Research Directions: Biotechnology Design

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Of other reefs: designing habitats in blasted seascapes

Rasa Weber[1,2,3,4]

[1]Matters of Activity, Cluster of Excellence, Humboldt University of Berlin (DE), Berlin, Germany; [2]Interfacing the Ocean - Swiss National Science Research Fund, Zurich University of the Arts, Zurich, Switzerland; [3]University of Arts and Design Linz (AT), Linz, Austria and [4]Zürich University of the Arts (CH), Zurich, Switzerland

Impact Paper

Cite this article: Weber R (2024). Of other reefs: designing habitats in blasted seascapes. *Research Directions: Biotechnology Design*. **2**, e13, 1–13. https://doi.org/10.1017/btd.2024.16

Received: 19 December 2023
Revised: 30 April 2024
Accepted: 28 May 2024

Keywords:
Sympoietic design; marine habitat; ocean; artificial reefs; convivial conservation; feral ecologies; blasted landscapes; sympoiesis; healthism

Corresponding author:
Rasa Weber; Email: info@rasaweber.com
Website: rasaweber.com

Abstract

Migrating reefs, unprecedented species assemblages, neophytes, toxicities, pollutants, aquatic ruins – The future of coral reefs in the Anthropocene is likely to look different from anything we have experienced so far. While the classic conservation debate on coral reef restoration still treats these ecosystems as "sick patients," a radically different view of convivial conservation is beginning to challenge exclusive human control over these endangered habitats. Putting aside notions of natural "purity" and adopting a much more humble and highly interconnected perspective on marine habitats, we can begin to see reefs as transformative, sympoïetic and blasted seascapes for a convivial future. The discipline of biodesign has been primarily focussed on researching ecological relationships with regard to new materials and products. The emerging interest in shaping the multi-layered ecological relationships of habitats for other-than-human lives, however, is steering design practice towards terraforming or, in the case of marine environments, "aquaforming." This paper argues for taking convivial conservation practices in marine environments as a starting point for the development of a new design methodology that focuses on the design of living systems in open environments: a proposed methodology called Sympoïetic Design.

> *»I argue against purism not because I want a devastated world, (. . .). I argue against purism because it is one bad but common approach to devastation in all its forms. It is a common approach for anyone who attempts to meet and control a complex situation that is fundamentally outside our control. «*
>
> Alexis Shotwell (2016), *Against Purity: Living Ethically in Compromised Times*: 8.

Introduction

The increasing efforts of ecological design research over the past decade have prepared the ground for bio-based practices in design and the development of new materials. Designers focusing on specific organisms such as mycelium, microalgae, bacteria et al., have begun to adopt laboratory environments, their scientific protocols and tools for developing a new interdisciplinary design research methodology commonly referred to as "biodesign" (Myers, 2018; Crawford, 2023). The transition from mining natural resources to cultivating them marks a paradigm shift in a bio-based material production (Hebel & Heisel, 2017).

However, given the drastic impact of humanity on planetary systems, the question arises as to whether the bio-based material solutions on offer are sufficient for contemporary ecological design practice to adequately address the multi-layered problems of the climate crisis. Progressive voices in design and architecture are currently discussing the concept of cohabitation as the basis for a new perspective on the built environment that proposes a collaborative project of shared survival.

While architecture has traditionally been regarded as a discipline that provides living space for *Homo sapiens*, the term "cohabitation" suggests shifting the focus of architectural production to the urban intersections between human and other-than-human species. Beyond the mere provision of living space, authors ask how these new convivial spaces can also be co-designed by a multiplicity of actors (Roudavski, 2020).

An in-depth analysis of an emerging field of design concerned with sympoïetic forms of living is necessary and beyond the scope of this publication. Nevertheless, a few examples of the recently developing design landscape should be mentioned here, which takes up the challenge of dealing with multispecies communities in order to create convivial habitat:

Architects Marcos Cruz and Richard Beckett extend the concept of conviviality from the architectural to the microbial level when they propose façades as "bioreceptive" surfaces for the settlement of other-than-human species (Cruz & Beckett, 2018). Some recent design projects even go so far as to design entire ecosystems, challenging the exclusive role of architecture for human use and designing ecosystems for marine species (See e.g. *Buoyant Ecologies*,

Architecture Ecologies Lab, California College of Arts, 2017; *As Close As We Get*, Superflex, 2022), for bees (*Mama*, Marlene Huissoud, 2022), for local wetlands (*Symbiotic Spaces*, Symbiotic Spaces Collective, 2022), or for corals (*Coral Brick*, Rrreefs e.V.). The design of ecosystems, however, that takes into account the complex roles, needs and relationships of various species is not yet sufficiently methodologically anchored in the field of design.

Furthermore, Het Nieuwe Instituut introduced the "Zoöp" model (co-op = cooperation + zoë = Greek "life"), to provide a legal basis that considers other-than-human species and humans as "collaborative legal entity" (Kuitenbrouwer, 2023) that form a "multispecies community" (Ibid.). This economic framework makes it possible to assess "quality and density of ecological relationships inside and among multispecies" actors (Ibid.), as Klaas Kuitenbrouwer, initiator of the Zoöps, explains.

