Operationalizing the Nature Futures Framework in the High Seas

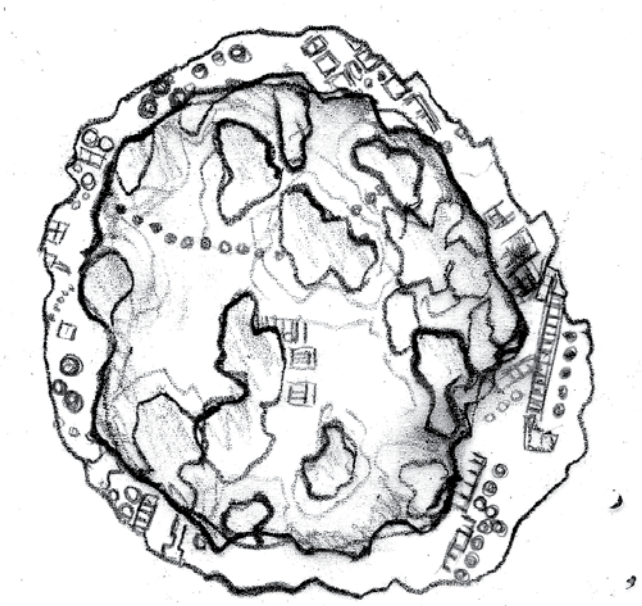
Final Report (2021-2022)

FUTURE ECOSYSTEMS FOR AFRICA

NEREUS PROGRAM
Predicting Future Oceans

THE NIPPON FOUNDATION

RESEARCH AND CONSERVATION
OPPENHEIMER



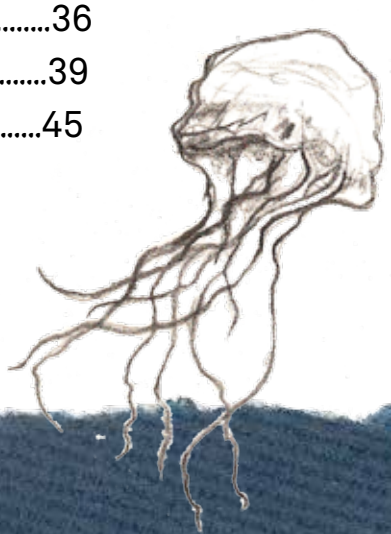
Acknowledgements

Thank you to our funders without whom these workshops could not have taken place. The Future Ecosystems For Africa programme at the University of the Witwatersrand in partnership with Oppenheimer Generations Research and Conservation for co-funding of the in-person workshop in Cape Town. The Nippon Foundation Nereus Program network, also for co-funding the workshop in Cape Town and the finalization of this report.

We would also like to thank the project advisory board, the workshop participants as well as our research assistants, students and artists: Bwalya Chibwe, Naomi Terry, Edoardo Superchi, Stacy Godfreey-Igwe, Silvana Juri, Ravi Maharaj, Hannah Lübker and CareCreative (Claire Homewood).

This report should be cited as
Pereira, LM., Ortuño Crespo, G., Merrie, A and Homewood, C. (2022). Operationalising the Nature Futures Framework in the High Seas. Nereus Workshop report, Stockholm.

Table of contents



Introduction

"The sea is everything. It covers seven tenths of the terrestrial globe. Its breath is pure and healthy. It is an immense desert, where man is never lonely, for he feels life stirring on all sides. The sea is only the embodiment of a supernatural and wonderful existence. It is nothing but love and emotion; it is the Living Infinite."

- Jules Verne, Twenty Thousand Leagues Under the Sea.

Situational summary

The perceived remoteness and vastness of the ocean has inadvertently created a psychological and cultural barrier between people and the global ocean, particularly in areas beyond national jurisdiction (ABNJ); which accounts for >64% of the ocean and >45% of our planetary surface. After decades of commercial fisheries exploitation by a small number of nations this once untouched part of our planet and its biodiversity and ecosystems face an uncertain future[1,2]. The *Mare Liberum* mentality that still prevails in international waters[3], in conjunction with the fragmented patchwork of sectoral management bodies that frequently lack the mandate or capacity to embrace a holistic approach to managing human activities, is a dangerous cocktail that not only threatens endemic high seas biodiversity, but also hundreds of species that migrate or straddle to and from the high seas and the coastal ocean of all island and coastal states[4,5].

Over the past century, humanity has ventured further and deeper into the ocean than ever before in search of food, oil and gas, minerals or efficient trading routes[6,7]. However, it was not until 1982, the year that the UN Convention on the Law of the Sea (UNCLOS) was opened for signature, that the jurisdictional boundary of ABNJ was established. This intergovernmental agreement attempted to ensure equitable access and sustainable use of biotic and abiotic resources in ABNJ; hereafter referred to as the high seas. Since then, the UNCLOS and the two subsequent implementing agreements on seabed mining and straddling or migrating fish stocks across jurisdictions (i.e. the UN Fish Stocks Agreement) attempted to operationalise the management of activities in the high seas through the establishment of global or regional management bodies. Four decades later, the governance seascape for the management of human activities and their impacts in the high seas remains fragmented, sectoral in nature and largely fails to achieve sustainability mandates[8]. The majority of these organisations operate through a consensus-based approach, which facilitates the blocking or vetoing of entire conservation or management measures by a single Party who does not agree. Alternatively, Parties may decide to remove themselves from the convention and still engage in that particular sectoral activity (e.g. Japan leaving the International Whaling Commission) or seek an exemption to specific regulations that are not in their interest (e.g. Iceland or Japan on the International Whaling Commission whaling moratorium), although there is a growing system to disincentivise such behaviour. This lack of accountability is perhaps best exemplified in the context of fisheries, where any fishing nation could theoretically drive a target or non-target species to ecological extinction through unregulated high seas fishing with relative impunity, as it would not be considered illegal, nor would there be substantial penalties.

"When everything is connected to everything else, for better or for worse, everything matters." - Bruce Mau

While the principal sectoral activities in the high seas are dominated by a small number of nations and companies[9,10], their impacts are felt by many in the coastal ocean. These activities not only impact ecosystems and species endemic to the high seas[11], but also hundreds of other migratory or straddling species, many of which are of high conservation concern[4,5], or which remain poorly assessed[12]. The trans-boundary connectivity of species, ecosystems and processes between the high seas and the exclusive economic zones of coastal and island nations inevitably makes anthropogenic activities in international waters of direct concern to all maritime states and their peoples[13,14]. As anthropogenic pressures on the high seas and migratory species increase, trans-boundary, cross sectoral management becomes more urgent than ever before. However, the current governance framework is proving incapable of harnessing the necessary creativity, incentives and buy-in to deliver a joint vision and subsequent roadmap to get to a better future.

Systems thinking offers the framework of leverage points for unpacking where to intervene in a system to enable the greatest change[15]. From Meadow's list of 12 potential interventions, Abson et al.,[16] summarise these into four types of system characteristics that can be leveraged towards the goal of sustainability transformations: material or parameters; feedbacks; design and, the set of characteristics with the deepest leverage potential, intent (Figure 1 Appendix 1). High seas governance processes currently influence three of the four realms of leverage: Material, Process and Design[16]. However, the most impactful area with the deepest leverage points – Intent – is arguably not being sufficiently addressed by the international community. Changing the fate of the high seas will require a paradigm shift to a new shared vision of the ocean we want across sectors, regions and cultures; something which perhaps may only be attained by generating and communicating different scenarios that lay out alternative models of coexistence between humans and life on the planet. This shared vision must not only integrate ongoing processes such as the next steps of the Convention on Biological Diversity (CBD) agenda and the upcoming, but for the moment stalled, biodiversity beyond national jurisdiction treaty, but explore the transformation of systems that are not structured to deliver equitable and sustainable outcomes. In this report, we outline a participatory process that was undertaken to try to address this gap by telling inspirational stories about a more desirable future of the high seas and how we might get there.

Tools for Re-Imagining the High Seas

"The most tragic form of loss isn't the loss of security; it's the loss of the capacity to imagine that things could be different." - Ernst Bloch

There is a critical need to engage more with our imaginations to be able to draw on more creative and dynamic stories about the future for improved decision-making in the present[17,18]. Stories are powerful in that they have the ability to create alternative futures; if we tell ourselves stories of despair and collapse, that is the more likely outcome, but if we are able to draw on stories of hope and change, these could become enablers for transformative change towards better futures[19]. However, as demonstrated by the Radical Ocean Futures scenarios developed by Merrie et al[20], there is also a need to address the contested reality of what a desirable future is[19]. Scenarios can be used to keep track of what sort of future is emerging, and how to steer a trajectory towards one that is more socially and ecologically sustainable. Any effort to steer towards a 'desirable' trajectory must engage with the normative discussion of what is and is not desirable, and for whom[17,18]. This is where it is critically important to be explicit about the different values that people hold, sometimes even in contradiction to each other in various times and places.

There are very few visions of what a transformed future for the ocean might be (for exceptions, see[20–22]), let alone what a desirable future for the high seas could look like from a diversity of perspectives and forms of knowledge[23]. Planque et al.[24] first detailed the development of separate scenarios based on distinct perspectives and subsequently described a process for the integration of these individual scenarios into multi-perspective, imagined futures[24]. However, according to Nash et al.[25] this two-step approach does not allow for end-to-end interdisciplinary collaborations that integrate worldviews from the outset. A lack of appreciation of difference by those with their own divergent perspectives can lead to conflict rather than cooperation as each tries to overrule the other with the powerful tending to win the day. Governance therefore becomes more difficult to negotiate as there is no clear idea of where it is we want to navigate towards, let alone a recognition of the potentially divergent pathways that different groups may want to take towards these alternative futures. We argue that given this moment of ocean governance negotiation, if we are to transform the current system by leveraging a deep paradigm shift in values, goals and worldviews of key actors, it is essential to co-produce a range of desirable visions for the high seas with key stakeholders, some of whose perspectives may differ.

We outline a framework designed principally for this task of creating more diverse, desirable futures for nature and propose an action agenda for realising this task. This is the Nature Futures Framework (NFF) developed by the IPBES Task Force on Scenarios and Models that has its foundation in recognising pluralistic values for nature[26].

Values help define what is important and significant for communities and in situations involving a range of different stakeholders, it is important to ensure that their diverse values are heard and included in the development of management options[27]. Work focused on attitudes and values has been suggested as a means to promote understanding and communicating among groups of stakeholders with different, and sometimes competing, world views. The need for such an approach that acknowledges diverse perspectives is now being recognised within the biodiversity community[28–30], and was the main motivation for the development of the Nature Futures Framework (NFF) by the IPBES Task Force on Scenarios and Models[26].

The NFF builds on an ongoing scholarship that engages with the need for a diversified framing on values of nature and its contributions to people, including an emphasis on relational values[31]. It is a heuristic that captures diverse, positive values for human-nature relationships in a triangular space (Figure 1). Each vertex represents one of three perspectives for valuing nature: nature for nature, nature for society, and nature as culture. These respectively build on the three values of nature (intrinsic, instrumental and relational values), reconfiguring them to co-exist simultaneously and allowing for a heuristic that is actionable for the modeling and scenarios community. The NFF triangle illustrates how it is possible to emphasise a complex mixture of values for appreciating nature depending where in the triangle you wish to be and thus allows for a plurality of perspectives to be held in different times, contexts and places.

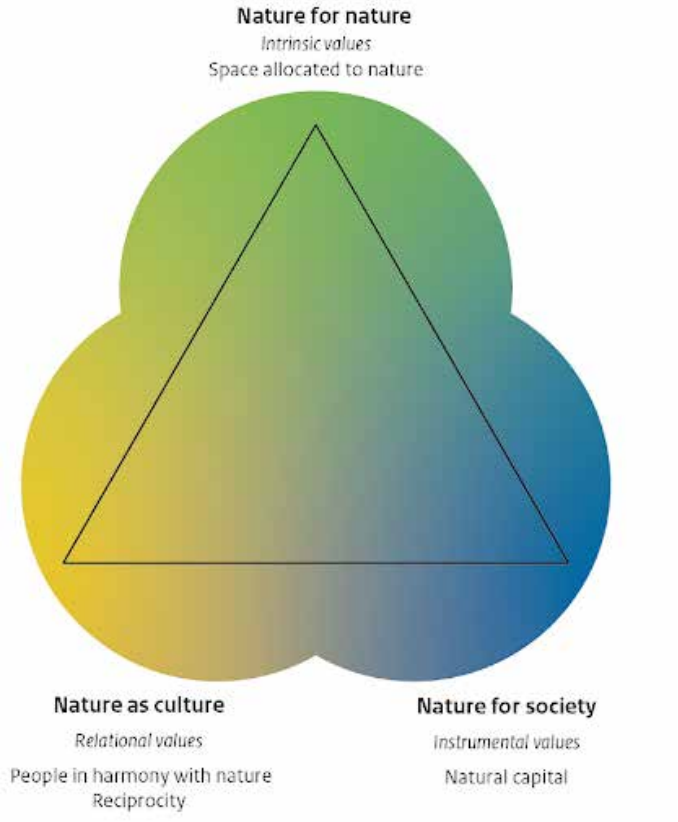


Figure 1: The Nature Futures Framework illustrating the three main value perspectives (Source: IPBES Task Force on Scenarios and Models).

Recognising the need for more pluralistic, transformative and scenarios for nature, the IPBES task force on scenarios and models developed the NFF for use in research and governance processes that require a sense of what potential futures could be possible, even the more radical. As such, we propose it as a good starting point for a discussion on what governance and future relations between nature and humanity in the high seas could look like in the medium-to-long term future. Existing research already looks at aspects of the different corners of the NFF triangle, but none of it has been brought together into one framework. For example, the rights of nature approach as applied to the high seas, which is deeply embedded within, but not exclusive to, the *Nature for Nature* value perspective increasingly emphasises how "legal systems should recognise nature as a rights-bearing subject, rather than an object owned and controlled by humans"[32]. There is also work that directly seeks to link traditional knowledge systems to the development of biodiversity beyond national jurisdiction treaty, which forms a component of the *Nature as Culture* value perspective of the NFF[33,34]. Probably most research focuses on the *Nature for Society* value perspective where the largest or fastest emerging high seas sectors of fisheries, shipping and mining need to be engaged.[35] Emerging industries, such as offshore renewables or marine genetic resource harvesting must also be included in the generation of future scenarios[36–38]. Accounting for socio-economic trends such as, seafood production & green-technology mineral requirements, or climate change trajectories, is crucially important to craft reliable future scenarios that capture the likely emergence of new patterns of use or risks and how they could be better managed[39–41].

