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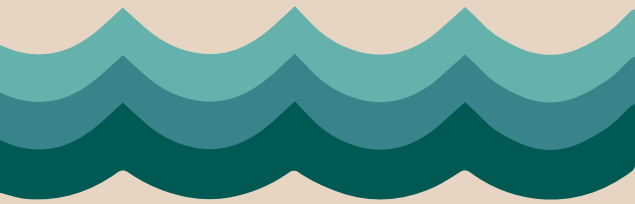
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**A Visit to the Aquarium
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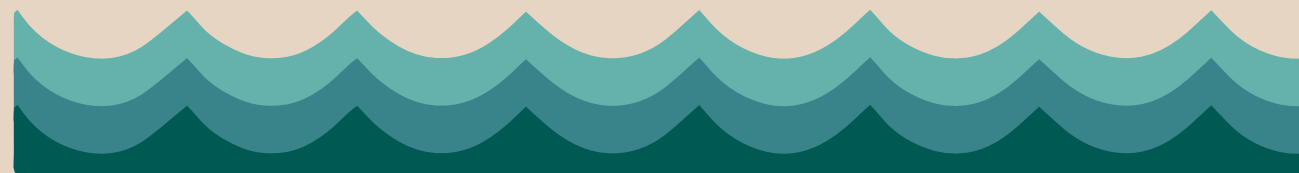
Letter from the editors



We don't call Earth 'The Blue Planet' for nothing. Go to the deepest, darkest corners of the Atlantic Ocean; go to the pure and pristine peaks of the Himalayas; go to the thirsty soil of an African savannah when it rains; go to the furious flow of the Amazon River in Brazil. There, you'll find it. Water. It's omnipresent. It's overwhelming. It's the narrator of our livelihoods. It's the topic of this issue of Tvergastein.

We tend to forget, yet, water is finite, irreplaceable and fundamental for all life on Earth. Today more than ever before, water issues pose some of the biggest challenges we face, and our relationship towards it can be described as questionable. Therefore, Tvergastein's Issue #11 will surf across a wide range of topics, from water governance and water pollution, to the history of refugees crossing the Mediterranean Sea.

This issue aims to reimagine humans' current relationship with water and to question our future on this planet if we are to remain apathetic towards these issues. We hope we thrill you as much as we already are with this theme. Cheers to that with a glass of water!



Wonderful Water

Mariandre Navas

A single droplet of water contains a whole chemical wonderland which remains unknown to most of us. The word “chemical” may chase many people off, scare them even, remind them of that frigid laboratory room in high school with the foul smells and the teacher with the oversized glasses and mismatching socks. Yet, in this article, I propose a revision of the unique chemical properties that water possesses in order to change the way we think about it, and ultimately, the way we act and relate to it. We need, after all, a new pair of eyes to look at water and appreciate it for what it is — a wonderful element in nature.

Water & Us

We shower. We drink. We wash. We irrigate. We surf. We cruise. We flush. I could go on and on with all the actions that are related to water in our daily lives. That humans could not live without water is an understatement. Water, ladies and gentlemen, is our friend. Why do we treat it with such carelessness then? Why do we take it for granted?

Amongst our water sins we find:

- A high demand for water due to our population increase accompanied by a lavish use of it¹;
- Our agricultural activities consume water like an ever-thirsty monster, a whopping 70% of worldwide fresh water to be exact²;
- Two million tons of sewage and other pollutants are drained into the world's water every day. This accounts for the problem of eutrophication, the pollution of water due to agricultural runoff, domestic sewage, and industrial activity³;
- And, oh yes: Climate change. Dry areas are getting drier and clouds are moving away from places where rainfall is a crucial determinant of life, emptying thus the available aquifers and water bodies⁴.

Putting aside all these sins and depressive aspects of the situation, I ask myself, do we really know what water is? Do we understand it? Do we know enough about it? Perhaps a look at these magical—there's no other word for it, trust me—chemical characteristics of water will change our perspective of it. Hold on to your Helly Hansen socks and expensive iPhones, kids. We are about to travel back to my freshman days.