In their recent discussion of a (non-)modern and (de-)colonial perspective on design practices, designers Claudia Mareis and Nina Paim aptly describe the discipline "[a]s a practice deeply linked to the rise of capitalism, industrial mass-culture and the exploitation of both natural resources and human labor (. . .) [that] contributes to the logic of Western modernity as both enlightening and oppressive, both productive and extractive" (Mareis & Paim, 2022: 15). Recognizing that design and architecture have been anchored in a deeply anthropocentric worldview for most of their disciplinary existence, the authors therefore conclude that design has inevitably been unable to live up to its own claim to be "universal." Recently emerging subcategories such as Ontological Design (Winograd & Flores, 1986; Willis, 2006; Escobar, 2018) and Cosmopolitan Design (Yaneva & Zaera-Polo, 2015), on the other hand, propose a repositioning of the discipline as a situated, non-modern and interspecies collaborative practice.

As architectural theorist Alberta Yaneva and architect Alejandro Zaera-Polo write in their introduction to "What is Cosmopolitical Design? Design, Nature and the Build Environment" (2017), "[e]cology has become an alternative to modernization: a new way to handle all the objects of human and non-human collective life" (Yaneva & Zaera-Polo, 2015: 4). The question therefore arises as to how an ecological practice can be translated into a methodological design approach that addresses the fundamental environmental impacts of ongoing human encroachment on the livelihoods and habitats of countless species – a cosmopolitical approach is needed, as philosopher Isabelle Stengers reminds us, in which the "technical, cultural, social and political dimension" (Stengers, 2015: 102) must inevitably and intimately relate to each other.

In this paper, I argue for a design methodology that focuses on the complex interconnectedness of living systems, including a variety of species communities and the sympoïetic relationship of biotic and abiotic life when creating (artificial) habitats. Designing habitats in open environments is a risky and sometimes messy practice that requires moving beyond a human-centered design approach (Cooley, 1980) in favor of designing *for* and *with* other-than-human entities. Based on Donna Haraway's concept of *sympoïesis* (Greek: σύν sun = together, ποίησις poïesis = creation) (Haraway, 2016) and its historical reference to the evolutionary principle of *symbiogenesis* (Mereschkowski, 1910; Margulis, 1990), this article proposes to call such a practice *Sympoïetic Design*.

Sympoïetic Design seeks to fill a disciplinary gap by considering the sympoïetic relationships between species as a basis for ecosystem design, as argued in my paper "A Sympoïetic Ocean. Design Research with/in the Marine Holobiont" (Weber, 2023).

I use the complex ecological challenges of a rapidly changing ocean as the backdrop to outline the concept of Sympoïetic Design by comparing different strategies of designing artificial reefs – a historical form of aquaforming. By looking at three different examples of artificial reefs through the lens of philosopher Alexis Shotwell, I will take up her argument "against purity" (Shotwell, 2016) to conceptualize habitat design as a vital strategy of multispecies survival that – impure, compromised and compromising – could play a relevant role in abandoning the ideal of the human as 'doctor' of (living) systems. Based on this analysis, I will conclude with a *call to action* through my own impure and compromised design experiment in the sea.

Designing habitats

In order to approach an unfamiliar habitat, such as the sea, with the means of design research, it is necessary to experience the environment in an immersive and embodied way. Elsewhere I argue in favor of the method of direct immersion in marine ecology through scuba diving as a form of *ecological attunement* (Despret, 2008; Lipari, 2014; Franinović & Kirschner, 2021). A comparison of design research and marine biological methods in underwater environments can be found in our forthcoming publication "Attunement to the Ocean. Underwater Methods between Design Research and Marine Biology." (Weber & Wegner, 2022).

With the coral holobiont melting in "hot and acid oceans that become more acidic and hotter by the decade" (Haraway, 2016: 72), humans are beginning to create cultivated habitats to provide a fertile substrate for corals, fish, sponges, algae, etc. in an attempt to tackle declining biodiversity. Even if these attempts are undertaken with the best of intentions, they are not free from imposing an inherent "biopolitical regime" (Foucault, 1978; Braverman, 2018; Helmreich, 2016) on the lives of reef dwellers. To preserve coral life, conservation management is beginning to make irreversible selective choices. Most of these biopolitical measures taken in the context of coral conservation and management are still based on the binary logic of distinguishing between "healthy" and "diseased" habitats, between "native" and "invasive" species, between "pristine" and "anthropogenic" landscapes. Coral propagation has thus become a highly speculative biopolitical practice (Figure 1).

Our own species' extensive involvement in coral lives and livelihoods reveals interesting analogies to human reproductive medicine: The establishment of *coral nurseries* (note the term), as breeding grounds for broken coral branches – *assisted spawning* of corals in the lab – and the use of *Coral-IVF* (in vitro fertilization), which raises "corals from their embryonic stage to the level of constant supervision" (Levy, 2020: 34), do not only confront us with our productive capacities for care-taking, but also remind us of our *hubris* toward human responsibility for and stewardship of marine ecosystems. "Coral (. . .) fates", as some marine scientists admit, "are not easy to define with certitude (. . .)" (Stévenne et al., 2021). Following Michel Foucault's concept of biopower (Foucault, 1978), the question therefore arises as to how much control humans can exercise over life in the sea through highly selective categories that ultimately, to use Foucault's words, "make live" and "let die."

The promising claim behind these efforts may be the idea of returning nature to its "original state." However, this promise also directly raises the question of how to determine such a "pristine" or "natural" state? What parameters, norms and time periods do we clandestinely apply to define the "original" function and species composition of a reef?

https://doi.org/10.1017/btd.2024.16 Published online by Cambridge University Press

Figure 1. PhD Thesis SYMBIOCEAN, the installed prototype »Kiki« underwater, minus 10 meters. Diver: Noémie Chabrier. Photographer : »Aquanaute« Stéphane Jamme. Location: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Design: Rasa Weber. Date: August 2023.