.

"Even if you never have the chance to see or touch the ocean, the ocean touches you with every breath you take, every drop of water you drink, every bite you consume. Everyone, everywhere is inextricably connected to and utterly dependent upon the existence of the sea."

- Sylvia A. Earle, The World Is Blue: How Our Fate and the Ocean's Are One

Below we set out a process, working with a small subset of diverse stakeholders and interest groups, to determine what a desirable future for the high seas might be. We lay out the process and outcomes of a deep exercise in participatory futures thinking to derive a set of visions and skeleton scenarios.

Methods

Online workshops

The overarching structure of the online workshops followed the general structure of the three horizons framework[42], but adapted it from the more linear, innovations-led approach. Referencing the three 'horizons' of the framework- present, future, and transition space, we hosted three online workshops with a group of high seas experts (Figure 2). The online workshops were structured as follows: Workshop 1: the aim was to determine challenges to the high seas in the current regime that need to be overcome (Horizon 1); Workshop 2: the aim was to imagine visions of the high seas in the future using the Nature Futures Framework (Horizon 3); and then Workshop 3 aimed at starting a discussion of how to get there (Horizon 2) that was to be preparatory work for the fourth, in-person meeting that aimed to refine all of these steps.

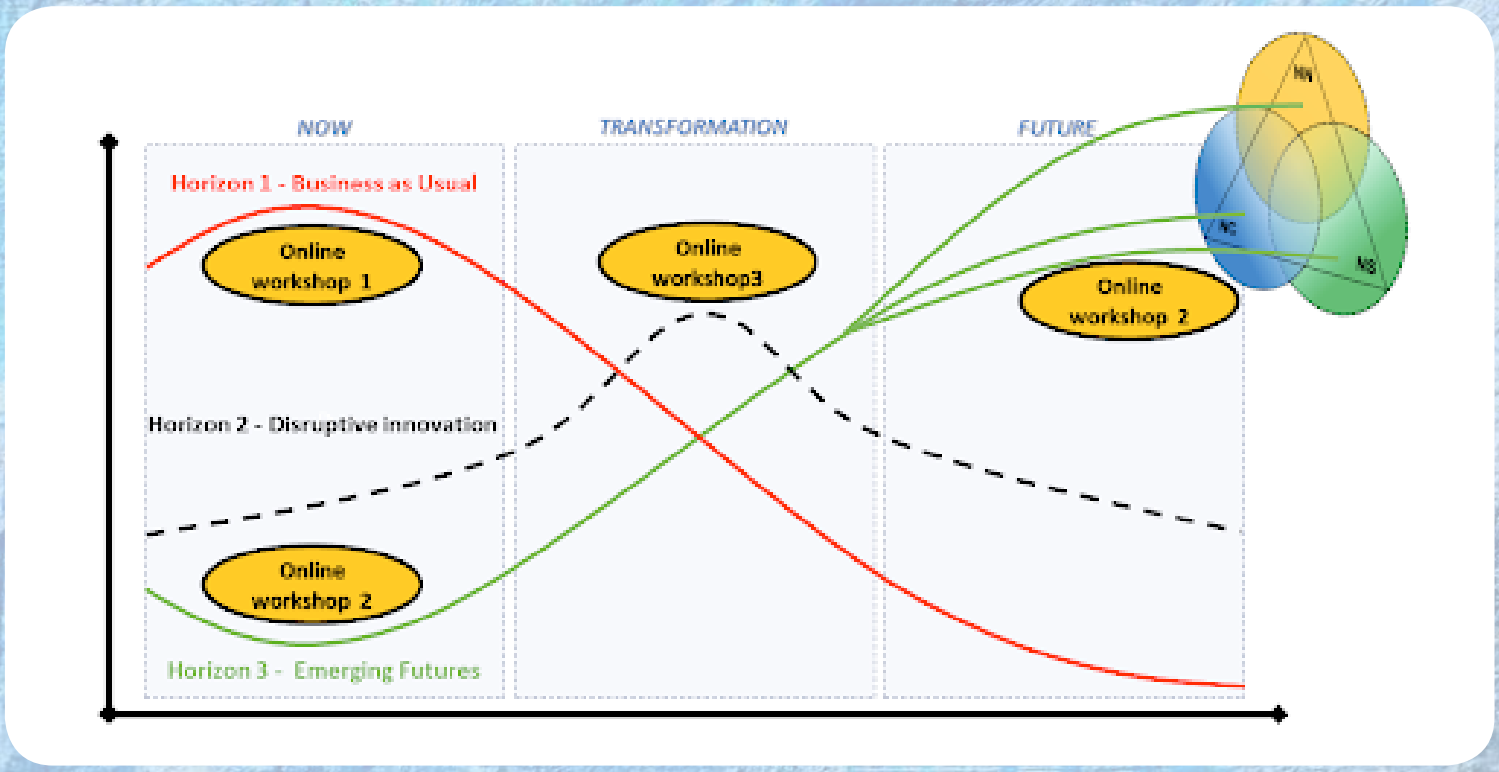


Figure 2: 3 Organisational diagram of the three online workshops, following the three-horizons framework[42].

As this was intended to be a participatory process, but since it is impossible to get full representation of all stakeholders for the high seas, we designed it as an expert-led process. As it is critical to have the right mix of people in the room when undertaking such processes[46], we chose participants based on three factors: 1- that their work connected strongly with the high seas; 2- that there were diverse perspectives represented (ie research, but also governance and business) and 3- that we had a good range of ages and geographies represented. As it was quite a big request to make of people to attend 3X3 hour online sessions over the course of 6 months, we started with reaching out to people with whom either the convenors (Ortuño Crespo and Pereira) or the advisory board of the project (Table 1 Appendix 1) had connections and then snowballed further participants from there. All participants were asked to sign a consent form prior to the workshop and it was agreed that Chatham House rules would be followed. Ethical approval for the research was granted by Stockholm Resilience Centre in May 2021.

We held two sessions for each of the online workshops on seperate days to account for the different regional time zones and availability of the participants. Given the global distribution of workshop participants, each of the three workshops had two sister replicate sessions: 1: Africa, Asia, Europe, Oceania & 2: Africa, Europe, Americas. The same structure was followed for both workshops. The first day hosted the Americas, Africa and Europe group and the second day, the Asia, Oceania, Africa and Europe group.

Online Workshop 1 (Horizon 1) - Identifying High Seas Challenges

As a first step towards this visioning process we invited participants to take part in the first of three virtual workshops via two separate sessions that were held on the 12th and 14th of July 2021. We had a total of 26 participants and 5 facilitators from +20 different countries and a variety of sectors including academia, private, governmental and inter- and non-governmental organisations (See **Workshop 1** report for more information on participants). The main objectives of this first workshop were to acquaint participants with the NFF and three horizons frameworks and to identify the main challenges associated with the high seas using S.T.E.E.P. (Societal, Technological, Economic, Environmental & Political) to identify said challenges. Before the workshop, participants were invited to fill in an online survey identifying the challenges in the ABNJ. The virtual workshop was held over Zoom and we used Miro, a virtual whiteboard platform for note taking and voting (See Workshop report 1). The workshop was divided into three sessions:

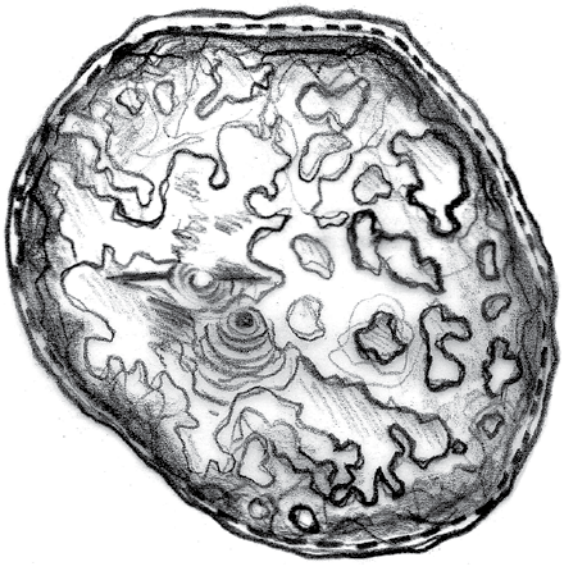
Session 1: In the first session participants and facilitators introduced themselves and explained their relationship with the Ocean; this helped build trust amongst a diverse group of people who, for the most part, did not know each other. This was followed by a short introduction to the overall workshop structure and rationale.

Session 2: In this session the challenges from the pre-workshop survey were briefly outlined with the objective of refreshing everyone's mind on the potential challenges they may want to focus on later in the workshop. Participants were then assigned to one of the two breakout groups where they brainstormed the most important high seas challenges using the S.T.E.E.P. categories; they could repeat challenges from the pre-workshop survey, or identify new ones. The outcome was a total of 130 challenges across the categories, which the participants were then asked to prioritise by voting for their top 5 challenges by placing their assigned color-coded dot on the relevant sticky note. Each of the participants had 6 votes for this (see Figure 2 Appendix 1).

Session 3: The participants all returned to the main meeting room from their breakout rooms and prioritised the top 10 combined challenges (5 from each breakout room) based on their relative importance and feasibility using the same voting protocol, but this time by placing their dot on an axis (Figure 3 Appendix 1). The reasons why addressing a challenge may require more or less effort were left open to interpretation and could be related to political will, technological capabilities or costs. This resulted in a prioritisation of challenges that were most important and also the hardest to address. Since two replicate sessions of Workshop 1 were conducted, a total of 20 high seas challenges were identified and prioritised (See Workshop 1 report[43]).

Post-workshop Thematic Analysis

While the discrete categorical framework provided by S.T.E.E.P. was intuitive and practical for the purpose of identifying challenges during the workshops, participants emphasised the cross- cutting nature of many of the challenges identified. After the workshop we collated all the challenges and conducted a thematic analysis to cluster the challenges again and identify alternative thematic areas.



Online Workshop 2 (Horizon 3) - Seeds of Innovation & Future Scenarios

The aim of this workshop was to explore the Third Horizon through imaginative worldbuilding & storytelling methods. Participants co-designed futures in line with the three different corners of the Nature Futures Framework: Nature for Nature, Nature as Culture and Nature for Society. The main method for story building follows a similar protocol to science fiction prototyping, which brings scientific and objective empirical understandings of the world into dialogue with imagined seemingly implausible futures[20].

A core objective of this workshop was to overcome current mental models and transcend ways of thinking that tend to extrapolate and reinforce the status quo[44]. This required enabling the freedom to think and try what may seem impossible, despite the constraints of being in an online environment. This is an important challenge in doing visioning exercises because, while creativity is an ability that humans have the potential to develop, it requires a series of personal and contextual conditions (traits and environment) and a proactive and intentional exercise[45], especially because it is aimed at challenging existing norms and processes as a way to bring forth something new[46]. In line with this, the workshop structure was planned around a series of steps that could depart from current knowledge in order to then transcend it and enable a collective creative process. This process was facilitated by the design of a generative tool[47] in the form of virtual worksheets on Miro. Three spaces were developed with the aims of: synthesising participant's contributions, supporting facilitation and conversation, and the possibility for participants to develop a storyline based on the previous contributions. In addition, creativity is also influenced by non-rational processes such as emotional states or intuition[45]. To this end, the facilitators made use of inspirational images, music and multiple references to visual or other sensory qualities: colors, shapes and smells.

Workshop 2 took place on 13th and 15th September 2021 with a pilot run on the 8th September with a smaller group who couldn't attend the other workshops. It began with a welcome to the participants and a recap of the 3 Horizons Framework and Nature Futures Framework. The facilitators asked participants to put aside the challenges discussed in the first workshop and instead enter a mindframe more conducive to creating radically transformative future scenarios. The workshop was again organised into three sessions.

Session 1: As homework, each participant had completed a questionnaire asking for them to submit a seed- a process, initiative or way of seeing the world that was currently marginal, but that they thought could contribute to a better future for the high seas[48]. In the first plenary session the participants explained their seeds and the mature condition of the seed. An artist had created some seed inspired artistic representations capturing some of the aesthetic, visual and metaphorical features described by the participants (For a detailed description of the seeds, please see **Workshop Report 2**[49]). As participants introduced each seed, they were arranged at each NFF corner using a collage-based method inspired by an exquisite corpse surrealist game[50] (Appendix 1 Figure 4). The adoption of this technique was meant to inspire and trigger the participant's minds beyond familiarity and into a space of possibility, setting the stage to allow for playful exploration and collective imagination. The arts-based method of collage enables a logic that can enable multiple and plural significations or associations, as it challenges "all dogmatisms" and the need to search for one truth[51]. The resulting fragmented and fantastical assemblages were shared back to the participants with a short presentation of the artist's outcomes and thought process.

Session 2: Participants were then allocated to a breakout room (one for each corner of the NFF: i.e nature for nature, nature for society or nature as culture) based on how well their seed connected to that value perspective. Each breakout room consisted of a facilitator and a note taker team and the participants that belonged to the value perspective based on their seed contribution. The facilitator guided the team through a discussion of what a future world would look like with the mature seeds and asked them what else would be needed to create this ideal world. This section of the workshop focused on a worldbuilding exercise that prompted participants to characterize, imagine and describe a future world. By asking participants to reflect on changes by means of five lenses such as technology, politics and governance, social norms or ecosystems, the group members and facilitators could build on each other's ideas to give shape to an outline of a world that was solid enough upon which to later layer a narrative. Towards the end of the session, the group was asked to close their eyes and try to imagine the world that had been created and to name the sights, sounds and smells they would experience. Finally, a name for the new world was discussed and decided on. Naming the world was meant to help the group agree upon the vision while acknowledging it as a collective creation that could be easily described or remembered.

Session 3:

The breakout room groups reconvened after a break and began a science fiction prototyping exercise. The facilitator led them through the story building using six prompts i.e “Every day…”, “Until one day…”, “Because of this…”, “Then that…”, “Until finally…”, and “Ever since…”. The stories began with the group on board a research vessel named “the Manta” and with each one of them having a role and tasks. Using the story prompts the narrative was fleshed out (Figure 5 Appendix 1). In order to push the participants to think about a much more radical, far future, seven characters were developed, each with a bit more of an affinity to a particular NFF corner (See Appendix 2). Each group rolled a dice to see which of the characters they would encounter in their story, and develop the narrative accordingly. The group told a story of how their everyday life on the Manta is disrupted by an event, their meeting of one of the main characters, how they resolve problems and how they adapt and evolve to further protect their worlds.