Enter Chiquín

It was at Del Valle University in Guatemala City that I met Professor José Carlos Chiquín. Classes were held in the auditorium and he'd always show up with his tie-dyed laboratory

coat, kind of like the chemistry version of Patch Adams. What I'll never forget about Chiquín is that he inspired us to look at water with eyes of wonder, amusement, and respect. Although there are many, in the following four points, I will sum up the chemical characteristics of water that Chiquín taught us, and that, in my regard, makes it one of the most awesome elements we find in nature.

1. Water is the universal solvent

Water is composed of two elements: oxygen and hydrogen. Easy as that? Not so fast. Because oxygen is slightly negatively charged and the two hydrogen particles are slightly positively charged, this in turn gives the water molecule its polarity⁵. Other substances' will be attracted both to the negative and the positive particles of water, which makes the substance disassociate and dissolve⁶. The catch is that no

“We shower. We drink. We wash. We irrigate. We surf. We cruise. We flush. I could go on and on with all the actions that are related to water in our daily lives. That humans could not live without water is an understatement.”



other material can dissolve as much substances as water does, as far as man knows⁷. This is why water is regarded as the universal solvent.

2. Water is less dense in its solid phase.

Think of ice for a moment. When you take a glass of water and throw in some ice cubes, BAM!, they float. Although very few people acknowledge this as a surreal phenomenon in daily existence, the implications are enormous. The solid state of water, that is ice, is less dense than its liquid state. This allows certain species to live underwater while it is winter, because the ice doesn't sink and squish their habitat⁸. This allows lakes to freeze from top to bottom

and ice to act as an insulative layer⁹. If that wasn't enough, this allows you to skate on top of a frozen lake too. Ha!

3. Water has capillary action

Now think of plants and roots. Water's property of cohesion results in capillary action, and therefore, allows plants to breathe and transpire. What does that mean?! Water's molecules tend to “stick together” and pull up when a tube is inserted in a body of water¹⁰. Plants drink up water this way. If it wasn't for water's cohesion, there would be no pump that could drive water into the plant's xylem. No plants=no oxygen=no life on Earth. The math is simple.



4. Water in its three states

It is very rare that a substance exists naturally in the world in all three states (gaseous, liquid and solid). Substances tend to be found in either one of them. Water, however, is the exception¹¹. This allows rivers to flow (liquid state), glaciers to form (solid state), and vapor to drift off into the air (gaseous state), all at the same time. The water cycle would be very different if it only existed in gaseous state; ecosystems wouldn't thrive if it wasn't for solid ice; and the weather would be certainly different if water only occurred in nature in one state¹². It is water's ability to be multi-phased that allows life to flourish so easily on our planet.