Under the term *convivial conservation*, the conviction that we can preserve an "untouched state of nature" far removed from human influences has recently been problematized by a group of conservationists who are trying to integrate the Anthropocene into their environmental efforts (Reichholf, 2006; Pearce, 2016; Kegel, 2022, Büscher & Fletcher, 2019, 2020). *Convivial conservation*, as proposed by political scientist Bram Büscher and Robert Fletcher, breaks with the traditional nature conservation debate, which still promises a return to an "original" or "pristine" landscape, and instead starts from the premise that the claim of a return to a pre-human state is no longer tenable.

Applying the conceptual framework of convivial conservation to the design of marine habitats harbors enormous potential by renegotiating the power relations between humans (as designers) and other living beings and embedding artificial habitats as cultural landscapes in the concept of "nature." The design of artificial reefs thus provokes an important question: are we preserving and restoring 'original' ecosystems, or are we creating new human-environmental co-dependencies that turn coral reefs into cultured habitats?

A brief history of artificial reefs

A look at the history of human-induced cultivation of marine life confirms the assumption that "ecological" measures for nature conservation have always been driven by human, and thus, by resource-related interests: Surprisingly, from a historical perspective, the typology and use of artificial reefs and fish traps, for example, are often blurred to a certain extent and exhibit overlapping functions. By providing rocks and coral rubble as a substrate for the growth of marine life, the earliest (re)construction efforts of reef habitats were primarily aimed to create a fertile ground to increase fish populations (Farrell, 2021) and thus positively influence human fishing practices. Other examples of the dual function of artificial reefs that serve as fish traps are the Brewarrina fish traps of the Australian Aborigines (Martin et. al., 2023), which, according to estimates, could be up to 40,000 years old; the bamboo traps in the Philippines (Tsuji, 2009); or the 100-year-old Penghu stone fish weirs, with the "The Double Heart of Stacked Stones" in Taiwan as the best-known example (Chen & Lee, 2023).

Given these historical traces, it seems questionable whether the protection and restoration of coral reefs can be viewed solely as an ecological act of conservation or if these earliest forms of habitat creation were always a sophisticated and long-term project of aquaforming by humans. How pure are our human intentions when shaping habitats?

Impurity by design

Philosopher Alexis Shotwell develops a radical proposition in response to the politics and ethics of complex systemic challenges by suggesting to abandon philosophy's generalized pursuit of *purity* and instead embrace "open normativities" (Shotwell, 2016: 154) and "constitutive impurity" (Ibid.: 1–20) as the starting point of all our human actions. In her disruptive book "Against Purity – living ethically in compromised times" (2016), she further proposes to "understand (. . .) ourselves as relationally constituted" (Ibid.: 139) within the web of life and its sociopolitical constraints. The concept of *impurity* that Shotwell introduces to interrogate issues of race, gender, ecology and colonialism also allows for a fundamental shift of perspective when addressing the ongoing human-induced destruction and pollution of habitats. The philosopher makes clear that we are still subject to the fallacy "that we can access or recover a time and state before or without pollution, without impurity, before the fall of innocence, when the world as a whole was *truly beautiful*." (Ibid.: 3) In this sense, contrary to popular belief, the Anthropocene does not mark the loss of "a natural state of purity" (Ibid.: 3), but a time of indissoluble co-dependencies.

Shotwell's plea for impurity, implication and compromise might to some designers and conservationist, that grapple everyday with the challenge of restauration and conservation, seem like a walk on thin ice. It may seem dangerous or even heretic to propose that we adopt our "blasted landscapes of disturbance regimes" (Ibid.: 9), as Shotwell quotes Anna Tsing, as the blueprint for the

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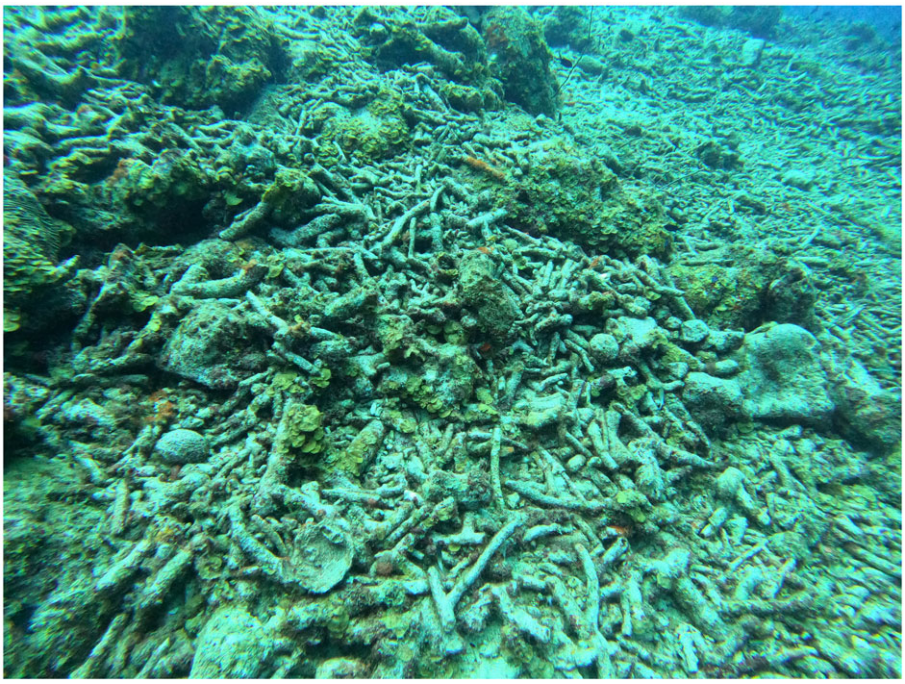

