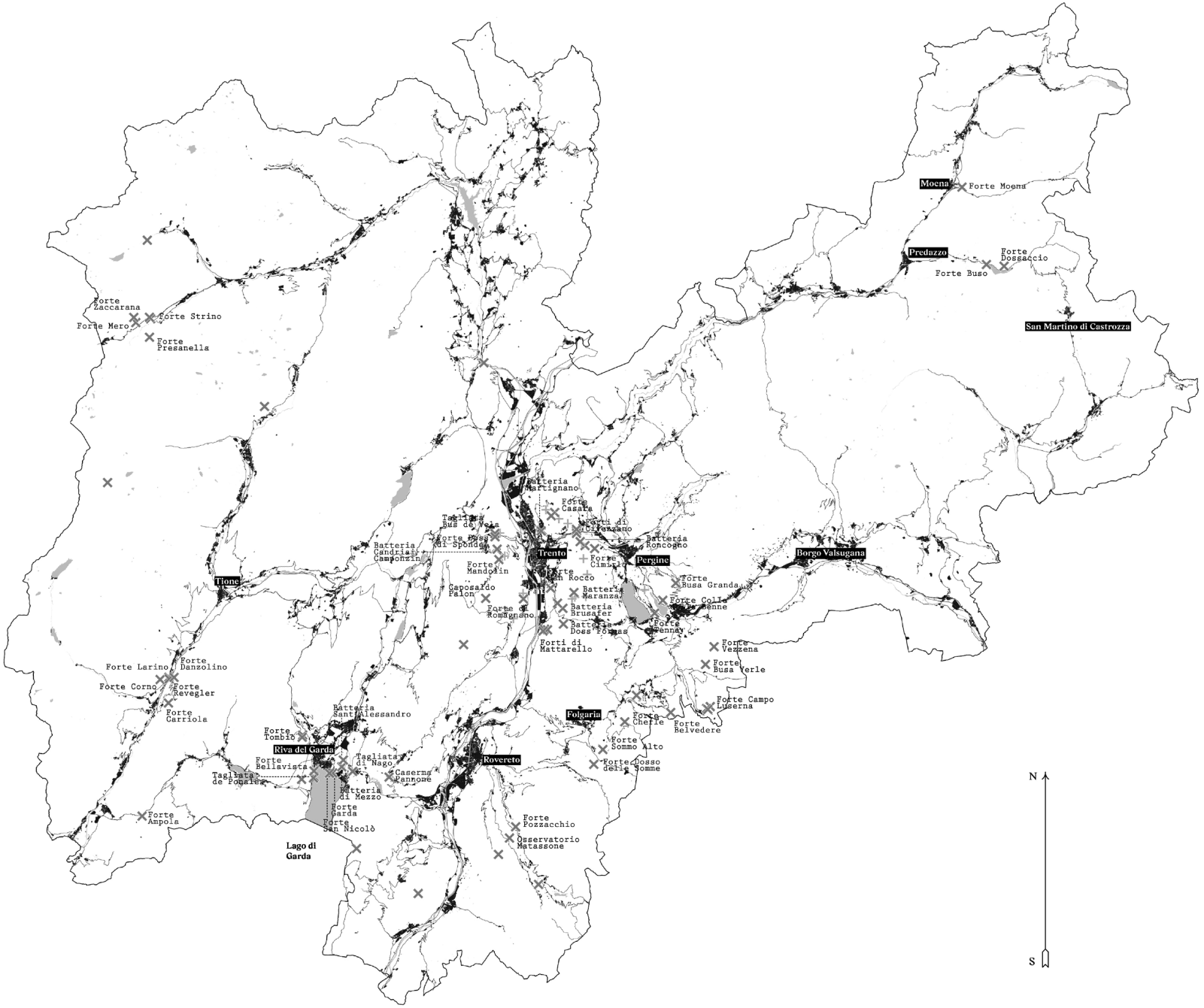


Fig 02 Maquet in felt inspired to Forte Valmorbia (TN) from the maquette series *Soft Landscapes* realized for the exhibition "Paesaggi Forti" by Cristina Gallizioli. Photo by Riccardo De Vecchi, 2022.