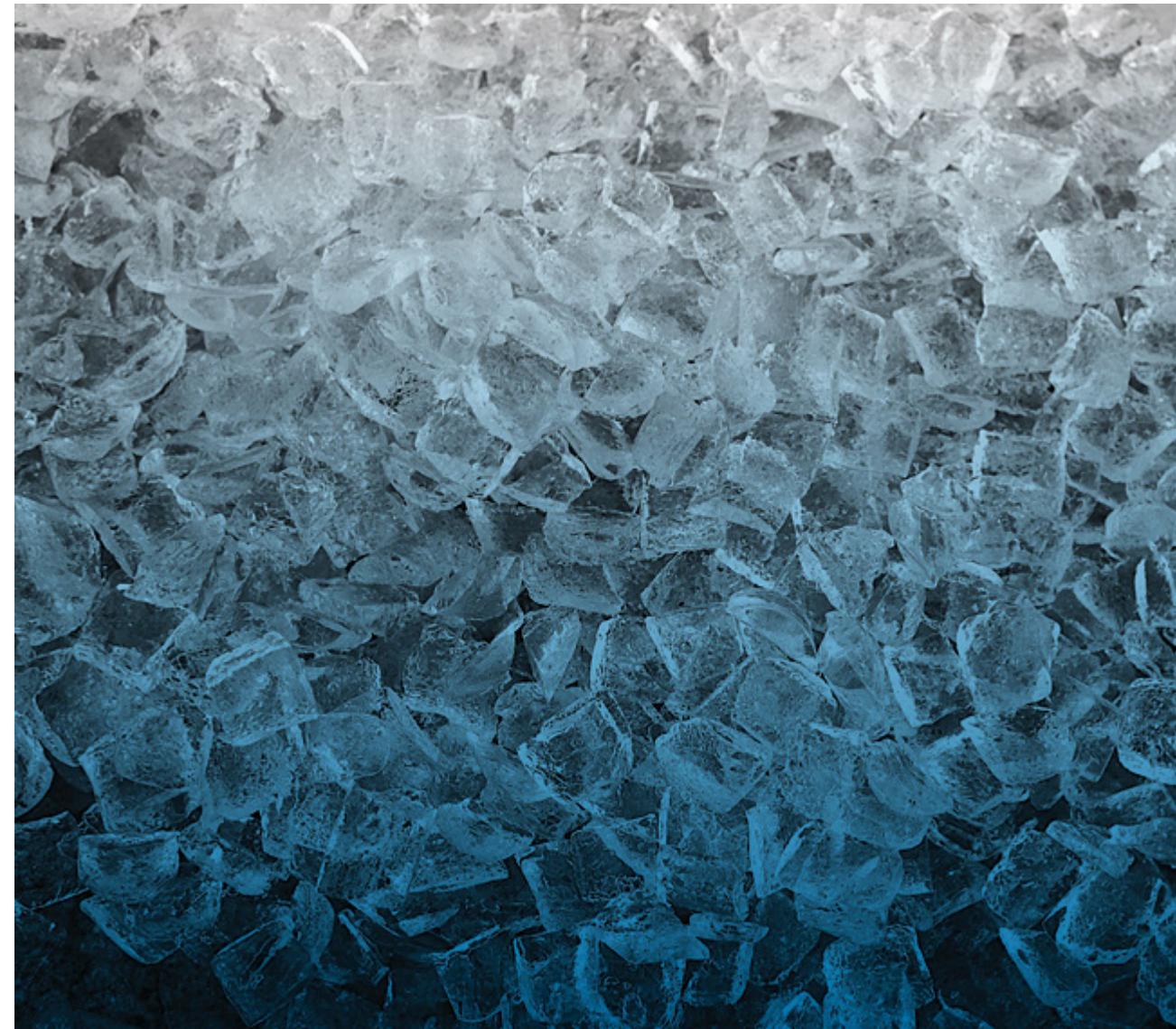
I suggest then, that by acknowledging our dependency on water and its unique chemical properties we might get a shot at changing our relationship with it and our detrimental habits. It is right here, right now that we can throw away the lens we use to look at water and see it with new eyes of wonder.



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- ¹¹ University of Cambridge. 2018.
- ¹² University of Cambridge. 2018.

"It is right here, right now that we can throw away the lens we use to look at water and see it with new eyes of wonder."



Should we Send Hans Brinker to the Greenland Ice Sheet?

Climate Change, Geo-Engineering
and Resilience

Bas Altena

The melting of the Greenland ice sheet could potentially result in rising sea levels as a result of excess water. Evermore, civilization is facing similar environmental challenges. With this in mind, Bas Altena uses the example of Greenland to ask the questions, should we interfere with nature? And if we choose to, what is the best course of action to take?



Hans Brinker is a personality in a book by Mary Maps Dodge, who writes about the habits of the Dutch through this fictional person. One such story starts with Hans Brinker taking a walk late in the night in a low lying area of Spaarndam, the Netherlands. He discovers a seepage coming from a hole in a dyke and immediately responds by putting his finger in it. It stops the leak, but he cannot move back or forth for extra support. He cries for help, but nobody hears him, thus he is forced to remain there overnight and is found the next morning by the priest of the town. The priest understands what has happened and praises him as a hero, as he has prevented the village from flooding.