Figure 2. Diving at the remains of a former coral reef. Location: Mega Cruise Pier, Willemstad, Curaçao (ANT). Diver: Mike Duss. Research Project: Symbiocean (2022 – ongoing). Photographer: Rasa Weber. February 2022.

design of marine habitats. Does the concept of working with blasted seascapes risk abandoning the protection of "nature" to continue our destructive path?

To classify this assumption, it is essential to critically reassess the modernist notion of a "passive nature" as something "out there" (Yaneva & Zaera-Polo, 2015: 3), as anthropologist Albena Yaneva and architect Alejandro Zaera-Polo's proposal for "Cosmopolitical Design" boldly argues. The criticism formulated by the authors, which builds on Isabelle Stenger's "Cosmopolitics I & II" (2010, 2011), concludes that nature cannot be "mastered by engineers and scientists from outside" (Ibid.: 3).

The design of habitats is a deeply situated act that involves a multitude of actors such as different species, materials, technologies, human disciplines, energy flows, but also their toxicities, pollutants and ruins. Habitat design should therefore no longer be the subject of a clear-cut debate "*about 'nature,'* about conflicting human interests, but about people and wildlife and, more generally, about people and landscapes" (Ibid.: 3); with the inevitable remark that these categories can never be considered as neatly separable.

"Blasted landscapes", to borrow Eben Kirksey and Anna Tsing's term (Kirksey, eds., 2014), or in the case of marine habitats – *blasted seascapes* (Figures 2 and 3) – represent patches of hope in the context of which we must position our current efforts to design and culture habitats. A detailed analysis of the concept of blasted seascapes can be found in my paper "Queer Reefs. A queer ecological journey into blown seascapes" (Weber, 2024).

When I speak of Other Reefs, I suggest that we sharpen our understanding of artificial habitat design as a sympoïetic act and, to some degree, relinquish system control. Of Other Reefs is a proposal to conceptualize future reef ecologies as feral, uncurated, chaotic and sympoïetic life forms that reside in the blasted landscapes we ourselves have created. Habitat design is by default an act of impurity, as it always starts from a conflicted, presupposed and compromised environment that has *never been pure*.

Artificial Reefs – Three case-studies of blasted seascapes

The sometimes deliberate, but often unconscious, choices made in the design of artificial reef habitats provide an interesting window to observe the relationship between us humans and other-than-human species in the way we have historically shaped and culturally constructed these seascapes as projections of "hope." The following three examples illustrate the contradictory history of reef design as a messy process with/in aquatic "ruins" (Tsing, 2014; Shotwell, 2016), where success often remains difficult to predict.

Chuuk lagoon

The re-appropriation of the ruins of military disaster by a seemingly pristine ecosystem does not necessarily speak to the unbridled resilience of nature, but could just as well be seen as the emergence of a new ecological alliance between human-made infrastructures and marine ecosystems:

A small atoll in the middle of the Pacific, once the scene of one of the pivotal events of World War II, is today known as one of the "world's biggest ship graveyard" (Trumbull, 1972). Chuuk lagoon (formerly Truk Atoll) was a stronghold of Japanese naval power in 1944, claiming nearly 5,000 human lives and the destruction of 265 aircraft (Ibid.) after an attack by the U.S. military, not to mention the casualties among marine organisms. Most of the remains of war stayed under the sea surface and were slowly adopted by marine organisms as a habitat.

Today, almost a century later, Chuuk Lagoon is known for having the highest concentration of "artificial reefs" in the world and attracting a burgeoning dive tourism scene. The genre of *dark dive tourism*, in which divers are drawn to the morbid charm of a former war site, was partly inspired by Jacques-Yves Cousteau's famous television documentary "Lagoon of Lost Ships" (1972), which focuses on the romantic notion of life thriving amidst ruins. Cousteau puts it aptly in his unmistakable voiceover:

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Figure 3. Diving at the remains of a former coral reef. Location: Mega Cruise Pier, Willemstad, Curaçao (ANT). Diver: Mike Duss. Research Project: Symbiocean (2022 – ongoing). Photographer: Rasa Weber. February 2022.

> »I am struck by a contrast. In the dry world above, fragmented structures loom in rusted ugliness. But here, beneath the surface of the lagoon, the skeletal remains are fleshed out with new life; They blossom with myriads of creatures.«
>
> Jacques-Yves Cousteau (1972). *Lagoon of Lost Ships*, minute 16:36.

The case of Chuuk Lagoon seems to confirm the conventional belief that marine life thrives everywhere anyway. The lagoon and its medial portrayal feed the normative divide between a "pure" coral reef and its "encroachment" by human presence; In this case the ruins of ships and airplanes, which must be "reclaimed" by an all-enduring "wilderness." The case provides ideal justification to the claim that we simply need to "let nature do its thing" (Lewis, 2019: 264) – a slogan that all too easily drifts into Neo-Darwinian notions of evolution as having a steadily progressive character.