After the workshop, the stories were written up into a complete narrative, and key dynamics were drawn from each story (See **Workshop report 2**). These final stories will be published online in a special issue of Vector ‘Speculative Fiction: Prediction, Innovation, & Futures’ in April 2023.

Online Workshop 3 (Horizon 2)

-Transformational Pathways & Leverage Points

The final workshop was a precursor to the in-person meeting. Here, participants started by placing the challenges and drivers on the iceberg model (i.e. categorising according to what is an event, what are patterns of behaviour, what is a systems structure and what is a mental model)[52]. This generally follows the leverage points approach where deeper points of leverage are linked to paradigms and mental models[16] (See Appendix 1 Figure 1). Based on this categorisation, two challenges that the group wanted to work on were identified and the rest of the workshop was spent discussing how these could be addressed.

Firstly, all the relevant actors related to the challenge were mapped, then the indirect and direct drivers of the challenges and finally the potential responses to address these drivers and the responsible actors that could enable these interventions. Potential barriers to these responses were also identified. The responses were then placed on the leverage points figure to see how deep of a transformation they might be able to enable. The most transformative were then placed on the second horizon of the three horizons figure in chronological order (See Figure 6 Appendix 1).

The second session focused on choosing the seeds that are most relevant for addressing the identified challenges and to map what needs to be done to enable the seed to grow (Enabling conditions), who needs to do this (actors) and what the barriers to the seed growing are (Figure 7 Appendix 1). These were then also placed on the three horizons diagram and there was a realisation that some of the same mechanisms were needed both to make the current system decline, but also to enable the preferable future system to grow.

Time was a constraining factor in the workshop and so the outcomes of this process were used as inputs into the in-person workshop rather than as an output in and of itself.

In-person workshop 4:
Cape Town 2022

A smaller group of participants who were able to travel met in Cape Town from 28th February - 3rd March 2022. Six participants representing research, governance and practitioners and the two co-convenors met at Monkey Valley resort, Noordhoek, Cape Town for 4 days of intensive workshopping to finalise the scenarios that were emerging from the process. As this was an intensive process, not only for the work that needed to be done, but also as one of the first in person meetings after the pandemic lockdowns had been lifted, each morning started with a check-in to see how everyone was feeling and social events were organised for every evening.

Day 1:

Recap what had been done and decide whether the three final vision endpoints were chronological (ie as they had been written, the Nature for Society story happened before the Nature as Culture and the Nature as Nature was furthest into the future) or whether they were three deviating endpoints. This required a lot of discussion and it ended with a World Cafe process where three sub-groups steadily built on descriptions and indicators of each of the stories. It was decided that to stay true to the NFF, it was best to design three endpoints that deviate from each at different points along a timeline rather than happening chronologically.

Day 2:

Participants return to the challenges by combining the iceberg models from the two final online workshop sessions to see whether there were any additions that needed to be made. Realising that it was going to take too long to unpack specific intervention pathways to address each of the challenges, instead an appreciative enquiry approach was used whereby the 'bad' mental models of the present were flipped into an alternative iceberg model that could be used as basis for developing the three final stories (Figure 3). It became clear that it was necessary to have these as a common starting point from which the three stories could then emerge and that further work would need to be undertaken to see how the 'flip' could be enabled. This reasoning aligns well with the IPBES Task Force on scenarios and models methodological guidance that refers to common features that are needed to get 'into' the normative space of the NFF before it is then possible to outline specific features for the corners.

The larger group broke up into two. One group focused on plotting out interventions from this 'flipped iceberg', (which became the basis of the Horizon 2 pathways) to get to the three divergent futures, i.e. what features needed to be common to all and what were differentiating interventions that characterised the different stories. The other group brainstormed indicators and models for each of the storylines, for example unpacking what kind of metrics would need to be developed to create inter-species empathy (Appendix 1 Table 1).

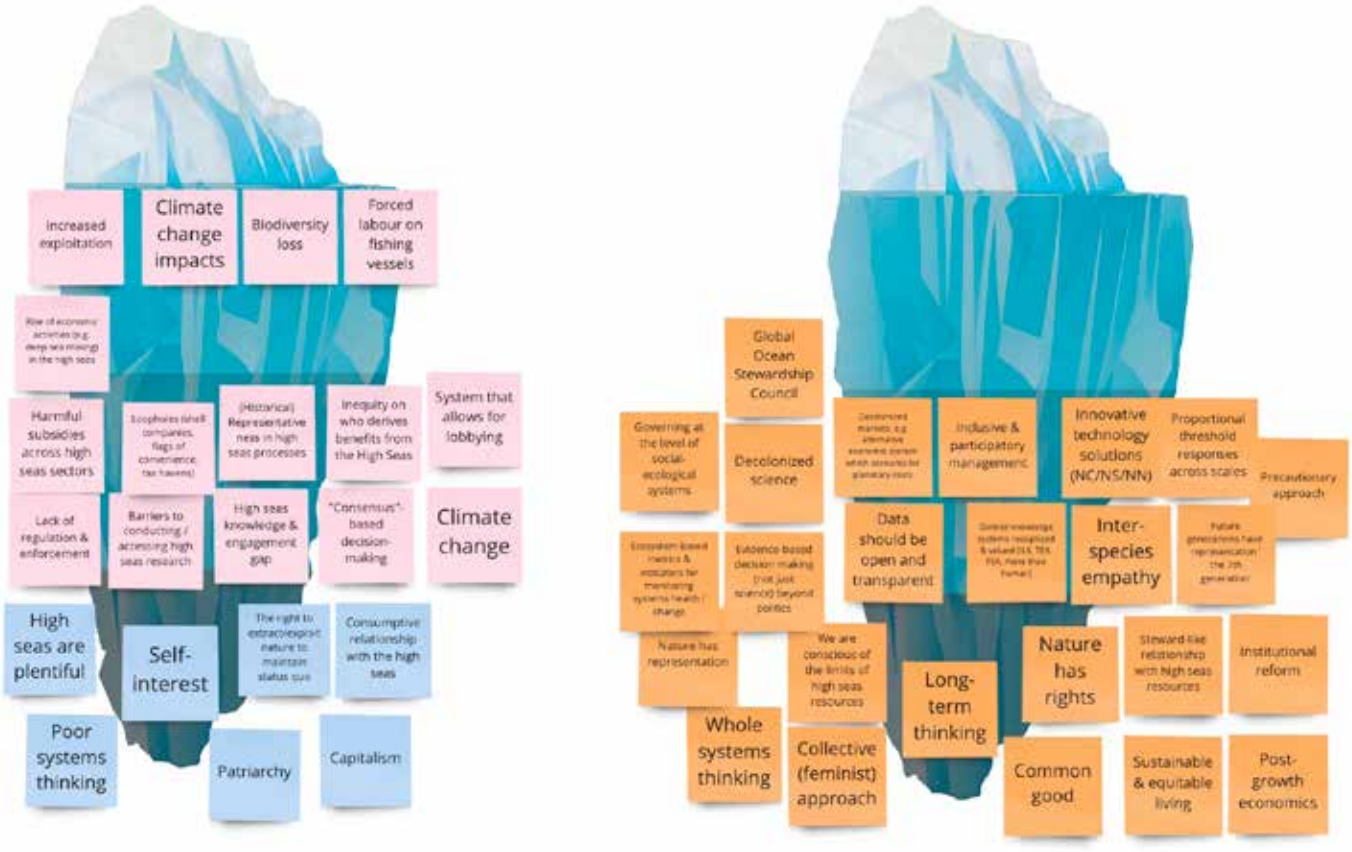


Figure 3: Iceberg model with the problems of the current system on the left and the reimagined future using appreciative enquiry on the right

Day3:

Each group finalised their work and then the afternoon was dedicated to an immersive artistic experience facilitated by CareCreative and documented by Sandile Fanana. Using paint, strong material and junk items, as a group we co-created a visual representation of each of the Horizons, starting with the chaotic challenges in Horizon 1 (Figure 4) and then the calming end point visuals of Horizon 3 (Figure 5) and then through a performance, enacted how the transformation from one system would need the current system to break down and allow the alternative future to emerge. (Figure 6). This shared creativity allowed the group to land in a similar understanding of what the journey from the present to the alternative futures could look like and made it easier to agree on the specific pathways.

Painting Horizon 1: Present Challenges

"Climate change, increase in storms, heatwaves, nuclear waste/ war, over fishing, refugees/ migrants/ oppressed people, islands submerged, mutations of uncared for species, sad picture, money wasted, lost communities, humanity shackeled to a dependence on fossil fuels, capitalism, plastic pollutions, downward spiral, media pretends it's not happening, money driving everything, noise pollution, corals are dying, addictions, slaves, trapped in bad habbits, explosions, motivated by greed. Many colours = chaotic difference."

Painting Horizon 3: Future Potentials

"Positive direction, room for everyone and everything. Based on RESPECT, empathy and kindness, human to human and human to nature. We have broken inter species communication barriers, using technology for good, what does biodiversity want for its future, redistribution of justice for human and non human, using technology for good, humans are supporting nature now rather than eroding it, we have transitioned from a fast life patterns based on capitalism to a slow life community pattern, matriarchy. We are not naive and we will not repeat the same mistakes as the past, maybe there are unforeseen problems, new ways to harness energy in line with nature: accessible and equitable. Hope and light. Positive values, 3 streams: NN, NC, NS. Squid/ Cephalopod inspiration: efficiently pump water and move in an unknown direction, but with purpose, intelligent beings that don't take more than they need: a phosphorescence in the creature against the deep seas = a signal of hope. All cultures of the high seas are represented, resilience, preserving primordial forms of life, inspiring characters from our stories, learning and passing on knowledge. A peacefulness and quiet. A more enjoyable painting to make than the first. Relaxing and calming. Harmonious diversity."

Painting Horizon 2: Transformation...

"Something is brewing, change is happening, shifts: movement. Symbol for transformation, towards a more collective future, a new global council of ocean stewards, involvement of existing arrangements that take responsibility for nature, culture and society. Love and harmony between nature and humans is beginning to expand. Change from the stomach (the emotions) from the first painting and then with the tools of logic and science we channel change. The feelings are the impetus for the eruption of change. Change coming in waves, Nature is at the centre, at the core. Collectivity was the base. We have to do it together, from a broken and nonfunctional planet to a whole and healthy one. Expanding in all directions. Nature will be fine without us, but we can't survive without nature. What are we really aiming for? When we know then we can encourage change in that direction. We allow a different system of values to emerge, we promote these values for the next generation. We are making these tentacles as elements to hold onto (future visions) as things start to break down (the ripping starts to happen). Holistic Visions. Multiple tentacles/ multiple features/ ways existing simultaneously and the present breaks down. No hierarchy of possible futures but there are many, desirable, compatible with humans and nature despite their differences. Some characters along the paths to change are encouraging us. Waves of change, ripples in the sand = connections of love and harmony coming through. Global transformation. Maybe in the future there are not so many humans on the high seas: It is acknowledged as a global commons. We built on each other's ideas and concepts as a way to attain a healthy future. If there is no collectivity then nothing can work."

Day 4:

Each sub-group shared the work they had done with inputs from all, reflected on the process and decided on the final outcomes of both the pathways and the indicators. Next steps in terms of what outputs would be most useful and a delegation of tasks closed the workshop.

Results

Problem Space & Challenge Prioritization

The global ocean beyond national jurisdiction is subject to a wide range of direct and indirect stressors which act cumulatively and degrade the health of multiple ecosystems in this shared portion of the ocean. For example, climate change is impacting biodiversity and its governance in the ocean, adding uncertainties to their future under different scenarios of greenhouse gases mitigation, fisheries development and management. Specifically, in the high seas, changing ocean temperature and primary production are driving shifts in distributions and abundance of large pelagic fish stocks such as tunas and their fisheries. Productivity of deep-sea demersal fish stocks are also expected to be affected as a result of decreasing nutrient inputs from the photic zone as well as due to ocean warming, deoxygenation and acidification. Potential catches are projected to decrease, particularly in tropical regions.

Through the two iterations of the first online workshop participants identified up to 135 societal, technological, environmental, economic and political challenges, which are currently eroding the resilience of the high seas and degrading its health. These challenges were further contextualised using 6 themes, which alongside the categories in S.T.E.E.P. provide a useful bi-axial framework through which we can define and refine the 'problem-space' in ABNJ, as well as classify the innovative solutions and potential pathways for transformation that participants will identify in subsequent workshops.

Theme 1: Overexploitation / pollution / climate change
Theme 2: Peoples, attitudes and culture
Theme 3: Disparities / cohesion
Theme 4: Legal frameworks
Theme 5: Data / knowledge / actionable intelligence
Theme 6: Socioeconomic / politics

Participants in each of the two Workshop 1 sessions engaged in a ranking exercise to identify what they perceived were the 10 most important challenges.