The response of Hans Brinker represents the general Dutch attitude, where interference with nature, and more specifically with water, is common. This is reflected in real world examples like polders, delta-works, but also artificial wild-water and ice-skating rinks. These examples are results of a culture that tries to understand and then interfere with the natural environment.

Today, with the potential collapse of Greenland, and its consequent sea level rise, it is therefore no surprise that ideas about geoengineering emerge on this topic. One such example was expressed on a science-oriented radio show in an interview with Rob Govers [i]. He wonders if it is feasible to construct a dyke around Greenland, reversing or delaying global sea-level rise. This question was answered by Han Vrijling, a hydraulic engineer, who stated that such a circumventing dyke would be too big to construct. However, recently similar propositions have been formulated [1], making this an issue worth considering. Regardless, both the technical and philosophical aspects of geoengineering need to be laid out. Consequently questions emerge: to who are we obliged: other humans, future generations, other living things, or even ecosystems? To what extent, and how could/should this be

executed? With these questions in mind, the following text will briefly describe the current state of research about ice sheet stability, the options of prevention, followed by an ethical assessment concerning the legitimacy of such intervention.

What is the current state of the Greenland ice sheet

Roughly speaking, the Greenland ice sheet gains mass from precipitation, but loses mass from melt and iceberg discharge. This iceberg production comes from marine terminating glaciers and in recent years accounts for 50% of total mass loss [2]. The ice flow is channeled through troughs (fjords), and in the case of Greenland this results in less than a dozen glaciers contributing a fair amount of the total discharge [3].

Our understanding of marine terminating glacier discharge

The ice sheet can have several mechanisms to become unstable, through self-enforcing feedback loops. The size of an ice sheet is dependent on climate. Their relation can be connected through the atmospheric lapse rate. If this relation shifts to a warmer state (horizontal translation of the line in figure 1), or a less steep sloped relation, more melt will occur. This will result in more melt at the surface, bringing the ice sheet down into lower and thus warmer altitudes.

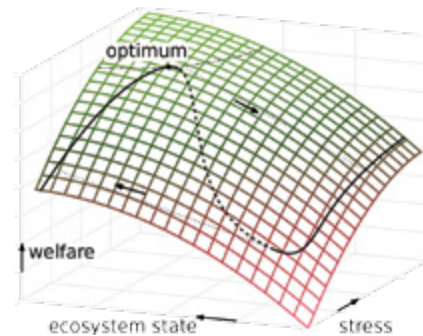


Figure 1: Schematic of the two negative feedback loops that affect the Greenland ice sheet



Photo: Steve Halama

The bed of the ice sheet is mostly under sea-level, as over the centuries Greenland has formed a depression by its own weight and erosional sliding force. This property creates another unstable situation. A lower ice sheet increases the buoyancy force and increases ice loss at the glacier front, this results in a shift of the grounding line. If the bed slopes towards deeper depths, which is typically the case for Greenland, buoyancy increases even more. Hence, a tipping point seems to exist, where the ice sheet system gets out of balance and will search for a new system state [4,5]. Lastly, the increase in meltwater reduces the friction at the bed, making sliding and thus ice transport to the sea more rapid.

The timescale of these feedbacks is shocking; while the first is over centuries, the second feedback system seems to be possible within several decades. If this is the case, solutions need to be found.

Changing the environment

If a dozen outlets of the Greenland ice sheet are dammed, this might prevent the collapse of the ice sheet, or preserve to some extent the present system state. Before considering the moral grounds for this interference, some major environmental changes are highlighted

“The response of Hans Brinker represents the general Dutch attitude, where interference with nature, and more specifically with water, is common.”





Photo: Marjorie Teo

first, so an insight is given on the impact of such action.