Recognizing that reefs have never been pure and that we need to deepen our awareness of the destructive forces that we humans unleash when we encroach on land- and seascapes anywhere on this planet does not mean that we applaud governments and industries for the irreparable damage they inflict on people and ecosystems. As Shotwell points out, "being against purity does not mean being for pollution" (Shotwell, 2016: 9)! As we observe the transformation and reclaiming of catastrophic environments into new habitats, we must recognize that we ourselves become part of this mutating nature, establishing ourselves in irreversibly altered conditions. A toxic relationship.

The subway reef program

The romantic belief that the environment can easily recover under any unfortunate circumstances due to its "resilience" risks rendering any conservation efforts moot. Ultimately, however, the design of artificial reefs is not as simple as is commonly assumed:

As part of the U.S. Subway Reef Program, 2,500 decommissioned subway cars were sunk in the Atlantic as a substrate for reef building organism. The video work "Ocean II Ocean" (2019) by artist Cyprien Gaillard poetically documents the almost ceremonial sinking of the stainless steel "brightliners" after 58 years of their service. The subway cars were carefully cleaned and shipped to the coasts of Delaware, Georgia, New Jersey, Maryland, South Carolina and Virginia as part of the federal program to promote marine growth, which ran from 2001 to 2010 initiated by the City of New York. In addition to the motivation of supporting the recreational fishing and diving industries, the project presumably saved the New York City Subway an estimated $30 million that would have been required to scrap the railcars in a land-based program.

Ironically, the Subway Reef Program did not go as planned. To this day, the Subway Reef Program is controversially debated as either a successful or failed ecological restoration measure. While some of the discarded steel skeletons became a substrate for new forms of marine life, a larger proportion of the wagons, which were to remain in the sea for at least 25 years, quickly decomposed due to their unsuitable material composition and have been lying around on the seabed ever since. Much of the steel skeletons probably never served their purpose of supporting marine growth and are now another scattered and fragmented legacy of human presence in the ocean. After all, designing an artificial reef habitat may not be quite so simple.

The Osborne Reef

The practice of dumping industrial waste into the sea as a "living substrate" is likely to be taken to extremes by the Osborne Reef, which has sadly gained notoriety as one of the biggest environmental disasters in the history of the ocean:

In the 1970s, Broward Artificial Reef Inc. launched an artificial reef development program on the Florida coast with an ambitious plan to build the world's longest artificial reef project by dumping 2 million discarded car tires into the ocean initiated by the Goodyear Tire and Rubber Company with the support of the U.S. Navy. Alarmingly, the tire bundles soon broke loose and turned

https://doi.org/10.1017/btd.2024.16 Published online by Cambridge University Press

into dangerous projectiles, destroying all marine life in their way. The Osborne Reef project began with a disastrous alliance of conservation policy and the industry – a coupling we should always view with great suspicion. Today, more than 50 years later, private companies are still busy capitalizing on attempts to clean up the disaster site.

A plea against healthism

Aside from the fact that marine restoration practices are much more delicate and complex than we humans are willing to admit, the ecological, infrastructural, material and technological layers of what architects Brugidou & Clouette refer to as "anthropOcean" (2018) need to be negotiated in the design of marine habitats. The messy, complex and unpredictable reefs ecosystems do not demand that we continue our destructive path in a "whatever works" logic, assuming that life will thrive anyways. Rather, they suggest that our usual conservation methods need to act as a counter to the capitalist logics of conservation policies and adapt to the changing dynamics of crisis-ridden oceans.

If corals begin to migrate to cooler hemispheres f. ex. (Sakar, 2017; Chaudhary et al., 2023), which species should we consider as aliens or neophytes of the future? Some marine biologists thus state that, "Coral reef ecosystems of the future, and the associated management/governance approaches used to protect them, are probably going to be unlike anything previously seen. (. . .)" (Bellwood et al., 2019: 608). So, the question is: "What needs to be managed, why and how?" (Ibid.: 608)

However, some voices in the discourse on coral reef conservation and restoration techniques still advocate treating these ecosystems as if they were a "sick patient" (Earle, 1996; Goreau et al., 2015):

The Biorock technology, for example, developed by architect Wolf Hilbertz and biochemist Tom Goreau in the 1970s, is a technique for creating a bioreceptive substrate for the growth of endangered coral species (Hilbertz, 1979 & 1987; Weber, 2022). It works by electrolysis in seawater to deposit limestone onto conductive steel structures, which then serve as a substrate for the restoration of marine life. Significantly, Tom Goreau eventually named his technology "electrotherapy" (Goreau, 2022) – a name that suggests it is a "cure" for deteriorating marine ecosystems. In this context, Goreau also brings up the concept of "geotherapy." With unwavering optimism, he explains: "There's a one-word term for Healing Earth: *Geotherapy*, regenerating the planet's natural life support systems, like a doctor prescribes a cure to restore a sick patient to health" (Goreau, 2019).

Surprisingly, even diver and biologist Sylvia Earle states in a similar tone "that effective restoration efforts are comparable to the actions of doctors treating a *sick patient*" (Earle, 1996: 303, emphasis added). Yet, Earle also admits that restauration processes can frighteningly easy lead to disruption and destruction and that *"true healing"* (Ibid.: 303, emphasis added) cannot necessarily be achieved through acceleration and "quick-fix solutions" (Ibid.), but rather through "time and active, natural processes that are beyond human understanding" (Ibid.). Meanwhile, Goreau even goes so far as to claim that technology may be able to "restor[e] ecosystems to *reverse global warming*" (Goreau [online], 2014, emphasis added). During an interview, however, Goreau qualified this statement, as follows: "I am not in favor of geoengineering. I am in favor of the natural mechanisms. But we are now at that point where that may not be enough" (Goreau & Weber, 2023, minute 28:30).