Political

1. Private sector lobbying for exploitation
2. Creating a cohesive vision what should be prioritized nationally and internationally
3. Consensus decision-making in global policy arenas
4. Consensus-based decision-making/ lowest common denominator
5. Importance of systems-thinking to understand the teleconnections between impacts / regions

Technological

6. The vastness of the ocean is a challenge - you can't use satellite imagery to see under it (only the surface and the seabed
7. High cost of collecting data in the High Seas

Societal

8. National interests prevail over international concern in protecting high seas
9. Intergovernmental processes are not inclusive enough (environmental justice)
10. Patriarchal/ capitalist consumptive relationships with the High Seas

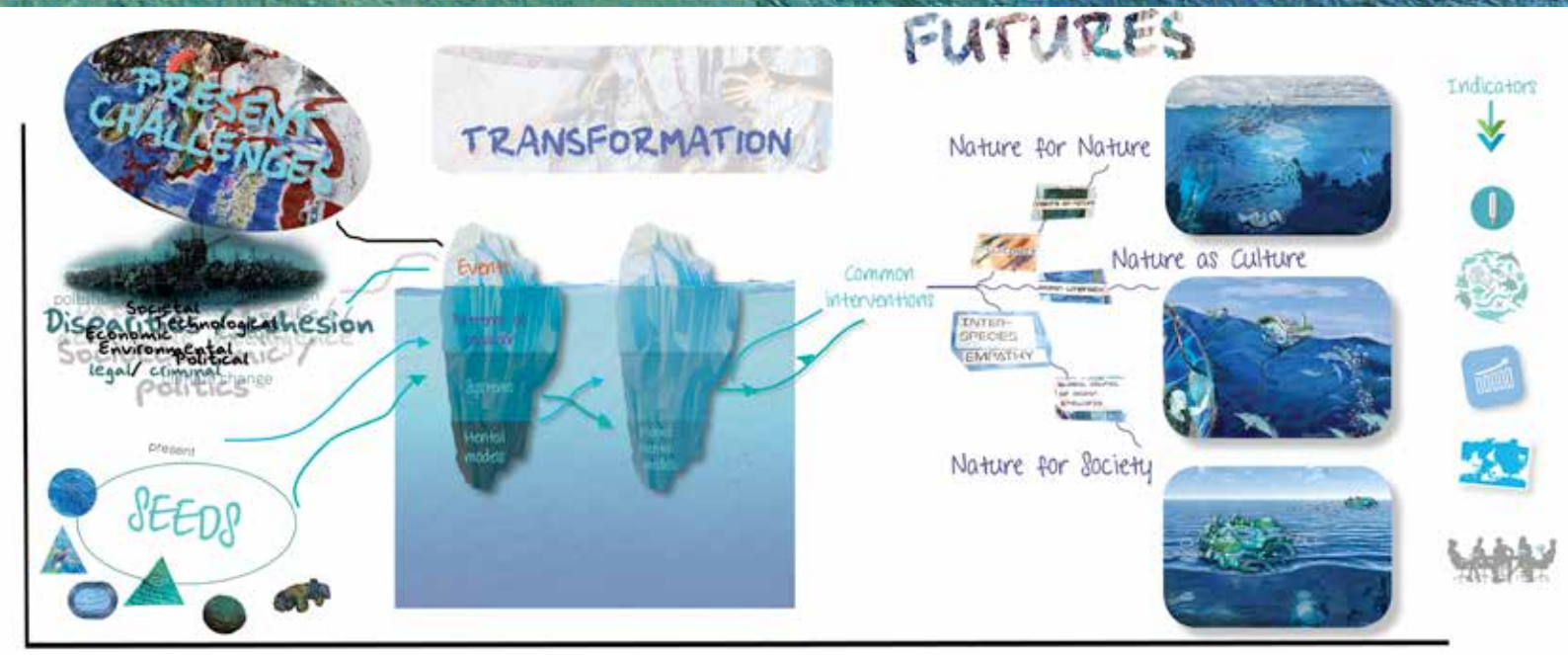
Environmental

11. Not well understood enough to manage - very little data, processes not understood, oceanographic processes inferred
12. Forced labor on fishing vessels
13. Climate change impacts (BBNJ NEREUS REPORT)
14. Biodiversity loss in ABNJ, including lack of understanding of the environmental and ecosystem-level impacts such as cascades.

Economic

15. Rise of economic activities (e.g. deep-sea mining) in the high seas
16. Capitalism's perpetual growth model
17. Harmful subsidies across high seas sectors
18. Inequities - who can profit in the High Seas

The Road to High Seas Transformation



The final icebergs from the in person workshop highlighted some key challenges in our current mental models of the high seas that need to be addressed before transforming to a more sustainable relationship. This aligns well with the proposal by the IPBES task force that refers to the need for both common features of the NFF (that need to the same for all futures; that build the normative aspect of what's inside the triangle- or desirable- rather than outside the triangle- what's not desirable) as well as specific features. These common features included powerful socio-economic forces such as **capitalism** that precondition a **consumptive relationship** with the high seas as places where people have the **right to extract nature**, creating a self-reinforcing feedback loop that maintains and entrenches the status quo. At the same time, the notion that the **high seas are plentiful** reinforces this extractive mentality. A problematic governance factor identified is that the current consensus-based decision-making frameworks are leading to a **lowest common denominator** in decisions rather than an aspirational outcome. A more general observation was **poor systems thinking** that leads to siloed decision-making and a lack of a comprehensive overview of high seas governance and actions.

In order to 'flip' the iceberg to have mental models with a more sustainable foundation, these challenges needed to be addressed. The current capitalist socio-economic paradigm was replaced by a more **collective feminist approach** that emphasised **sustainable and equitable living** where the common good was emphasised. This also took into account the need for an **equity-based approach** that took redistribution of access and resources into account. A more **stewardship-like relationship** with high seas resources was also needed, embedded within conscious thinking about the **limits of high seas resources**. A **whole systems approach** that had foundations in **long-term thinking** rather than short-termism was another paradigm shift that needed to be undertaken. Finally, a fundamental aspect of the flipped

iceberg model was to ensure that **nature has rights**.

Having flipped the icebergs, the group realised that there would be a series of shared actions that still needed to be accomplished before the trifurcation into the three scenario pathways. As pointed out in the methods, the group was also fully aware that key specific actions leading to the change in mental models in the flipped iceberg are also critical to unpack, but that this required further engagement in order to do it justice.

During the process of discussing common interventions that would be needed within each of the three pathways, there were some critical ones that were needed across all of the stories and so these formed the baseline within the second horizon.

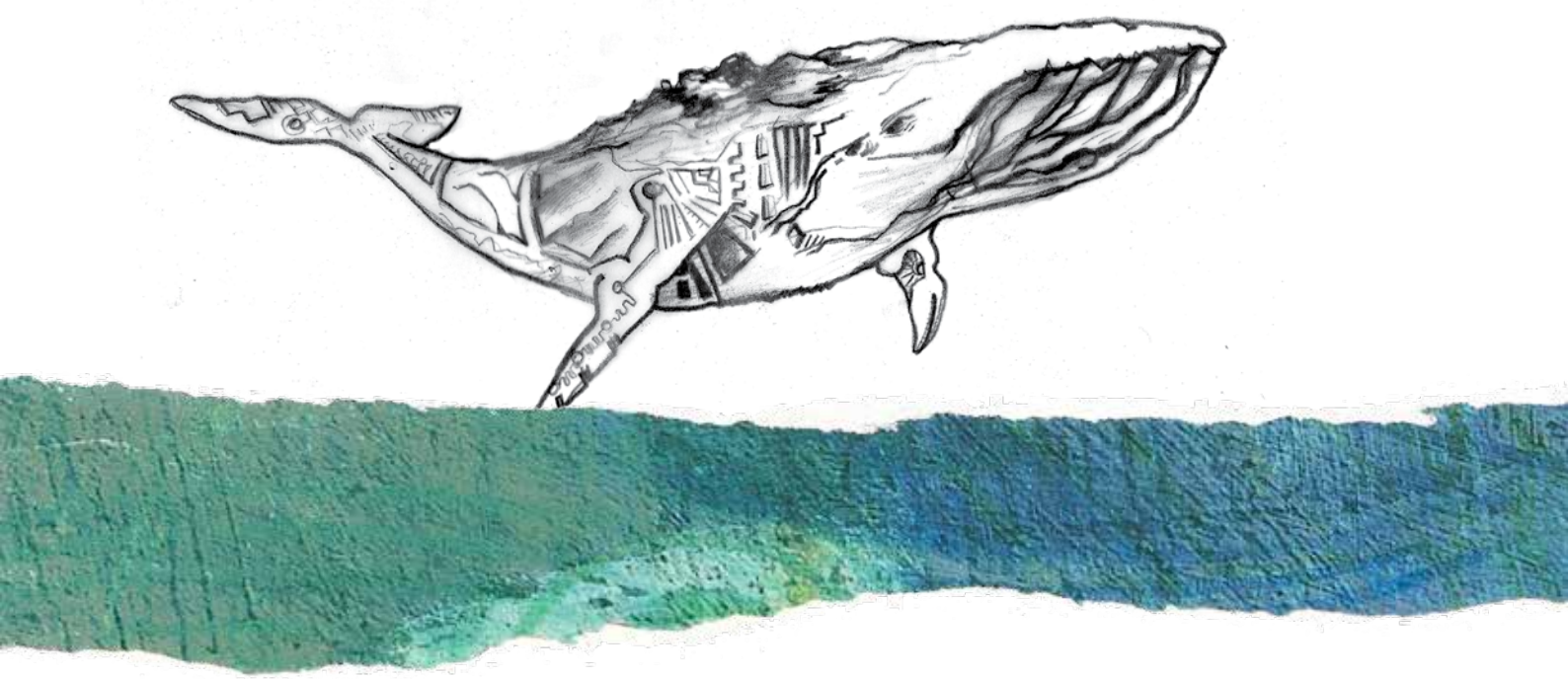
Institutional reform - Inclusive and participatory management is critical for sustainable futures to arise, as is the need to institute a precautionary approach to management. An interesting suggestion was the need to govern at the level of social-ecological systems in the high seas rather than sticking to old models of jurisdiction. Long-term thinking could be instituted by ensuring that future generations have legal representation- thinking that stems from the Seventh generation principle of the Haudenosaunee Confederacy (Iroquois). Similarly, the need to ensure that nature has legal representation (emphasising the nature has rights discourse that was also brought up as a seed during the second workshop) could also eventually lead to a cultivation of inter-species empathy.

Scientific foundations included the need for ecosystem based metrics and indicators for monitoring systems health/change and assurance that data are open access and transparent in terms of who has generated it, how and for what reasons. The need for decolonising science and from that, metrics (e.g. alternative measures of economic well being), was a critical intervention that could also ensure that more diverse knowledge systems are recognised and valued. Such a move would require new monitoring technologies, such as AI and blockchain to monitor catch composition, as well as an eDNA monitoring network. At the same time, the need to measure human impact beyond just what humans are able to perceive would need to be developed.

Through a more transparent system of generating data (across multiple knowledge systems), evidence-based decision-making could then move beyond politics and focus on the actual state of play requiring action, based on a more holistic understanding of what needs to be monitored and tracked (see the indicators in Table 3, Appendix 1). Ensuring that consumption is commensurate with needs would be another key requirement, requiring some sort of consumption threshold and leading to a more equitable allocation of access, benefits and burdens across nations and peoples.

These interventions led to a common starting point of the need for an Ocean stewardship council, which was already mentioned by the participants at the start of the second workshop. It was also clear that UNCLOS 2.0 would look different in the different future worlds (based on the need to allocate access across different regimes), but that its reform was essential to shifting towards a better trajectory. There was also a need to define the relationship between EEZ and the high seas. In some instances, the removal of the classification between national and international waters made sense, but in others it could be seen as alienating. But, as different governance regimes emerged at different levels for the three futures, it became clear that EEZ high seas could be re-defined in the three emergent futures as follows:
NN: high seas as human no-go areas versus EEZ defined as areas where humans can use the ocean (where access is not necessarily based on coastal access)
NC: no EEZ as all ocean is held as a global common
NS: EEZ and high seas need to be aligned in their management as they are interdependent

The subsequent three branching points were then the specific features that defined the different pathways leading towards the three corners of the NFF in a more exploratory scenarios framework.



Future Worlds

Nature for Nature
- Sentient stewards of the sea

Transformative elements explored in the scenario:

The point of departure for this scenario is the negotiation of a new Law of the Seas Treaty. A UNCLOS 2.0. This treaty and the scenario puts Nature centre stage. Resources are directed towards better understanding nature and developing appropriate technologies to further such understanding. A key provision of the UNCLOS 2.0 is that Nature is granted personhood and therefore must be considered to have rights equal to humans, this has multidimensional implications which are addressed in the scenario. Other supporting treaties such as the convention on biodiversity must also transform as well as a radical change in jurisdiction, which creates an enabling environment for not only protection of vast areas of the high seas, but a focus on restoration and rehabilitation. Due to the focus on nature, direct human presence in the high seas is severely limited but there are

a network of floating stations that have a mandate for restoration and to support augmented carbon sequestration. However, these stations remain vulnerable to sabotage and piracy. As an implication of the granting of personhood to non-human entities, there is a fledgling 'convivium' being set up that has non-human representation and may prove to be a successor of the new governance institution; the 'global ocean stewardship council' featured in the scenario. This institution is supported by an enhanced international criminal court focusing on environmental crimes. The high seas in this future scenario includes extensive protected areas that are complete no-go areas for humans. They are vulnerable to pathogens, invasive species, population explosions and other threats and are monitored extremely closely with a network of sensors that can detect ecosystem thresholds and monitor the condition of the areas and the species which inhabit the areas in real time. A key transformative feature envisaged in this scenario is an increased ability to enhance the natural carbon sequestration capacity of the high seas.

Narrative Format:

Short Science Fiction Story

Story Synopsis:

This story joins Ofera and her crew on their vessel the Manta in the 2100s. Ofera and her team are part of the Ocean Stewardship Convivium that are tasked with Monitoring, rehabilitating, repairing and restoring the ocean. During the story, we meet Jeremy, a timid sentient Microbe who, along with many other species have been granted personhood as sentient beings and manage the ocean alongside their human counterparts. Ofera, her crew and Jeremy must deal with the unexpected appearance of the Gaia swarm, a powerful rogue swarm of nanobots that operate independently of humans in their efforts to restore and protect the high seas.

Narrative excerpt:

"We are sending a message to the Ocean Stewardship Convivium. We will be demanding all sentient creatures have a REAL seat at the table: human, animal, microbe and machine. Moreover, Jeremy's consciousness will give first-hand testimony of the dangers of deep-sea drilling and carbon storage. Our aim is to achieve a ban once and for all on human activities on the seafloor."

Ofera started at the abrupt end of the message. She sighed and thought that the Convivium had better pay attention, given the tremendous uncontested power the Gaia Swarm wielded in the High Seas. Lifting her gaze from the stern and the rapidly setting sun in the west, she realised she had been saying her goodbyes this entire cruise. Turning around toward the bow and looking out at her crew, she realised that the ocean apparently had other things in mind for her and the Manta and that a new mission was just starting to emerge...

Nature as Culture - Polycultural fractals of the ocean

Transformative elements explored in the scenario:

Here, a starting point for the scenario was a shifted relationship between humans and nature. In this future world the human-nature relationship is built on deep empathy, an intrinsic sense of equality and a foundation in fairness both within human societies and between nature and humans. Both spirituality and folklore have become more prominent as attributes of human relations and in relation to nature. Governance is focused on a devolution from the global to the local. A feature of these local governance systems are pockets of micro-sovereignty where local groups take decisions and have control over different processes and activities such as community-based sustainable fishing & family farming. This devolved governance system is enabled and supported by a very different economic system. This world has a large number of interacting community-based economies, which includes sharing, bartering and similar mechanisms. In terms of the legal system, redistributive justice is a significant focus, with an approach emphasising human rights. Corporations are held to account, they must be accountable for having been granted personhood and the responsibilities that entails under the law. They are accountable for disasters that are worsened by their

activities past and present and culture-related crimes that impact on human rights. Punishments for corporate malfeasance can be harsh including dissolution and/or economic reparations. Corporations can no longer settle out of court, but must face their accusers and defend themselves in every case. Technology in this future world is in support of circular processes such as multitrophic, integrated aquaculture. Education is accessible, community-based, focused on ocean literacy and centred in cultural and spiritual values that acknowledge and incorporate different systems of knowledge. On the high seas, seasteading exists, so humans do inhabit the oceans on floating structures, but these are there mainly in support of those who may have lost their original, traditional, historical relationship with the ocean (i.e. due to sea level rise and linked climate factors). However, it closes with a reflection on how despite our best intentions, humans still need to learn more about the kind of impacts that we have on nature, opening up for a wider discussion on empathy.