A physical dam prevents the intrusion of warmer water into the fjord. In addition, water levels will oscillate less in accordance with the tidal currents. The water behind the dam can be adjusted accordingly and will for a great amount be fresh water. In addition, the sediment load and its redistribution will change. Most presumably sediments will pile up close to the front of the glacial outlet because the sediments arrive in stable waters without currents or circulation.

The importance of tidewater glaciers

The calving front of glaciers is an important playground for biological life [6]. The tidewater glaciers in the Arctic are essential for ringed seals and consequently also for polar bears. Blocks of ice are dispatched from the glacier and strand on the beach or are fixed in sea-ice. In winter, icebergs are covered by drifting snow, and as such become a shelter for breeding and birth. If there is an absence of sea ice the stranded icebergs function as an alternative breeding ground for ringed seals. Consequently, these pupping grounds are

important hunting grounds for polar bears. Thus, if the iceberg cannot get out of the fjord, the hunting areas decrease and polar bears will have a clear advantage.

Also, other mammals take advantage of the fresh and salt water mixing at the glacier front. Through ebb and flow currents plankton is transported from the outer fjord to the glacier front. Here the plankton dies because it gets in contact with fresh water and these lifeless bodies rise to the surface. These are a rich food source for all kind of mammals, such as white whales and seabirds. When there is interference, these biological hotspots might migrate to the artificial outlet of the dam, or they might disappear.

On morality

There seems to be a possibility to, at least to a certain extent, tame the ice discharge of the Greenland ice sheet. With this knowledge we arrive at the philosophical question if and why we should initiate interference. This would be rooted in our responsibility or duty to others; our morality. The group denoted here as "others" can range in size dependent on the school of thought. The smallest group of

"others" are the negatively affected countries, in low lying coastal areas and the native Inuits of Greenland.

However, for Regan [7] the group of "others" to consider covers not only human welfare alone, but any entity which can feel pain, is conscious, or is a subject-of-life. Even a wide group is specified by Taylor, to look for the good of every living thing. Every living thing has a goal or is in pursuit of something to maintain its existence. What lacks in these approaches is the scalability, especially concerning our subject. The damming of Greenland involves generations of humans, multiple species and different communities. Thus, with all these stakeholders concerned, we should consider philosophic writings focused on ecosystems, such as those of Arne Næss.

Our options

The text above gave an idea of the important physical processes of the ice sheet and the practical implications when dammed. With this knowledge as a backbone, we should explore the direction society needs to head towards. Three options for action can be identified:

- We can transform, by actively changing a (ice sheet) system.
- We can anticipate in reaction to this transient state change of the outlet glaciers, by adapting.
- Finally, we can mitigate, through restricting the progress of ice loss.

From the writings of Arne Næss [8] we can easily extract his standpoint concerning the transformation of nature by humans. For example, within sight of his cabin on Tvergastein metallic masts carry shiny electric cables to Oslo. Though the construction of electric poles might be elegant from an engineering point of view, it misfits the landscape. More importantly, its goal is to

“The damming of Greenland involves generations of humans, multiple species and different communities.”



facilitate luxury and blunts our ability to value the natural environment. Transforming Greenland just for the sake of comfort, without consideration for the surroundings, raises some moral tensions. However, two other options remain – to adapt and to mitigate – and these seem more subtle, but require further examination.

Why not interfere

Opposition to interference with nature is mostly rooted in a bio-centric worldview. Here one strives for a romantic model of the wilderness, where nature is unspoiled and uncorrupted by human action. However, if one aims for a constant and immutable wilderness, it will result in protection and regulation of such preserves. This might not be beneficial for the wilderness, as the persistence of life needs changes in order to function. For example, wild fires might have an important function within preservation, even though they are destructive or even catastrophic.