But what is enough?

Given the recent U.N. report that climate change is on the brink of "catastrophic warming" (U.N. IPCC, 2023), which might lead to unprecedented mass bleaching in 2024 (Einhorn, 2024) and the resulting impacts on ocean temperatures, that are turning the distribution of corals into a patchy landscape under constant threat (Ocean warming map: earth.nullschool.net), it seems hard to question any effort to "try[. . .] to protect what we have while we can" (Goreau & Weber, 2023, minute 28:20).

If we move away from what Shotwell calls "healthism" (Shotwell, 2016: 29) – which sees individual health (of humans, other species, ecosystems) as a given moral imperative – we may be able to develop a much more modest and highly interconnected view of marine habitats. "Health", as Shotwell points out, "is a contingent, multivalent and complexly intertwined" issue that is linked to "social and material environments" (Ibid.: 30). And here at least Goreau might agree with Shotwell's call for "collective response to collective harm" (Ibid. p. 30) when he claims: "I am more worried about the extinction of the ecosystem itself than the species" (Goreau & Weber, 2023, minute 27:50).

How can we collectively respond to the collective harm inflicted on marine ecosystems? How does an artificial reef look like that does not aim to reconstruct a pre-human coral reef? How do you design an ecosystem without claiming to "heal" nature?

The first attempts to consider unconventional norms for ecological conservation are making their appearance in the debate: When the Danish art studio Superflex places its pink underwater sculptures as "fish architecture" in the harbor of Copenhagen, it deliberately choses for a habitat-driven design approach in an ecosystem that cannot be perceived as "pure" (Superflex, 2022). Furthermore, the "Rigs-to-Reefs" practice (Pereira et al., 2023) proposes to repurpose decommissioned offshore oil and petroleum platforms as artificial habitats for marine life, assuming that the overlap of human infrastructure and marine life should be considered in the conservation debate (although it should be noted that this practice could be an all-too-easy exit for oil companies). Finally, the growing interest of marine biologists in commercial harbors as unexpected places to promote marine biodiversity (Madon et al., 2023) is leading to promising ideas beyond the distinction of "pristine" nature and "artificial" habitat, with the port of Marseille being one of the most popular experimental sites.

Working with coral reefs as "feral ecologies" that represent "ecological worlds created when non-human entities become tangled up with human infrastructure projects" (Tsing et al., [online] 2021) requires a twofold and thus delicate positioning: On the one hand, it must be acknowledged that *there may be no cure*, as any of our well-intentioned actions will always fall victim to the larger changes at stake in our current "catastrophic times" (Stengers, 2015). Recognizing that we are the cause of the crisis does not necessarily empower us to solve it. On the other hand, this realization must also be understood as a clear call to action! Again, Shotwell might be of help here when she says: "Listening well, taking responsibility and acting even though we recognize that we can't be pure is going to be much harder than disengaging would be." (Shotwell [online], 2017) So, how can we act when those actions are always compromised?

The seascape has always been subject to intense human impact and is in a constant state of change. For us, designers and humans, looking at the marine environment is an opportunity to understand that working on coral reefs is not just about treating the "health" of an affected ecosystem, but is fundamental to securing our *own* human existence – the doctor is therefore the *patient*.

https://doi.org/10.1017/btd.2024.16 Published online by Cambridge University Press

Figure 4. PhD Thesis SYMBIOCEAN, placing the prototype »Kiki« underwater, minus 3 meters. Divers: Noémie Chabrier, Mathieu Kelhetter, Rasa Weber, Anja Wegner. Location: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Photo: Mathieu Kelhetter. Design: Rasa Weber. Date: June 2023.

Figure 5. PhD Thesis SYMBIOCEAN, assembly of the prototype »Kiki«. In the photo: Rasa Weber. Location: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Photo: Mathieu Kelhetter. Design: Rasa Weber. Date: June 2023.

https://doi.org/10.1017/btd.2024.16 Published online by Cambridge University Press

Figure 6. Participants help to weave the conductive looms of »Kiki«. Left and below: Teal. Right: Julian. Place: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Photo: Rasa Weber. Design: Rasa Weber. Date: June 2023.