ters between artificial matter and botanical or animal species, a base for the emergence of a complex ecosystem. The remains of the forts are today the most recognizable architectural elements of this system: about 60 structures are still evident, and offer the possibility to be interpreted as terrariums on an architectural scale (Fig 01). In over one hundred years, they became sites of infestation, encrustation (Ingold 2013) and creolization (Glissant 1997) in which abandonment unfolded as a possibility and as a model for inhabitation. The ruin became a project, a building site where the actual configuration is the result of a radical co-design process in which authorship was continuously spread along its lifespan, shared between human and non-human agents, forces and phenomena. This design of the abandonment gave rise to the emergence of a series of punctual environments, fort ecologies (Ferrari and Favargiotti 2023) that found and made home within the once autonomous artifact, in a condition of *condominium* and reciprocal domestication (Metta 2022). From their original conception and fixed configuration, they were able to adapt over time becoming starting points for the emergence of new geo-ecological formations, turning aggressivity into welcoming openness and integrating alien approaches and influences. Each fort – shipwrecked over the mountains as a sort of dystopian Noah's arch – gave host and refuge to specific natural species, influenced the local environment, and stimulated a hybrid co-habitation (Morton 2013). based on the interplay between conflicting forces and agents. Today, their image is something in between a futuristic ikebana, an architectural terrarium and a failed reliquary of curiosities (Vogt 2015) in which waste cohabits with relics, artificiality merges with geology, botany, and biology, giving rise to a sort of unconscious alchemy. Designed as concrete independent shells and impermeable shelters, the abandoned forts were colonized and invaded by a springing and adaptive ecology, able to discover domesticity and inclusion inside buildings meant to exclude and protect. From cages, they turned into containers, ironically re-applying to military architecture the conceptual inversion proposed by Elizabeth Fisher's *carrier bag theory* (Fisher 1979). Besides war, drama, death, and history, an alternative narrative emerged, repurposing these artifacts into ecosystems able to host life and integrate, collect, and accommodate instead of secluding, preserving, and limiting (Fig 02).

Filled, surrounded, crossed, buried, superimposed by incoming presences and components, the original artifact turned over the years into a container, a recipient, a holder, or quoting Ursula Le Guin, into:

> "a thing that holds something else [...] a leaf a gourd a shell a net a bag a sling a sack a bottle a pot a box"
> (Le Guin 2020, pp. 28-29).

As terrariums create a parallel environment and separated ecosystem, these artificially manipulated mountain parts emerging from the earth's crust are now analogously acting as geologic substrata for incoming soil layers supporting the formation of local ecologies (Fig 03). In fact, the originally self-sufficient and closed system of the fort has turned into a porous one, infiltrated with thresholds, permeable boundaries and leaks allowing various degrees of communication and exchange with the surroundings, properly characterizing it as a vivarium. Defined platforms operating at the intersection between an 'inside' (Schneiderman and Campos 2018) and the outside world, the forts today are configured as objects spontaneously introducing an abacus of contact situations and interface between alternative components. In this sense the periphery of this once autonomous anthropic environment now deploys a series of spatial solutions and strategies of inside/outside interaction: like the walls in a terrarium, the edge is the place where contact happens, working as an outer skin (Zaera-Polo and Anderson 2021) where substances and strata coming from the landscape blend with the inner materiality of the fort. Analyzing its characteristics, we are confronted with a catalog of architectural situations of contact, support and relationship between the landscape surrounding the fort and the new-natural one, stimulated by the artificial intervention and the processes following its subsequent abandonment. The fort is not still or autonomous anymore but is a dynamic system acting as a terrarium: architectural features re-adapted over time and nowadays the solid base provided by horizontal surfaces and structural elements constitute the foundation for mineral and soil strata (Czerniak 2006), while the porous concrete or stone walls encapsulate and define the ecological boundary of the inner environment as the glass case would do in a terrarium. Through its processes, landscape infiltrated inside-over-around-beside the original structure, giving rise to different typologies and terrarium designs, each characterized by a different degree of interface and reception. We propose to divide the whole corpus of this collection into two main categories: stratigraphy | ecologies-on-top built on the element of basement and characterized by accumulation, incremental ground stratigraphies and vertical approach; boundary | around-the-ecologies emphasizes the different walls' designs and the expanded surrounding and horizontal configuration.

Fig 03 *Forte Carriola* from Gian Piero Sciocchetti archive, Università di Trento. Photo by Gian Piero Sciocchetti, 1980s

Each structure of this collection thus deploys different degrees of integration and landscape/architecture, natural/artificial, organic/inorganic interface, a specific spatial or design strategy (expressed by the action) and content/container logic (expressed by its name).