Narrative Format:

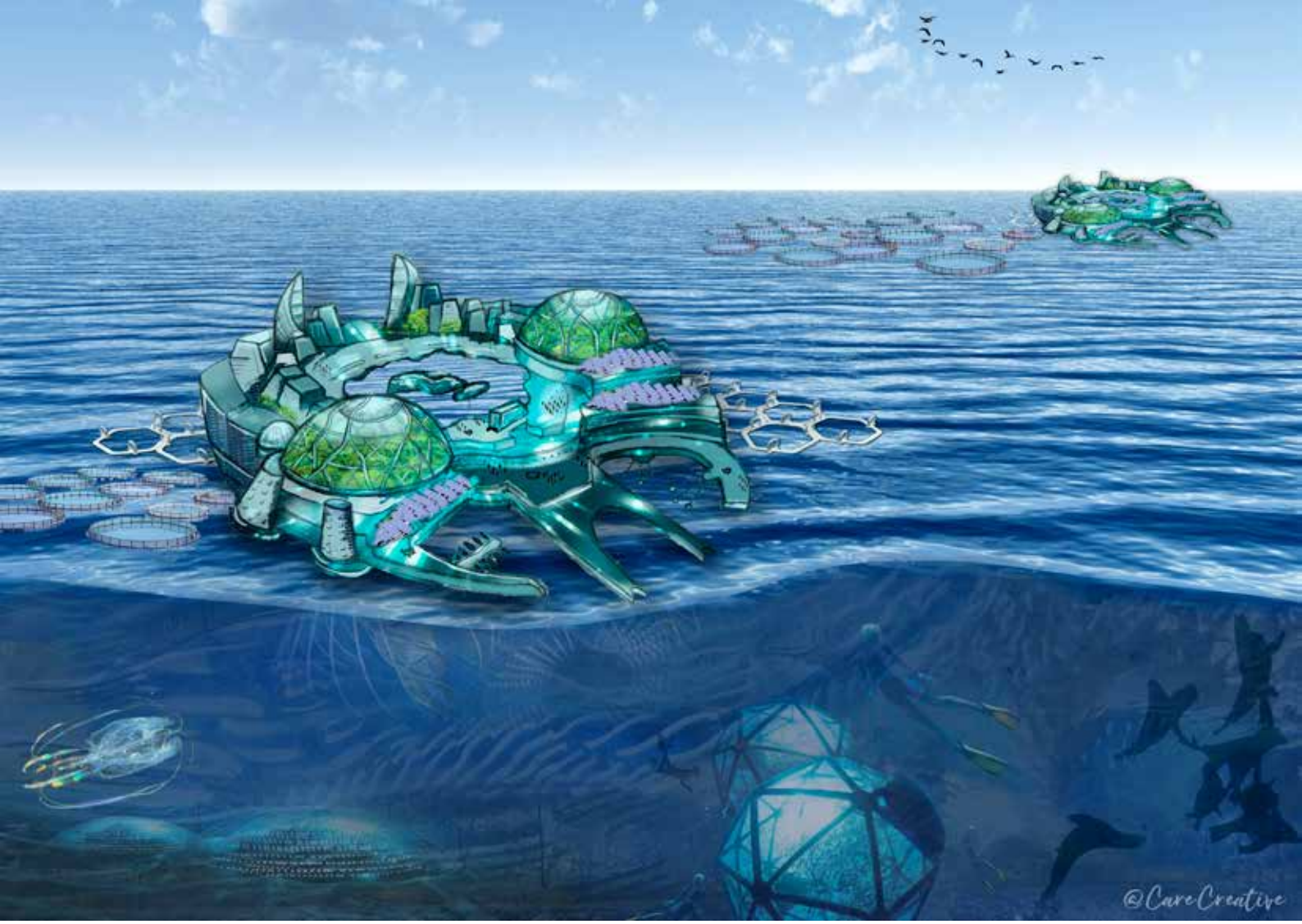
A short science fiction story that takes the form of Ehukai thinking back on past events that changed the future of the ocean.

Story Synopsis:

We join the story as Ehukai is reflecting on the life and achievements of their grandmother, Sefina Tausa'afia, celebrated lawyer and advocate for nature and marginalised ocean communities around the world. They reflect on her life from the artificial island, the Polynesian Seastead in the Oceana Protected Area. The story finds Ehukai in a reverie preoccupied with the negotiations for the law of the Sea Treaty 2.0, which was finally signed into 2082 after coming so very close to failing. During their reminiscences, they remember pivotal turning points driven by two singular and strange personalities; Zalazar Crobuzon, the mayor of the scar, an anarchist community of climate refugees and, the human-shark hybrid and multispecies rights advocate Adoara.

Narrative excerpt:

Suddenly, a lone and rather large figure entered the hall: the infamous Zalazar Crobuzon. Zalazar was the self-proclaimed mayor of the Scar, an anarchist floating community founded by ocean refugees. He was a bit of a legend and, despite his community's continued unlawful status, a respected member of the ocean governance community who was at the founding of the GCOS. Even before Zalazar spoke, Sefina and her team knew that this was the chance they had been waiting for. Rumour had it that Zalazar had been rescued by a dolphin when he was just a child. The old cetacean had shown the young man the way of the sea, teaching him how to live in harmony with and have profound respect for all species. Zalazar's quiet, but powerful, speech at that pivotal negotiation in 2088, backed up by the evidence presented by Sefina and her team, navigated the way for the legalisation of seasteading communities. Five years later, having worked closely with Zalazar and the people of the Scar, Sefina would be the proud founder of the Polynesian Seastead.



Nature for Society - The Nemo Chronicles

Transformative elements explored in the scenario:

The negotiation of a new law of the sea treaty is also a key foundation for this future world. However, in this future, the focus of the new governance instrument is in enabling heavy investment in advanced technologies to enhance the relationship between humans and the ocean. Overall governance is overseen by a Global governance system that operates out of One Blue Station, a state of the art floating research and decision-making platform. Human-ocean relationships are based on science and science drives almost all ocean literacy. Robots exist that fish selectively on the high seas and those operating fisheries have science as the foundation for their operational and strategic decisions. Vessels are equipped with both advanced sensor suites and highly selective gear that essentially eliminates bycatch. To support analysis of vast amounts of open data and in support of equitable access to those data, high speed internet is universally available, no matter how far out to sea. In terms of the overarching legal structure, there is a 'Universal Court' which has dispute resolution jurisdiction over all activities that take place on the high seas or affect them. Entities such as corporations and

individuals are aggressively prosecuted in support of extreme accountability. Along similar lines, there are stringent and technologically sophisticated Monitoring, Control, Surveillance, Enforcement and compliance systems operating in the high seas. Commercial entities can benefit from activities on the high seas, but profit levels are capped via a high seas operational tax and activities are closely monitored. People live on the high seas in a diverse set of seasteading communities. The effects of climate change continue to unfold and climate refugee shelters are also in operation on the high seas. The key principle governing operations in the highs seas is sustainable use of living as well as non-living resources embedded in a collectivist approach drawing on feminist governace and international relations theory.

Narrative Format:

A transcript of episode 42 of the 'History Hiccups' podcast

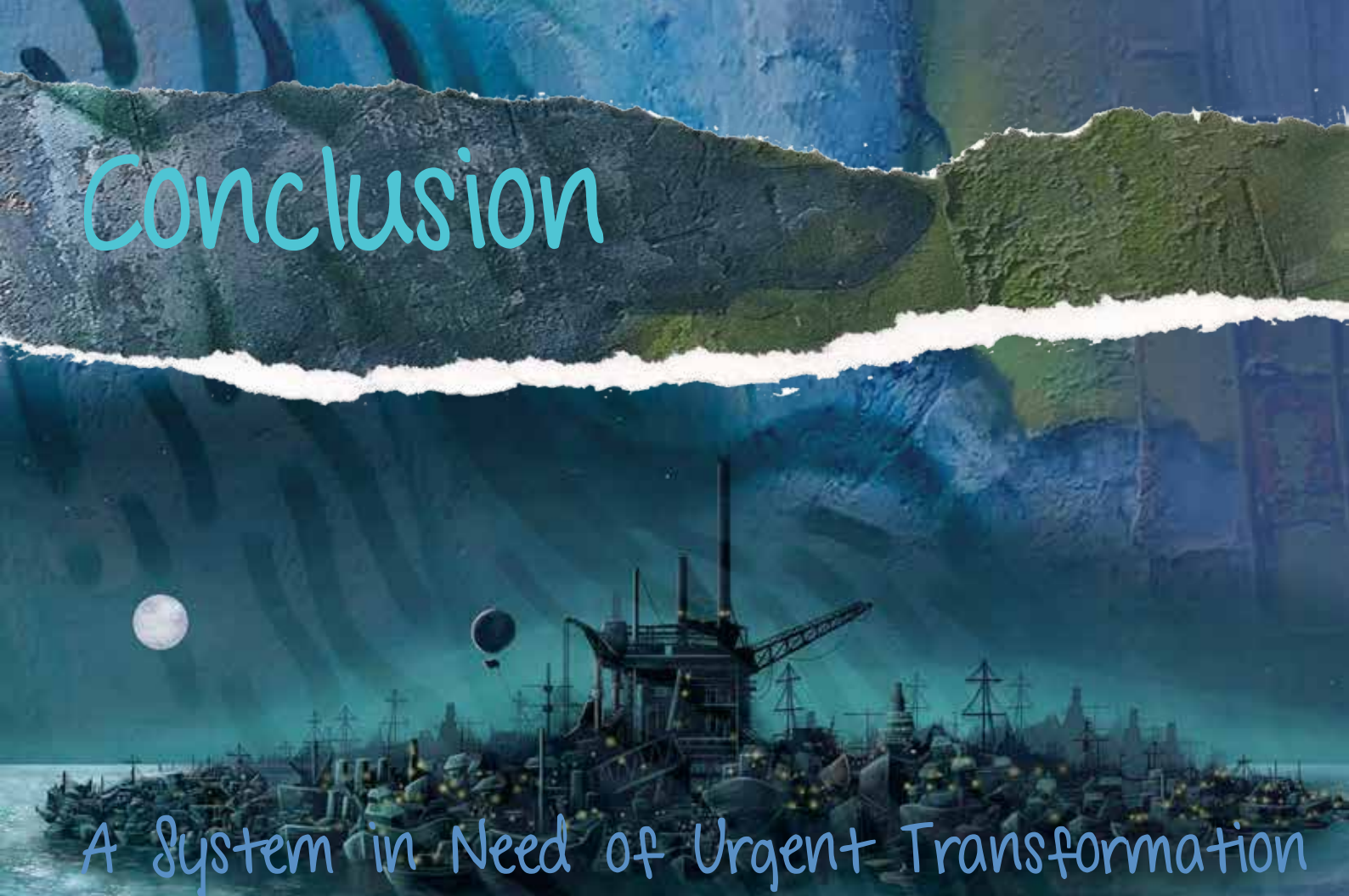
Story Synopsis:

In this story, we learn about the unscrupulous adventures of the infamous gene pirate 'Agent Nemo.' who mysteriously disappeared, bringing to an end his decade long criminal enterprise of stealing marine genetic sequences and then selling them to the highest bidder. The story is told from the perspective of scientists on One Blue Station & the crew of the enforcement vessel Manta who have been victims of Agent Nemo's piracy many times. The discovery of a new species of deep-sea turtle rocks the station and those empowered to govern the high seas. The race is on and as the story concludes, the crew come face to face with the white whale himself, Agent Nemo.

Narrative excerpt:

It is not hard to guess Nemo's real purpose on that pirate vessel: he was taking advantage of the wide range of species being caught illegally to collect genetic samples for some despicable business. And, astonishingly, thawing before their eyes on his makeshift workbench is a frozen, dissected 'Magnaturtur abyssium'. The crew quickly secures Nemo, cuts through the ice and crash-hack the terminal. They analyse the data and cross reference it with databases on illegal trade of genetic resources, piggybacking on the cloud computing power of the One Blue Station's quantum computer to begin tracking the markets and the buyers Nemo had been dealing with. They are able to determine that the marine genetic sequences from the newly discovered abyssal turtle was sitting in the file buffer and Nemo had not yet had time to upload it to the dark web before he was caught red-handed.