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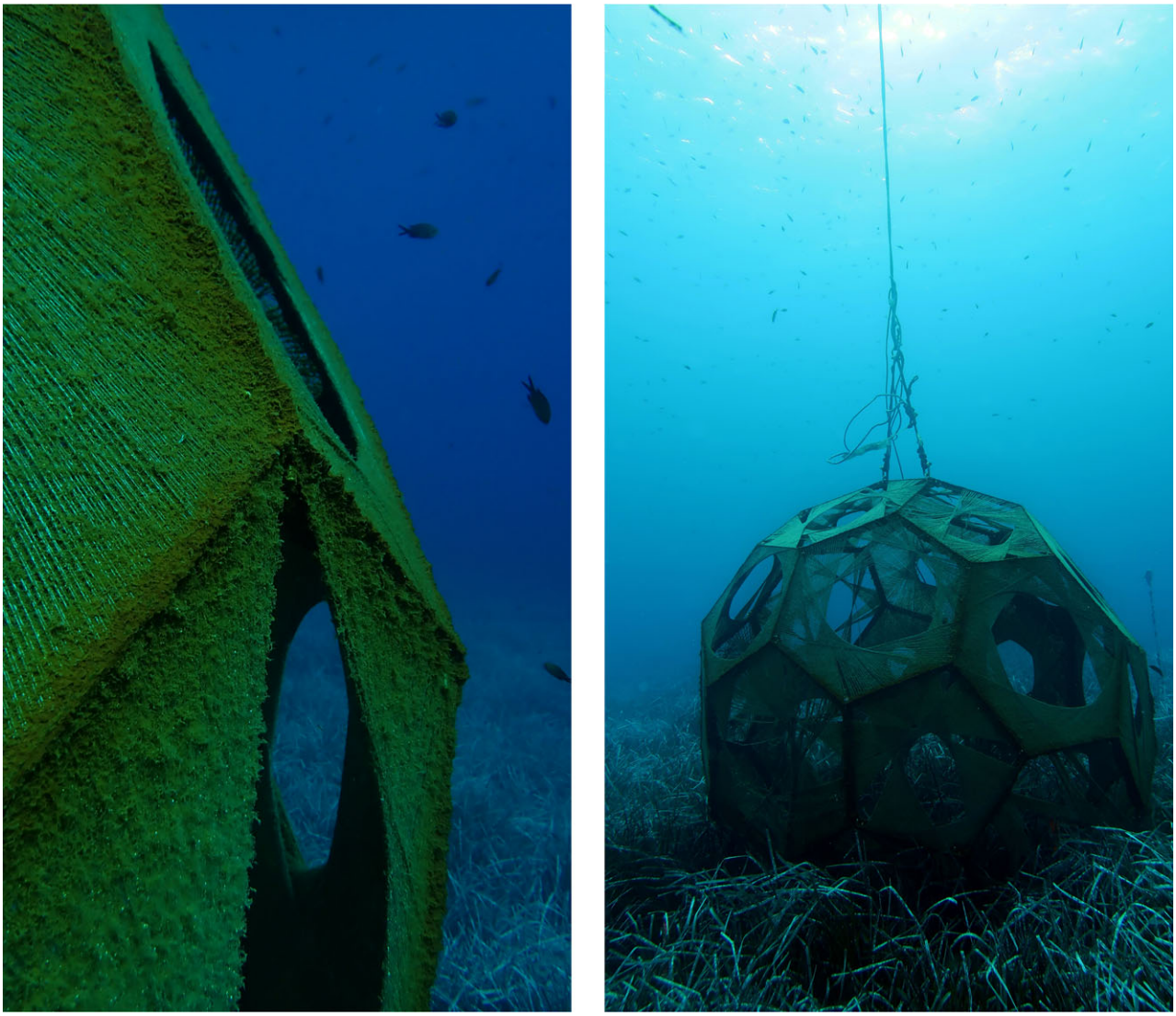

Figure 7. PhD Thesis SYMBIOCEAN, the prototype »Kiki« with first layer of pioneering organisms (left) and after its destruction by a storm (right). Location: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Photo: Noémie Chabrier. Design: Rasa Weber. Date: November 2023.

An/Other reef – Kiki as a marine case-study

»*The point, however, is to change it.*« (Shotwell, 2016: 195)

Moved by Shotwell's words, I conducted a field study on the design of a marine habitat in the Mediterranean. As part of my dissertation project "SymbiOcean", in which I am investigating the design of artificial reefs in marine environments, I developed a submerged prototype that probes open normativities in marine conservation. The structure was placed underwater in June 2023 at the STARESO scientific research station in Corsica (FR). Based on the Biorock principle (Hilbertz, US patent, 1995–2015: *US5543034A)*, which enables the accretion of minerals in seawater through electrolysis, I designed a woven structure that slowly solidifies into a limestone-like material (Weber, 2022) and serves as a substrate for the growth of marine life. The 2.5-m-wide sphere is designed as a lightweight scaffold made of a steel frame and filigree conductive steel yarns (Figure 4), connected to a solar panel on land, which supplies the structure with low voltage current to trigger electrolysis.

We named the structure "Kiki" (French for "cute") in ironic recognition of its enormous size and the incredible challenge of placing the structure in deep water (Figure 4). It took us two dives, a total of six divers and a boat to bring "Kiki" to her new home at minus 10 m (Figure 7). I have literally never used my fins to *walk* on the seabed while dragging a beast!

The prototype functions as a contact zone between different species and challenges the role of design as a human-centered practice by attempting to relinquish selective control over the composition of species. By abandoning these selective choices normally applied in the creation of artificial reefs (through fragmentation and transplantation) it argues in favor of a feral proliferation of so-called "pioneer organisms" that slowly begin to inhabit the structure.

Design anthropologists Åsa Ståhl and Kristina *Lindström* state that "a crucial (. . .) practice in *design anthropology* is the crafting of *invitations*" (Ståhl & Lindström, 2016: 183, emphasis added). While their idea was primarily formulated in terms of human interactions, the design of habitats similarly represents an *open invitation* to different life forms to settle on, or interact with it. In

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Figure 8. PhD Thesis SYMBIOCEAN, the installed prototype »Kiki« underwater, minus 10 meters. Diver & photographer: Noémie Chabrier. Location: STARESO – Station de Recherche Sous-Marines et Océanographiques de Calvi, Corsica (FR). Design: Rasa Weber. Date: July 2023.

this sense, "Kiki" could be described as an *invitation* for marine dwellers – an invitation that can be accepted or declined (Figure 5).