STRATIGRAPHY | ECOLOGIES-ON-TOP

The typologies of this category are the ones that work with a top approach, the structure stays below, and the organic part is generally more exposed than in the following category:

- *platform (supporting):* in this typology of terrarium – one of the most common – soil and vegetation are hosted on top of the fort/container, which in this case characterizes as the supporting base of a sort of dish garden more than as a proper recipient. Its almost flat surface provides a raised ground-floor for an elevated soil, exchange and air circulation are enhanced, and plants are favorably placed in direct contact with sunlight. Examples of this typology can be found in Batteria Candriai, Batteria Doss Fornas, Batteria Brusaferro, Forte Carriola, Forte Cherle, Forte Larino, while Forte Colle delle Benne, Forte Moena, Forte Pozzi Alti and Forte Luserna offer a less radical design: here the terrarium is only partially present and occupies a defined portion of the whole surface.

- *stand (holding)*: compared to the previous one, this typology combines the advantages in terms of light exposure with the presence of an inclined element oriented towards a preferential direction. Here the flat part is actually minoritarian and the inclined surface constitutes the main support for soil and vegetation to grow: the resulting composition is thus strongly affected by its general orientation, extension, width, inclination and angle. Forte Tenna is almost completely designed around this strategy, Forte Mero and Forte Zaccarana are mainly oriented towards south-west, west Forte Sommo Alto, east Forte Verle and Tagliata Superiore di Civezzano, south Forte Garda, Forte Belvedere and Cima Vezzena which, due to its extreme altitude and peculiar soil structure, characterizes more as a dry terrarium.

- *coffin (burying):* this typology does not differ much from the first in terms of possibilities to host the organic part, but here the structure is particularly integrated into the overall configuration and separated from its organic counterpart by thick soil and mineral layers (while they were still in direct contact in the previous typologies). This typology particularly fits those situations in which there is a need to enhance and highlight the

Fig 04 *Forte Dosso delle Somme in Altopiano di Serrada* (TN)
From the photographic series Remnants realized for the exhibition
“Paesaggi Forti” by Mark Wilson, 2021.

soil/vegetation component, maximizing the mineral and inorganic presence and leaving the base structure almost in the background and not visible. If Forte Busa Granda and Forte Valmorbia still offer a well-designed botanical composition on top, Tagliata Inferiore di Civezzano and Tagliata del Ponale developed a sort of dry terrarium or Japanese garden approach.