Conclusion



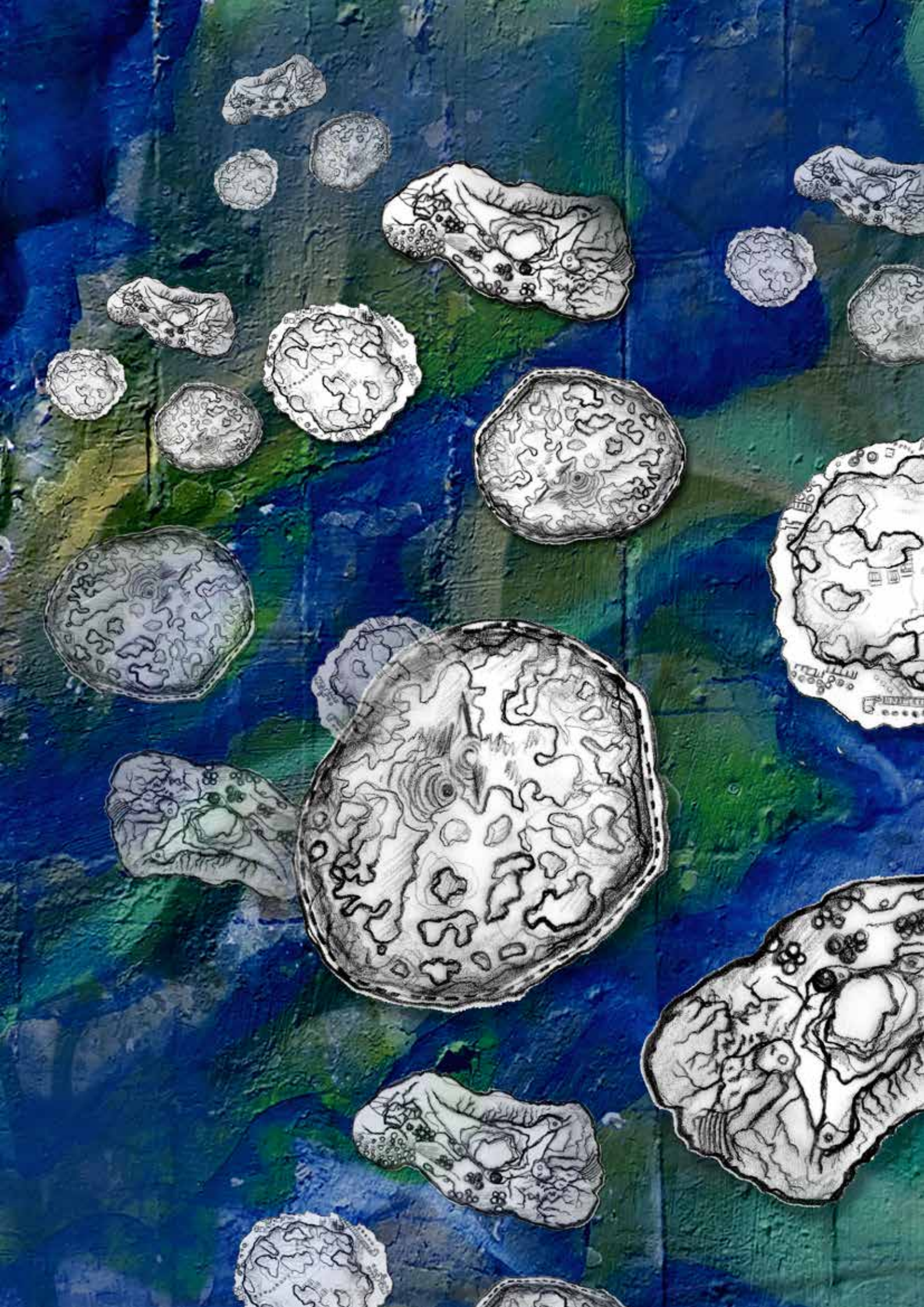
A System in Need of Urgent Transformation

Towards the end of the workshop series, the high-seas experts took part in semi-structured interviews about their experiences participating in creative and imaginative futuring methods (See Lübker[53] for more information). They described specific potential applications - particularly for storytelling - in their line of work. Interviewees stated that the creative work was useful to think differently or 'out of the box' about their area of expertise, pushing their cognitive limits and broadening their horizons. What may now seem like impossible and intractable environmental problems with few realistic solutions, may actually prove to be solvable, or at least more manageable, if we are willing to work together more abstractly, across multiple scales and dimensions, including those that challenge us or make us uncomfortable.

We find ourselves at a critical crossroads for the future governance of the high seas, the years 2021-2023 offer opportunities for direct impact on ocean governance, with the initiation of the UN Decade of Ocean Science, the currently stalled but likely to resume negotiations over a new international legally binding instrument for the conservation and sustainable management of biodiversity beyond national jurisdiction (UN General Assembly Resolution 69/292), as well as the postponed negotiation of the post-2020 Global Biodiversity Framework through the Convention on Biological Diversity (CBD) and even the Mining Code being developed at the International Seabed Authority. However, triggering a global transformation on how we use and protect the half of our planet beyond the jurisdiction of all nations requires a wide concerted effort that is guided by shared values and principles across regions and sectors: from the way we collect data, to how we handle asymmetric levels of access, risk and responsibility across stakeholder groups in different regions, sectors and jurisdictions.

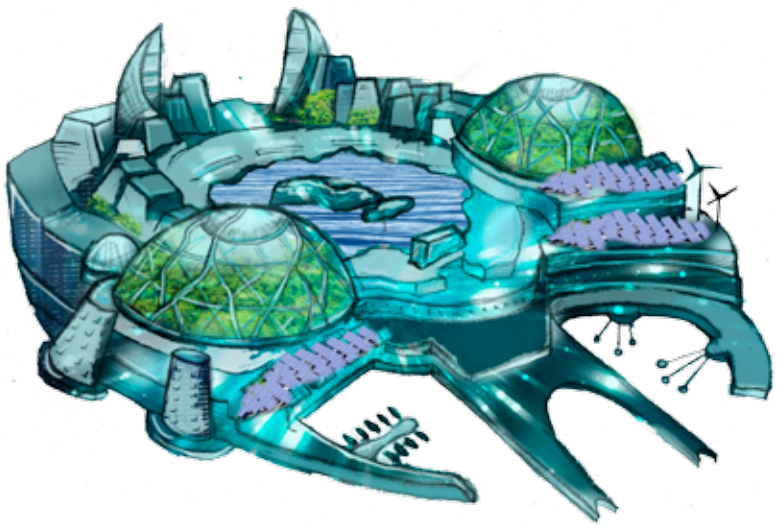
The aim of this series of workshops was to undertake a futures thinking process that could use the NFF as a mechanism to bring more transformative thinking into how humans conceptualise the high seas and therefore how we aim to govern the ocean. Rather than perpetuating an incrementalist approach, engaging with the far future through science fiction allowed a more radical appreciation of what could be. Such freeing of the imagination allowed participants to jump into discussions of what could and should be rather than what was possible under current framings. Crucially, many of the workshop participants play key roles in shaping the future of the high seas, whether through participating in ongoing negotiations or undertaking scientific research that will inform these negotiations, and intend to allow these activities to shape future approaches and outputs. They mentioned how such approaches could open spaces for dialogue and reflection, potentially evoking a heightened interest in the high seas beyond those stakeholder groups already engaged.

Infusing science with creative, artistic elements could interest and inspire audiences beyond academia[20], as stories are more accessible and memorable than traditional scientific communication[54]. Creative endeavours of co-production that promote and encourage imagination for current challenges should be considered as important tools in the science-policy interface[17], especially regarding the high seas, which is part of the Global Commons[55]. Creative imaginings should not only be a critical tool in how we assess potential futures, but also a way to elicit empathetic responses[17]. As researchers, we can enable a broader approach to stakeholder participation co-creation processes that can create a greater investment in these ideas and also help inform decision-makers of the options available to them. This workshop series was a first, but hopefully promising step towards generating a more creative praxis in how we imagine and then act for a better future for the high seas and for the Earth as a whole.



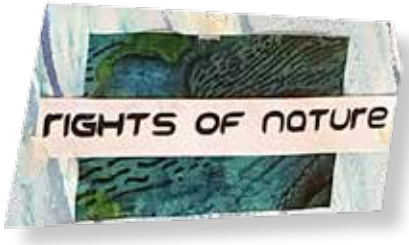
References

1. Sumaila, U. R. et al. Winners and losers in a world where the high seas is closed to fishing. Sci. Rep. 5, 8481 (2015).
2. Anticamara, J. A., Watson, R., Gelchu, A. & Pauly, D. Global fishing effort (1950–2010): Trends, gaps, and implications. Fish. Res. 107, 131–136 (2011).
3. Feenstra, R. Mare liberum : 1609-2009: Original Latin Text and English Translation. (Brill Nijhoff, 2009).
4. Lascelles, B. et al. Migratory marine species: their status, threats and conservation management needs. Aquat. Conserv. Mar. Freshw. Ecosyst. 24, 111–127 (2014).
5. Dunn, D. C. et al. The importance of migratory connectivity for global ocean policy. Proc. R. Soc. B Biol. Sci. 286, 20191472 (2019).
6. Jouffray, J.-B., Blasiak, R., Norström, A. V., Österblom, H. & Nyström, M. The Blue Acceleration: The Trajectory of Human Expansion into the Ocean. One Earth 2, 43–54 (2020).
7. Merrie, A. et al. An ocean of surprises - trends in human use, unexpected dynamics and governance challenges in areas beyond national jurisdiction. Glob. Environ. Change 27, 19–31 (2014).
8. Juan-Jordá, M. J., Mosqueira, I., Cooper, A. B., Freire, J. & Dulvy, N. K. Global population trajectories of tunas and their relatives. Proc. Natl. Acad. Sci. U. S. A. 108, 20650–20655 (2011).
9. Sumaila, R., Zeller, D., Watson, R., Alder, J. & Pauly, D. Potential Costs and Benefits of Marine Reserves in the High Seas. Mar. Ecol. Prog. Ser. 345, 305–310 (2007).
10. Carmine, G. et al. Who is the high seas fishing industry? One Earth 3, 730–738 (2020).
11. Ortuño Crespo, G. & Dunn, D. C. A review of the impacts of fisheries on open-ocean ecosystems. ICES J. Mar. Sci. 74, 2283–2297 (2017).
12. Crespo, G. O. et al. High-seas fish biodiversity is slipping through the governance net. Nat. Ecol. Evol. 3, 1273–1276 (2019).
13. Popova, E. et al. Ecological connectivity between the areas beyond national jurisdiction and coastal waters: Safeguarding interests of coastal communities in developing countries. Mar. Policy 104, 90–102 (2019).
14. Harrison, A.-L. et al. The political biogeography of migratory marine predators. Nat. Ecol. Evol. 2, 1571–1578 (2018).



15. Meadows, D. H. Leverage Points: Places to Intervene in a System. (The Sustainability Institute, 1999).
16. Abson, D. J. et al. Leverage points for sustainability transformation. Ambio 46, 30–39 (2017).
17. Pereira, L., Sitas, N., Ravera, F., Jimenez-Aceituno, A. & Merrie, A. Building capacities for transformative change towards sustainability: Imagination in Intergovernmental Science-Policy Scenario Processes. Elem. Sci. Anthr. 7, 35 (2019).
18. Moore, M.-L. & Milkoreit, M. Imagination and transformations to sustainable and just futures. Elem. Sci. Anthr. 8, 081 (2020).
19. Evans, A. The myth gap: what happens when evidence and arguments aren't enough? (Penguin Random House, UK, 2017).
20. Merrie, A., Keys, P., Metian, M. & Österblom, H. Radical ocean futures-scenario development using science fiction prototyping. Futures 95, 22–32 (2018).
21. Rintoul, S. R. et al. Choosing the future of Antarctica. Nature 558, 233–241 (2018).
22. Blythe, J. et al. Fostering ocean empathy through future scenarios. People Nat. 3, 1284–1296 (2021).
23. Evans, A. & Smit, T. The Myth Gap: What Happens When Evidence and Arguments Aren't Enough? (Eden Project, 2018).
24. Planque, B. et al. A participatory scenario method to explore the future of marine social-ecological systems. Fish Fish. 20, 434–451 (2019).
25. Nash, K. L. et al. Developing achievable alternate futures for key challenges during the UN Decade of Ocean Science for Sustainable Development. Rev. Fish Biol. Fish. 5, (2021).
26. Pereira, L. et al. Developing multi-scale and integrative nature-people scenarios using the Nature Futures Framework. People Nat. 1–24 (2020) doi:10.31235/osf.io/ka69n.
27. Pascual, U. et al. Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustain. 26–27, 7–16 (2017).
28. Sandbrook, C., Fisher, J. A., Holmes, G., Luque-Lora, R. & Keane, A. The global conservation movement is diverse but not divided. Nat. Sustain. 2, 316–323 (2019).
29. Mace, G. M. Whose conservation? Science 345, 1558–1560 (2014).
30. Wyborn, C. et al. An agenda for research and action toward diverse and just futures for life on Earth. Conserv. Biol. 00, 1–12 (2021).
31. Chan, K. M., Gould, R. K. & Pascual, U. Editorial overview: Relational values: what are they, and what's the fuss about? Curr. Opin. Environ. Sustain. 35, A1–A7 (2018).
32. Harden-Davies, H. et al. Rights of Nature: Perspectives for Global Ocean Stewardship. Mar. Policy 122, (2020).
33. Mulalap, C. Y. et al. Traditional knowledge and the BBNJ instrument. Mar. Policy 122, 104103 (2020).
34. Vierros, M. K. et al. Considering Indigenous Peoples and local communities in governance of the global ocean commons. Mar. Policy 119, (2020).
35. Ban, N. C. et al. Better integration of sectoral planning and management approaches for the interlinked ecology of the open oceans. Mar. Policy 49, 127–136 (2014).
36. Vierros, M., Salpin, C., Chiarolla, C. & Aricò, S. Emerging and unresolved issues: the example of marine genetic resources of areas beyond national jurisdiction. in Ocean Sustainability in the 21st Century (ed. Aricò, S.) 198–231 (Cambridge University Press, 2015). doi:10.1017/CBO9781316164624.012.

37. Elsner, P. & Suarez, S. Renewable energy from the high seas: Geo-spatial modelling of resource potential and legal implications for developing offshore wind projects beyond the national jurisdiction of coastal States. Energy Policy 128, 919–929 (2019).
38. Hein, J. R., Mizell, K., Koschinsky, A. & Conrad, T. A. Deep-ocean mineral deposits as a source of critical metals for high- and green-technology applications: Comparison with land-based resources. Ore Geol. Rev. 51, 1–14 (2013).
39. Cheung, W. W. L. et al. Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. Glob. Change Biol. 16, 24–35 (2010).
40. Levin, L. A. & Le Bris, N. The deep ocean under climate change. Science 350, 766–768 (2015).
41. Cheung, W. W. L. et al. Transform high seas management to build climate resilience in marine seafood supply. Fish Fish. 18, 254–263 (2017).
42. Sharpe, B., Hodgson, A., Leicester, G., Lyon, A. & Fazey, I. Three Horizons: A pathways practice for transformation. Ecol. Soc. 21, (2016).
43. Ortuno Crespo, G., Pereira, L. & et al. Nature Futures Framework - High Seas Workshop I - Defining the problem space (H1: where we are). https://futureecosystemsafrica.org/reports/ (2021).
44. Senge, P. The fifth discipline: The art and practice of the learning organization. (Doubleday, 1990).
45. Runco, M. Creativity: Theories and themes : research, development, and practice. (Academic Press, 2006).
46. Walia, C. A Dynamic Definition of Creativity. Creat. Res. J. 31, 237–247 (2019).
47. Sanders, E. B.-N. & Stappers, P. J. Co-creation and the new landscapes of design. CoDesign 4, 5–18 (2008).
48. Bennett, E. M. et al. Bright spots: seeds of a good Anthropocene. Front. Ecol. Environ. 14, 441–448 (2016).
49. Chibwe, B., Superchi, E. & et al. Nature Future Framework High Seas Report. Workshop 2: H3 Where do we want to go. https://futureecosystemsafrica.org/reports/ (2021).
50. Holbrook, T. & Pourchier, N. M. The Exquisite Corpse as A/r/t: Bodied Troublings of Qualitative Research-as-Usual. Vis. Arts Res. 38, 41–55 (2012).
51. Brockelman, T. P. The frame and the mirror: On collage and the postmodern. (Northwestern University Press, 2001).
52. Fuller Transformation Collaborative. The Art of Systems Change: Eight guiding principles for a green and fair future. (World Wildlife Fund, 2019).
53. Lübker, H. Towards Uncertain Futures - Envisioning Scenario Stories of Human Nature Relationships on the High Seas. (Stockholm University, 2022).
54. Dahlstrom, M. F. Using narratives and storytelling to communicate science with nonexpert audiences. Proc. Natl. Acad. Sci. 111, 13614–13620 (2014).
55. Claudet, J., Amon, D. J. & Blasiak, R. Transformational opportunities for an equitable ocean commons. Proc. Natl. Acad. Sci. 118, e2117033118 (2021).
56. Fischer, J. & Riechers, M. A leverage points perspective on sustainability. People Nat. 1, 115–120 (2019).