When making the prototypes, I also realized that weaving the looms proves to be a fantastic communication tool for collaboration with my human participants (biologists, sound artists, children) (Figure 6): A way of *weaving together* – or, as designer Svenja Keune put it, a way of "weaving entangled worlds" (Keune, 2021). On the one hand, the prototype is literally an object of dialogue that invites people to weave together; on the other hand, it interweaves the design field with conservation biology and the socio-political sphere.

"Kiki" illustrates the attempt to collaborate with sea organisms and co-create a habitat, as well as it grapples with ocean forces, the currents, the tides, the changing seasons in the Mediterranean and much longer periods of time.

STARESO staff monitored the project with 360° cameras and underwater action cams to demonstrate its slow transformation through the interaction with the local ecosystem. Ultimately, the design of Kiki as an artificial reef was influenced not only by the collaboration of various humans involved in its production process, but also by sea dwellers such as algae, fish and sponges that temporarily inhabited the structure, by currents that shaped and eventually even distorted its appearance and by material flows that influenced its species composition.

The prototype bore the wounds of collisions with underwater rocks (Figure 4), was deformed by currents, began to accumulate some algae colonies (*Cladophora glomerata*) and attracted schools of fish (*Chromis chromis*) since its first deployment in the sea.

"Kiki" remained submerged on the coast of Punta de la Revellata for six months until a Corsican storm decided otherwise and took her apart. "The queer art of failure" – to paraphrase Jack Halberstam (2011) – demands to be continued. The prototype questions the category of "brokenness" as a norm applied from a human perspective. When Shotwell reminds us how important it is to change things beyond pure or flawless solutions, she also calls for a change of perspective: a broken design object – broken for whom? (Figure 8).

Conclusion

Working on Other Reefs always carries the risk of getting it wrong in the end. Rather than restoring "pristine nature", these co-created habitats encourage architects and designers to relinquish control of the system and incorporate feral life forms and environmental forces into their design process. These habitats are created to establish "open normativities" in the conservation debate through a design practice that prioritizes conviviality and co-authorship over a human-centered design approach. An unpredictable process of Sympoïetic Design.

I will therefore conclude with Shotwell's words: "We need practices of open normativities to pursue visions and practices that are hospitable to future worlds to determine *what deserves a future"* (Shotwell, 2016: 163). It will be the subject of our convivial negotiations to formulate these open normativites. Who will be involved in designing a marine habitat *for* and *with* corals, sponges, humans, limestone, electrical circuits, technologies, climatic

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conditions, fish, storms, material flows, bacteria and algae in those blasted seascapes we currently inhabit?

Data availability statement. All data which is generated within the PhD Thesis "SYMBIOCEAN" as part of the Swiss National Science Fund research project "Interfacing the Ocean" will be saved and made accessible via the Medienarchiv of Zurich University of the Arts.

Acknowledgements. I would like to thank Station de Recherches Sous-Marine et Océanographiques de Calvi (*STARESO*) for their ongoing support and collaboration in monitoring my structures. My PhD-supervisors Karmen Franinović and Karin Harrasser for their fruitful critique. The entire team of collaborators including: Arnaud Boulenger, Sandra Bracun, Noemi Chabrier, Mélodie Chapat, Sylvain Coudray, Stéphane Jamme, Leonie John, Alex Jordan, Teal Jordan, Michael Karle, Mathieu Kelhetter (design intern), Michaela Roger, Bram van der Schoot, Kelly Stiver, Anja Wegner, Lena Wesenberg, Aubin Woehrel and all the other divers that helped me to install and monitor Kiki.

Financial support. This PhD project is funded by the Swiss National Science Fund project 'Interfacing the Ocean' led by Prof. Dr. Karmen Franinović and Dr. Roman Kirschner at Zurich University of the Arts, conducted together with PhD researchers Antoine Bertin and Anthea Oestreicher. The doctorate takes place within the practice-based PhD program cooperation between Zurich University of the Arts and University of Arts and Design Linz, supervised by Prof. Dr. Karmen Franinović (Design) and Dr. Karin Harrasser (Cultural Theory, University of Arts and Design Linz). As associated member, Rasa Weber has further joined the Cluster of Excellence "Matters of Activity" at Humboldt University of Berlin in 2022 and is part of its PhD research cohort. This research was supported by the Interaction Design Department of Zurich University of the Arts, PROCOPE Mobility Grants by EFG & the French Embassy of Berlin, the "Material Form Function" research group of "Matters of Activity. Cluster of Excellence." and the mobility grant of Linz University of Arts and Design.

Competing interests. Author Rasa Weber is employed at Zurich University of the Arts and part of the Swiss National Science Research Fund project 'Interfacing the Ocean' at ZHdK with PIs Karmen Franinović and Roman Kirschner. The author's thesis 'SymbiOcean' is supervised by Karmen Franinović (ZHdK) & Karin Harrasser (Linz University of Arts and Design). Rasa Weber is a research associate at Humboldt University of Berlin, 'Matters of Activity' Cluster of Excellence. The author has retrieved grants from PROCOPE Mobility Fund of French Embassy Berlin and DAAD, from the Transdiciplinary Artistic PhD program at Zurich University of the Arts and from travel grant of Linz University of Art and Design.

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