BOUNDARY | AROUND-THE-ECOLOGIES

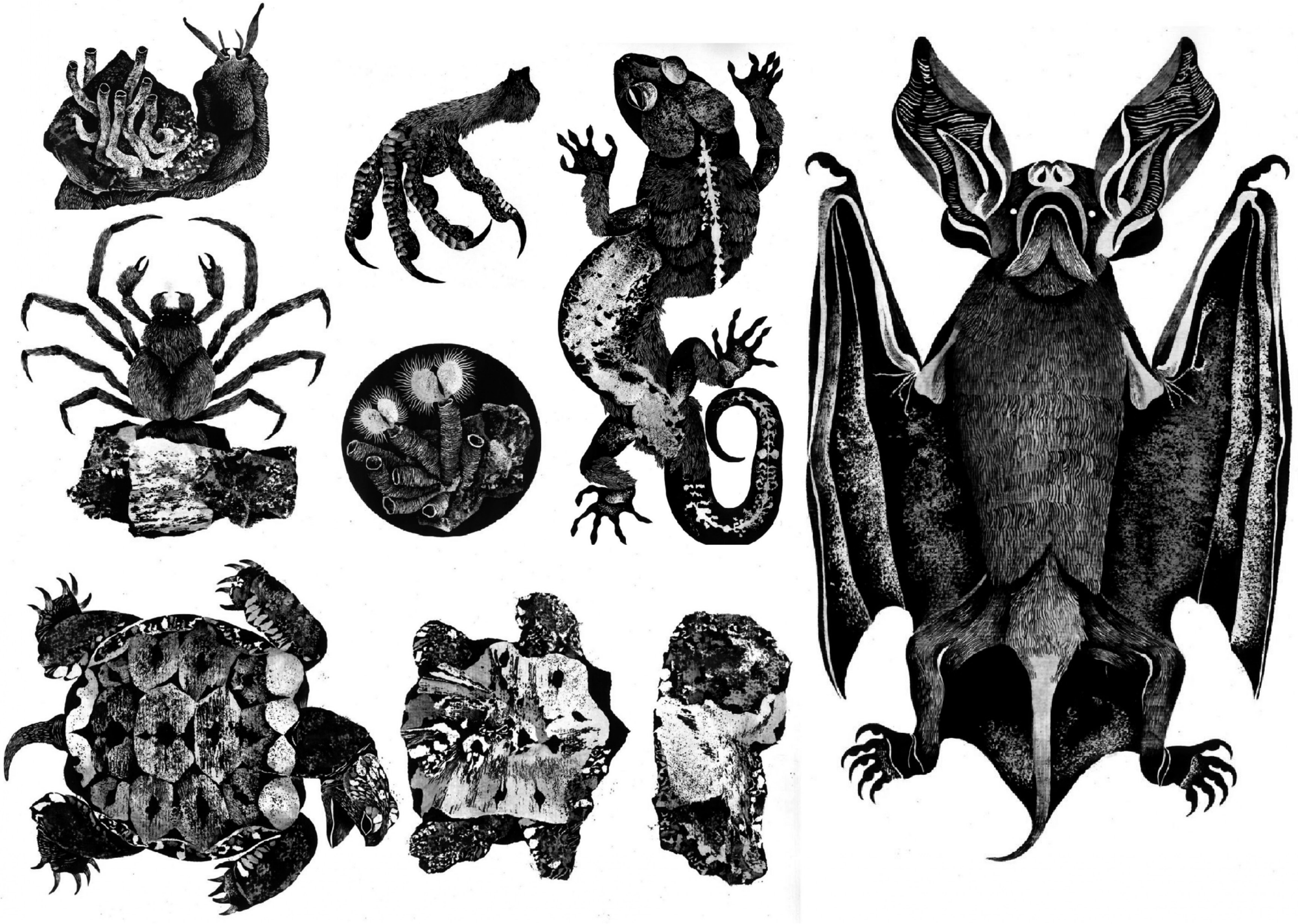
The typologies of this category focus on the case element and on a spatial development based on surrounding and enclosing more than on stratification, constituting proper or partial indoors:
- *skeleton (surrounding)*: in this category, shading plays an important role, the terrarium's walls completely envelop the ground and are elevated up, providing a good habitat for low vegetation. Usually, the proper terrarium is just a portion of the overall structure, which includes other spaces/environments: this is the case at Forte di Martignano, Forte Doss di Sponde, Forte Dosso delle Somme (Fig 04) and Batteria inferiore di Mattarello. Only Forte Ampola and especially Forte Barbadifior still offer pure examples, where the walls are completely dedicated to the terrarium and the fort is constituted by a series of open-air rooms. Often integrated with a *platform* or *support*, it could be seen as the first step of a *bowl* typology. A sub-category of this typology is *moat*, in which the open room (singular in this case) differentiates for its elongated shape and predominant orientation, surrounding one or more walls from the outside. Forte Alto di Mattarello is an example of particularly prolific vegetation, while Forte Dossaccio only partially envelopes the structure from two sides.
- *bowl (hosting)*: set halfway between *platform* and *skeleton,* this terrarium design could represent a sort of intermediate development phase between the two typologies. The soil's level is noticeably higher than in the latter, almost filling the walls' height to the top, while opposite to *platform* - where the ground could get considerably thin and is simply layered upon the elevated platform constituted by the structural base of the terrarium - here the result is obtained through a careful accumulation of organic material reached over time, possibly alternating different soil's granulometries and consistencies. The best application is at Batteria Superiore di Mattarello, where most areas along the outer walls display good examples of this technique.

- *enclosure (merging)*: one of the rarest terrarium designs, it can alternatively be seen as a development of *bowl* and *skeleton* typologies, with which it shares some of the same logic. In this case, the enclosure is incomplete, and the walls fade into the

organic part, making it sometimes difficult to understand where the terrarium's walls end or where the outside environment starts. Great part of the attention is thus taken by the mineral and botanical part, only comparable for predominance with the *coffin* typology, while the terrarium's elements (base and walls) almost withdraw and merge with the surroundings. In both Forte Sant'Alessandro and Forte San Rocco the walls seem to disappear and are almost conquered by the lush vegetation, fading the terrarium into landscape.