Appendix 1

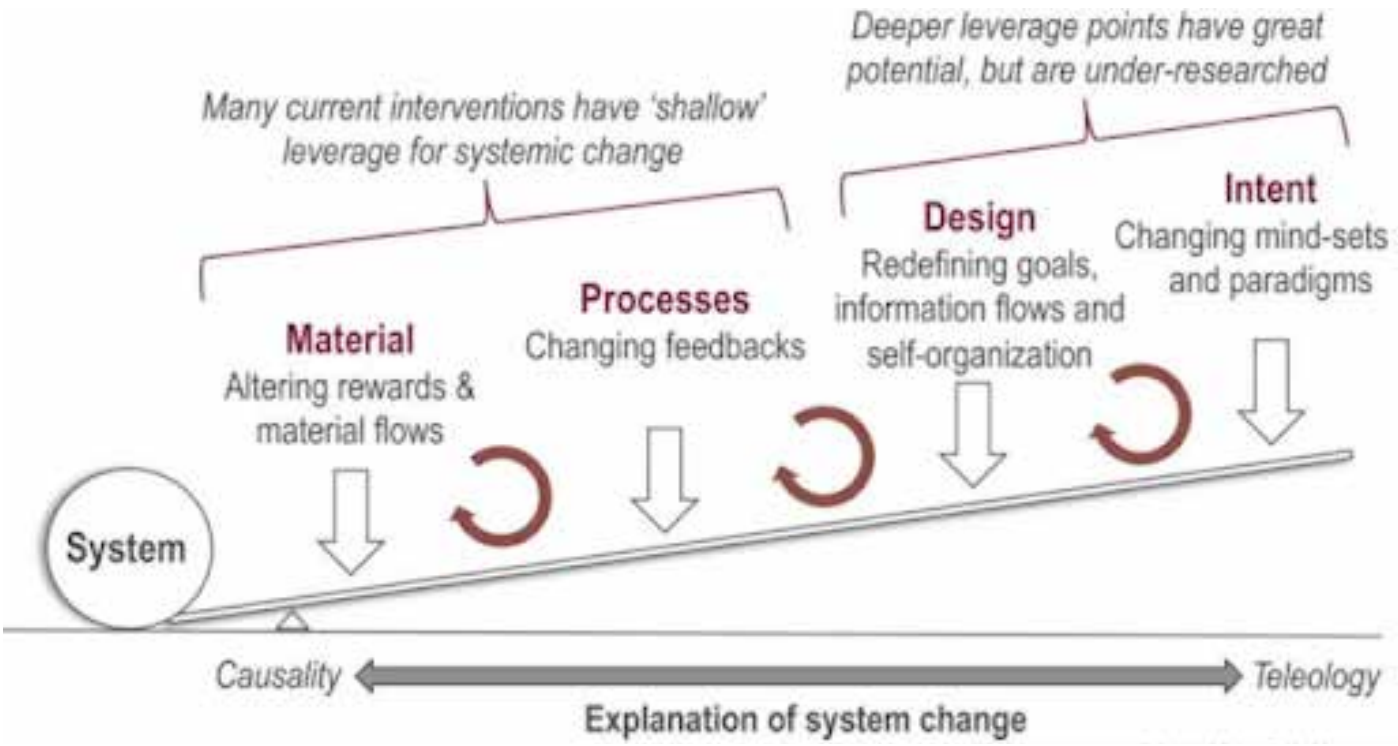


Figure 1: Illustration of Leverage Points for System Changes. Source: Fischer & Riechers (2019)[56] adapted from Abson et al. (2017)[16]

Table 1: Advisory Board for the Nature Futures Framework High Seas project

Name	Region
Renuka Badhe	Europe/Polar
Frida Bengtsson	Europe
William Cheung	Americas
Daniel Dunn	Asia-Pacific
Andrew Merrie	Europe
Rashid Sumaila	Africa
Clement Yow Mulalap	Asia-Pacific

Figure 2: 72 of a total of 130 challenges were identified by participants, across each of S.T.E.E.P. categories in both workshops; there was some overlap between the challenges identified across the break-out groups.

Figure 3: Index of importance (y-axis) and effort to solve (x-axis) for the top-10 challenges in one of the two workshops.

Figure 4: View of the assemblages resulting from the exquisite corpse-inspired technique

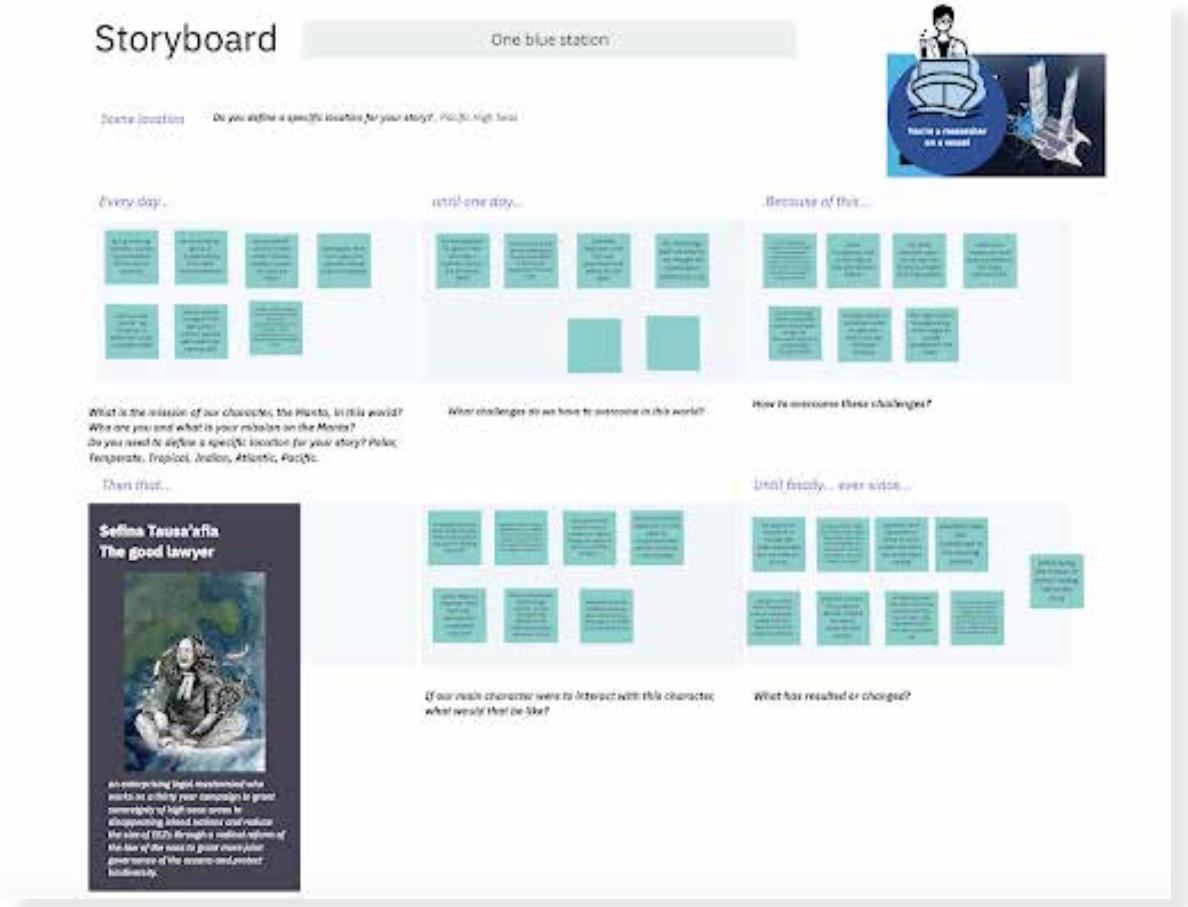


Figure 5: Example of a storyboard from the One Blue Station group

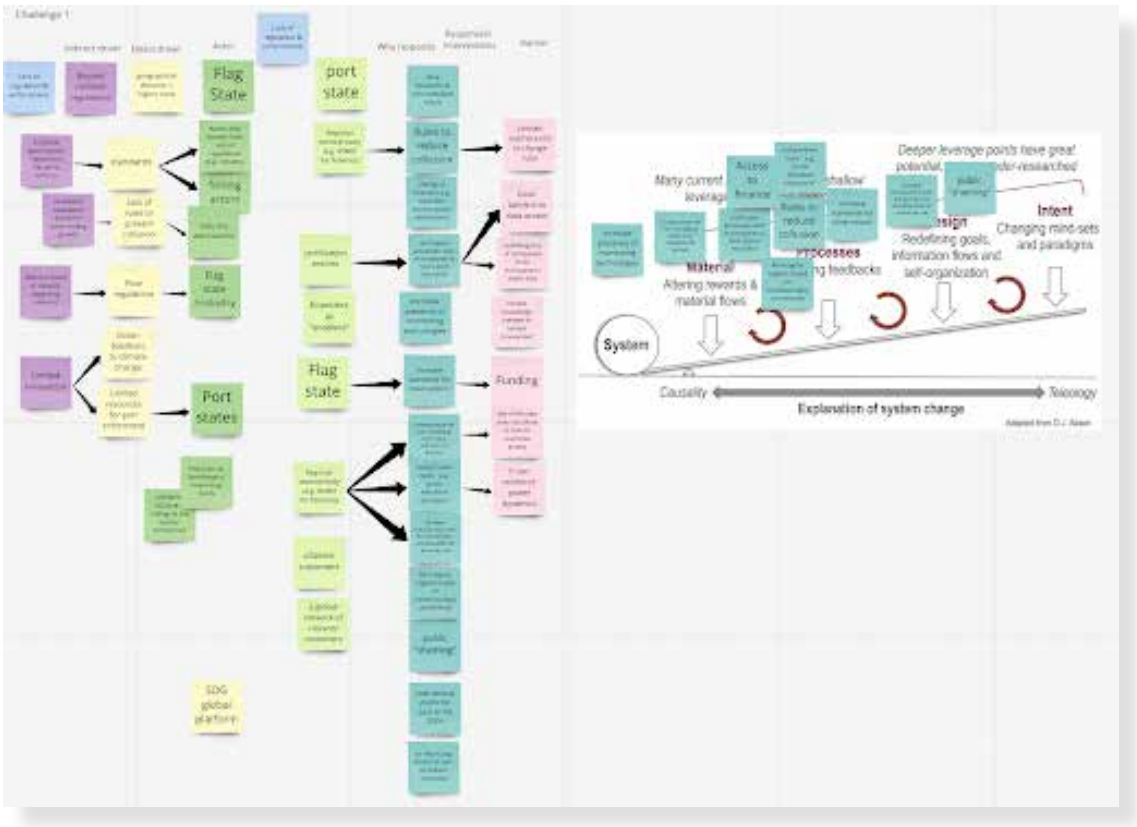


Figure 6: Layout of the third workshop process, including pasting the interventions on the leverage points framework