Over time, many typologies overlapped, mixing the different designs, and it is nowadays easy to find different terrarium solutions coexisting in the same structure. Amongst other examples, a particularly rich and peculiar case is constituted by Forte Tombio, in which *contour*, partial *platform* and *skeleton* logic are equally evident at the same time. We can now look at this heritage of military artifacts as a collection of cases from an imaginary museum of terrariums on a planetary scale, lost architectural ikebanas and emerging ruin ecologies set halfway between nature and design. Spread over the Alps as geographic objects (Turan 2020), they share an anthropic origin and the capacity to integrate nature artificially (Corrado 2012) through all these different strategies. Here, the usual scale of the terrarium is magnified to include environments whose spatiality is able to resonate with the size of mountains and valleys, directly shaping the landscape's portions that confront earth, soil, and geological factors (TVK 2022). As a system of man-made ecosystems, each of these elements unfolds a specific bestiary, lapidary and herbarium generated by the dystopic combination of features with contrasting origins and intermingling temporalities, giving rise to a unique and hybrid blend (Fig 05). The variety of these animal, mineral and botanical presences is affected by typology, altitude, soil's composition, relation to built materiality (stone, concrete, etc.) and spatiality (interaction between artificial and natural part, indoor or outdoor predominance). Set between architecture and landscape, these places created a specific and self-perpetuating ecological state, thus characterized by a performative design behavior. Proper terrariums are usually self-sufficient and constitute a sealed environment with a closed atmosphere and dynamics, but this kind of partially-open geographical terraria present a more complex logic (Graham 2016): nature works as a force that makes no difference between man-made objects and surrounding substances. In fact, in this case, the water cycle is influenced by exchanges with the outside, too, and informed by moisture evaporation from soil, buried structure, and surroundings.

Fig 05 *Bestiario from the illustration series by Simone Carraro, realized for the exhibition "Paesaggi Forti", 2022.*



Thus, while open terraria usually constitute more arid environments compared to closed ones, this architectural version still offers additional humidity in relation to the outside: humidity is kept in the underground parts of the fort and in soil layers, the vapor condenses onto the walls, and water gets stored inside their extreme thickness. Moreover, the now porous enclosure allows for heat and light to enter, guaranteeing a constant water supply and encouraging photosynthesis, besides the income of nutrients for plants and soil. This unique water cycle is paired with a solid one, in which organic waste, artificial ruin, and discarded elements are all digested together with scraps, memories, and organisms from the fort's past and present (Lowenhaupt Tsing, Bubandt, Gan and Swanson 2017), resulting in a comprehensive decomposition process that affects the structure and keeps regenerating it. So, besides the dichotomies between organic and inorganic, animate and inanimate, artificial and natural features an additional narrative unfolds: a narrative involving cycles of life and death, waste and construction, building and decomposition. The whole fort turns into a cyborg organism (Haraway 1991), a *detritophagus* being continuously assembling and disassembling substances and matter, digesting them into a sort of hybrid humus.

From an architectural perspective, this *ruin-as-a-project* conception calls for the application of a terrarium-logic to the design process, and for the introduction of architectural decomposition – opposed to classic architectural composition – amongst the other disciplinary fields. The ruin can be interpreted as the only architectural typology capable of becoming compost (Haraway 2019): often able to introduce more processes than those interrupted by its presence, it shows the possibility of stimulating biodiversity (Barchetta 2021) instead of reducing it. In this sense the aim of the imaginary museum of planetary terrariums we propose is to raise awareness on the whole range of actors involved in the formation of living spaces and in the reconfiguration of the built environment, constituting a catalog of self-contained laboratories, open-air tests, and co-design solutions depicting a series of mutual adaptation and assemblage strategies. Learning from the ruin and trying to replicate this approach means acting towards the promotion of a paradigm of indistinctness between architecture and landscape, where both dimensions find an integration as a way to cohabit the world. Expanding terrarium's behavior to architecture could also imply understanding architectural objects as terrariums already from the design phase, conceiving them not as purely human constructions but even as possible platforms of support for the emergence of specific geo-ecological formations (Escobar 2018).

Merging artificial space with the notion of ecosystem in the way we design and build could help us bridge the spatial inside/outside gap and detachment from the surrounding environment, promoting a more comprehensive fusion between local landscape, architectural elements, and emerging ecology (Steiner, Weller, M'Closkey, Fleming 2019). In this perspective, the unconscious ecosystems of the abandoned WWI forts of Trentino-Alto Adige offer the example of a century-old ongoing spatial experiment based on a self-driven evolution process and the radical coexistence of opposite forces, inhabitants, and dimensions, materialized in a series of more than 60 terrariums on a planetary scale.