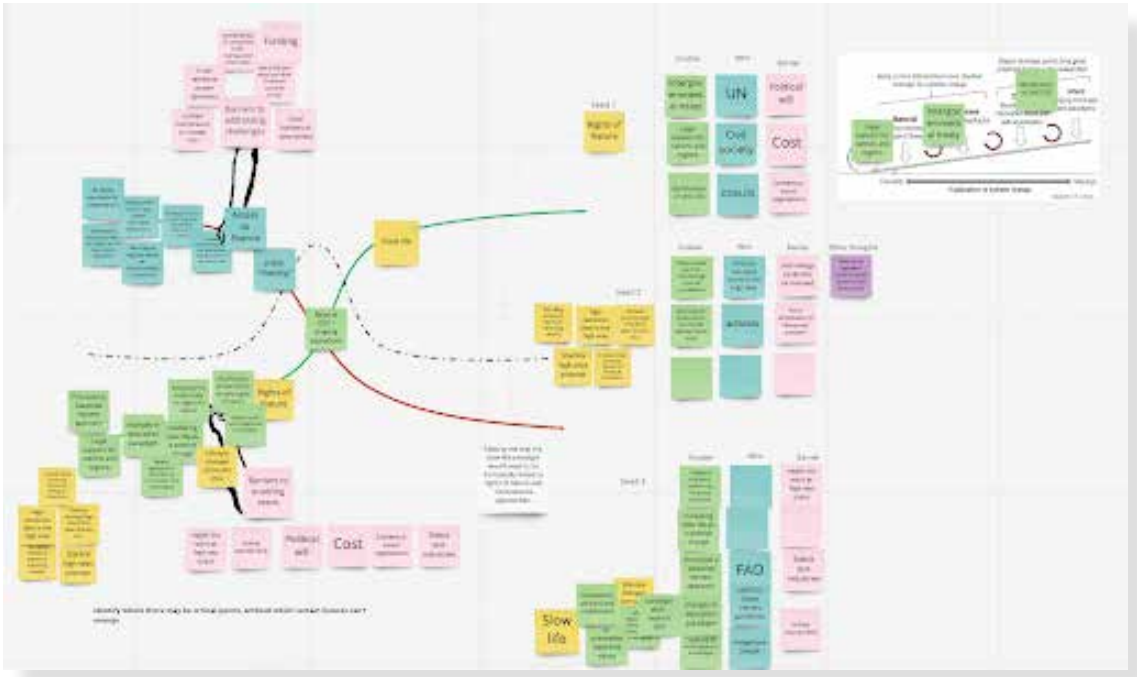
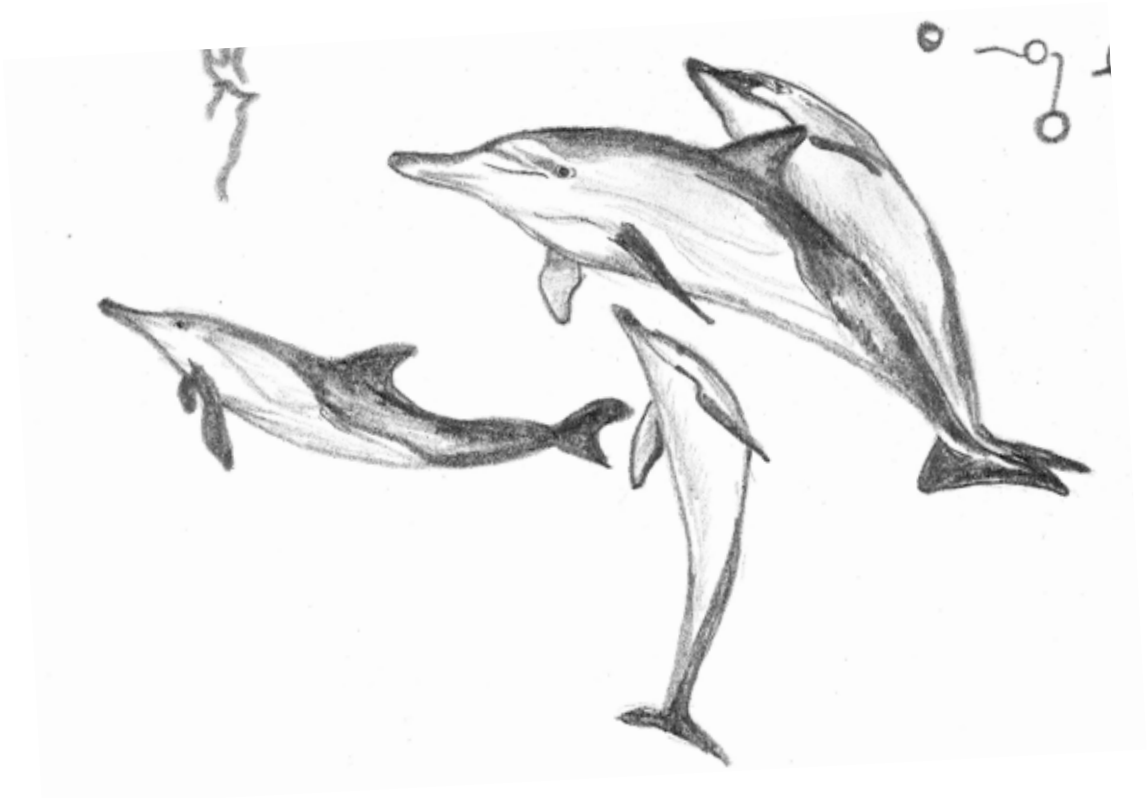


Figure 7: Mapping the interventions to grow the seeds whilst also addressing the challenges

Table 2: Indicators of relevance to the three Nature Futures corners

Indicator theme	Class	Indicator	Does the indicator exist?	If yes, at scale for the high seas?
Environmental	Abotic indicators	Ocean temperature	Yes	Yes
Environmental		Sedimentation	Yes	No
Environmental		Water column stratification & mixing	Yes	No
Environmental		Water chemistry (pH, nutrient concentration, salinity)	Yes	No
Environmental		Oceanographic connectivity	Yes	Yes
Environmental	Biotic indicators	Horizontal and vertical nutrient cycling	Yes	No
Environmental		Trophic Index and Efficiency	Yes	No
Environmental		Passive and active connectivity models	Yes	No
Environmental		Species distribution and abundance/density estimates	Yes	No
Environmental		Genetic connectivity / metapopulation estimates	Yes	No
Environmental		Nutrient cycling capacity of ecosystems	Yes	No
Environmental		Carbon sequestration capacity	Yes	No
Environmental		Ecosystem genetic and functional diversity index	No	No
Environmental		Population Status and Vulnerability	Yes	No
Environmental	Anthropogenic disturbance indicators	Phenological disturbance index	No	No
Environmental		Species nutritional performance indices	No	No
Environmental		Multi-species Nutritional Maximum Sustainable Yield	No	No
Environmental		Acoustic, chemical, light, endocrine disruptor pollution	Yes	No
Environmental		Species response velocities to climate change	Yes	No
Societal		Number, size and impact of seasteading communities	No	No
Environmental		Species distress index (hormone levels, genetic disruption, stressed induced mutations)	No	No
Environmental		Integrated ecosystem health index	Yes	No
Environmental		Spatial Climate Change Vulnerability Index	Yes	No
Societal		Index of ecosystem services valuation and performance	Yes	No
Societal		Ocean literacy level (number and effectiveness of education levels)	No	No

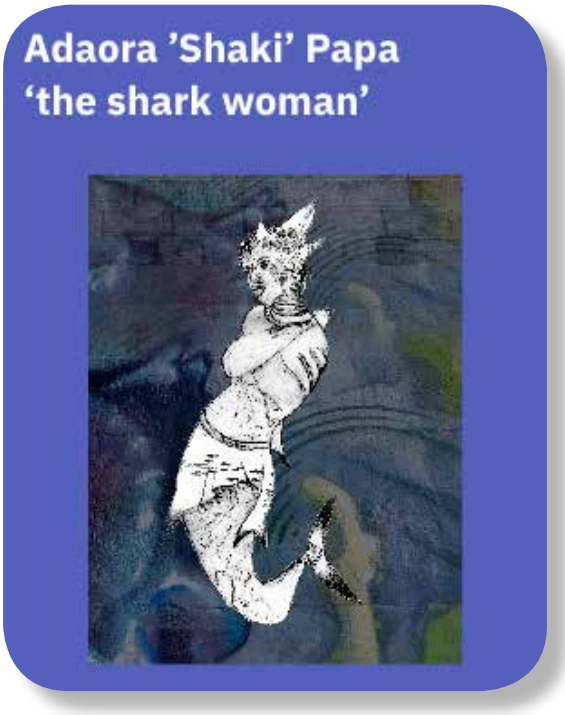
Societal	Performance and management	Indices for spatiotemporal anthropogenic overlap with nature	Yes	No
Societal		Exclusive Economic Zone anthropogenic impact export index	No	No
Economic		Sustainable ocean investment index (NBS, restoration, etc.)	No	No
Economic		Equitable resource access index	No	No
Political		Multilateral management performance index	No	No
Societal / Political		Representativity and inclusivity index	No	No
Societal		Cultural heritage integration index (TK, LC, etc)	No	No
Societal		Resource utilisation/ circularity index (RRR-based - reduce, reuse, recycle)	Yes	No
Societal		Human-well being index (in relation to high seas health and access)	No	No
Environmental		% Ocean explored biophysically (mapped, characterisation, etc...)	Yes	Yes
Environmental		% Ocean understood ecologically	Yes	No
Societal		% Ocean monitored	Yes	Yes
Societal		% Ocean protected	Yes	Yes
Political		Sectoral compliance-enforcement indices	Yes	No
Societal		Human biomimicry index (visual, chemical, acoustic integration)	No	No

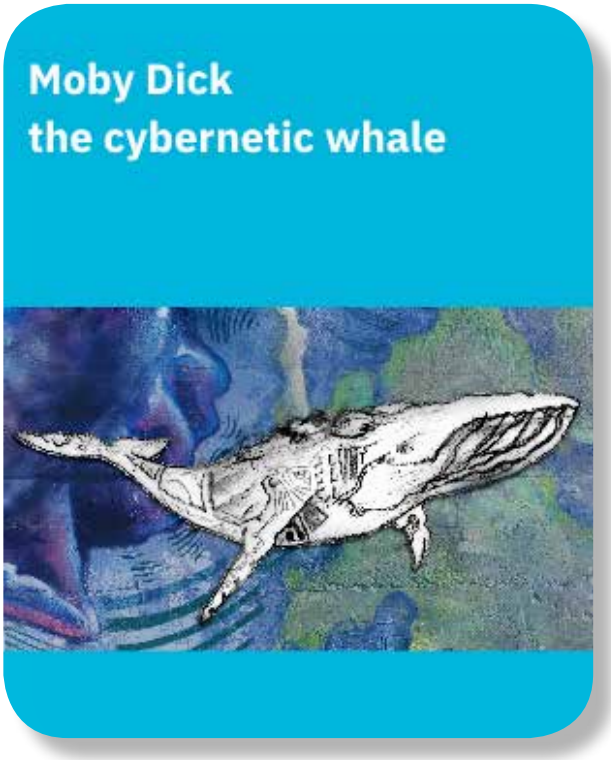


Appendix 2:

Nature for Nature

Adaora 'Shaki' Papa 'the shark woman'
- sick of trying to save the ocean from land, Shaki (her parents were marine biologists) has biohacked her body with many of the properties of the mako shark. Using CRISPR and stem-cell 3D printing, she has rough skin and replaced her legs with a powerful tail and gills. She campaigns tirelessly as a living embodiment of multi-species approaches to conservation and the death of anthropocentrism

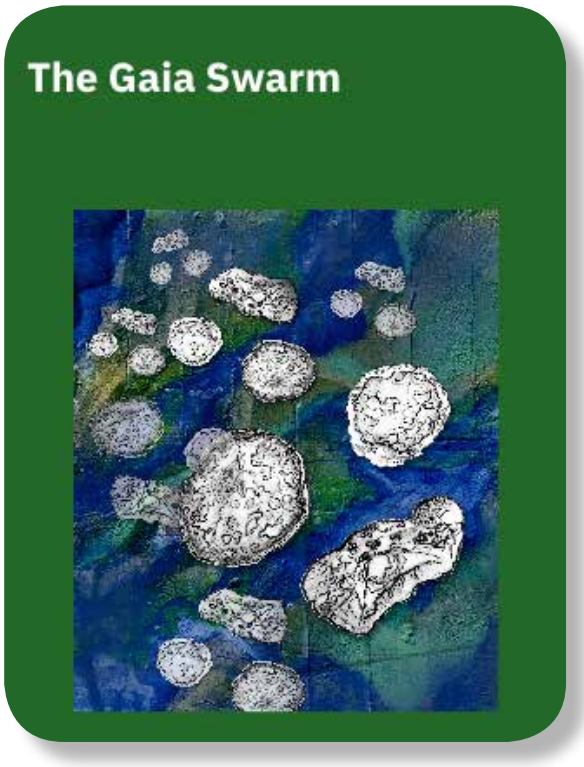




Moby Dick
- The cybernetic whale whose skin, due to extensive cybernetic augmentation, is bleached white and has started hunting illegal fishers in the spirit of vengeance and terror - channeling the animus of the ocean

Nature for Society

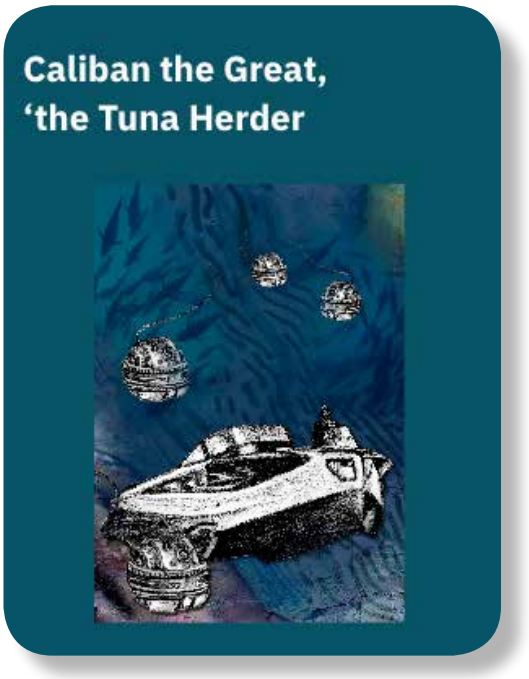
Agent Nemo
- A shady corporate spy that has an advanced deep sea submersible that strips genetic sequences from the deep ocean and sells them to the highest bidder for development of new biotech and pharmaceutical products.

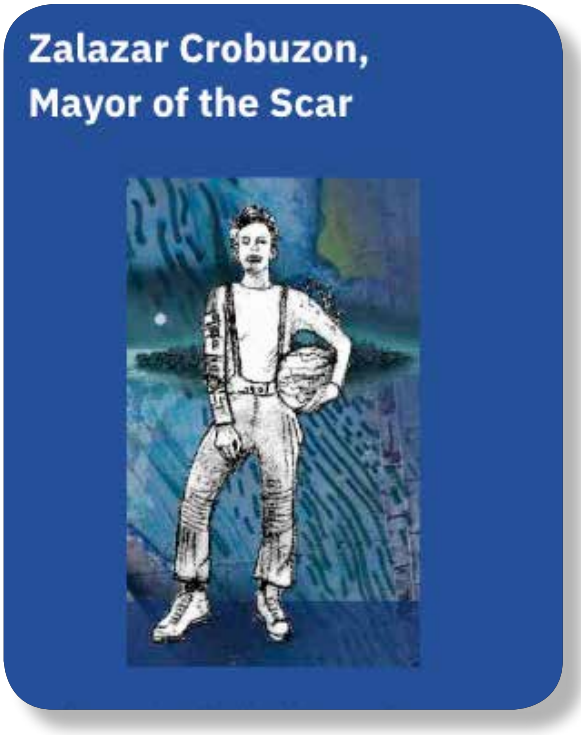


The Gaia Swarm
- A self aware and self replicating swarm of autonomous deep sea mining bots that switch from mining cobalt nodules to becoming guardians of biodiversity via a glitch in their coding.

Nature as Culture

Caliban the Great, 'the Tuna Herder'
- A mysterious figure in a bright purple boat that follows schools of tuna throughout the high seas, constantly monitoring their state via surveillance drones and keeping away predatory fishing fleets as the tuna move between EEZs.





Zalazar Crobuzon, Mayor of the Scar
- The scar is a flotilla of assorted mismatched ships representing climate refugees from across the pacific and from low-lying coastal areas. They gather and tie their ships together in the pacific gyre, building a floating city from their dilapidated ships and scrap from the great pacific garbage patch. They create a green anarchist solar punk city, floating on the ocean and growing their own algae which they process into novel biotech using floating bioreactors.

Cross-cutting

Sefina Tausa'afia - The good lawyer
– An enterprising legal mastermind who works on a thirty year campaign to grant sovereignty of high seas areas to disappearing island nations and reduce the size of EEZs through a radical reform of the law of the seas to grant more joint governance of the oceans and protect biodiversity.

Illustration, Design & Layout: CareCreative (Claire Homewood)