Another advocate against interference is Næss, he tries to place man inside a humble role, in harmony with their surroundings [8]: "our narrative traditions and practical activities are within our place and include its ecological communities. We don't try to control the world. We do not abstract ourselves from the living world around us." However, on the other hand Næss seems to suggest the opportunity

to mitigate, in his words, "live and let live". Furthermore, in his works he states we should try "to act beautifully, doing more than our share and giving back more to the Earth than we take", and we should "give gifts back to the Earth so that others can thrive". This principle of mutuality seems to suggest that interference might be possible if caution is taken. Being a bystander while havoc occurs is morally worse than interference. Furthermore, awareness of nature has increased, and interference with nature is now not only for the sake of luxury and human well-being alone, but for the sake of the planet.

In defence of building with nature

In recent years the consequences of the extensive exploitation of natural resources has become visible. This environmental awareness has ignited a paradigm shift, from re-active to pro-active engineering. Classic interference, which solves problems with man-made mega-structures, is seen as "hard-engineering". While an interdisciplinary approach, with the engagement of stakeholders, is emerging and listens to the name of "soft-engineering". Such engineering might be an alternative to the passive attitude towards interference.

Protecting ourselves from glaciers is not new, as glacier lakes can burst out when water levels exceed the dam of loose sediments that holds them together. The water that overtops transforms the debris of the dam into mud and might disintegrate the entire natural dam in a short period of time. Glacial lakes are high in the mountains and have thus an extremely high potential energy. Hence, these floods are a threat for lower living mountain communities, because of their short but strong pulse of released power. However, these potential dangers can be identified and remediated, even in a natural way by constructing a spillway [9]. This prevents the lake reaching a dangerous size.

These restoration efforts, to arrive at a stable point within a natural system, can be applied to other large and complex systems as well. Two examples will be given of such efforts, both rooted from the Netherlands. Firstly, a soft engineering approach of beach nourishment to counteract the coastal recession [10]. A more usual deposition of sand is dredged all in one instance in a specific shape. Then over the stretch of twenty years the redistribution of sand along the coast will be done through the natural forces of nature. It incorporates to some extent the ecological aspects within its design, the disturbed sub-surface ecology can recover after the intervention has occurred. This paradigm shift in coastal management is rooted from empirical knowledge, or more simply, a critical evaluation of past trial and error attempts in Dutch coastal defence [11]. Which emphasise:

- if there is a choice, leave the system untouched
- if there is a history of human intervention, adopt a more flexible approach
- when implementing, choose for reversible and local measures.

However, this coastal management could only have been possible when a sufficient understanding of coastal dynamics is known. Such modelling efforts have come in recent years to such a level of detail that the morphological aspects of sand redistribution can be predicted. The question is thus; can this be accomplished for ice sheet dynamics? Though the example is a new era of engineering, and benefits the welfare of stakeholders, there is still human interference. The solution is not within a stable state of self-sustainability.

The second example is based on the ecological restoration of shallow lakes. Due to the industrialization of agriculture, fertilizers

have polluted lakes transforming them into toxic algal blooms. Due to nutrient loading of such lakes, the biomass has started to shift to the upper part of the water column. This reduces the amount of light for submerged water plants. With the decrease of submerged vegetation, a shelter for small creatures is lost and the prey-predator system changes. Eventually, the water becomes turbid and stays as such, because fish that benefit from the turbidity hunt for creatures in the subsurface.

The shallow lake comes in a self-sustaining state; external forces have no direct effect as the phosphorus are within the sediment and function as internal loading. The population transforms to bottom-feeding fish, such as bream and carp, weeding the subsurface and causing turbid water through the mixing of sediment. This brings the lake into a negative

feedback loop, which can occur in a rapid transition. Evolving into a new stable state, where a shift is only possible if the fish stock is removed, or by lowering the water level. In that case, submerged vegetation can come back and clear the water, creating a favourable situation for more submerged vegetation, returning to a positive feedback loop.

The simple intervention made a great amount of lakes in the Netherlands more fertile and diverse again. This case is more striking than the former as its initiator, Scheffer, has worked these principles into a theory [12]. In the lake ecosystem a hysteresis function between different states is identified, as illustrated in Figure 1. This type of function can be seen in many more natural systems, and its transition points are generally known as tipping points.

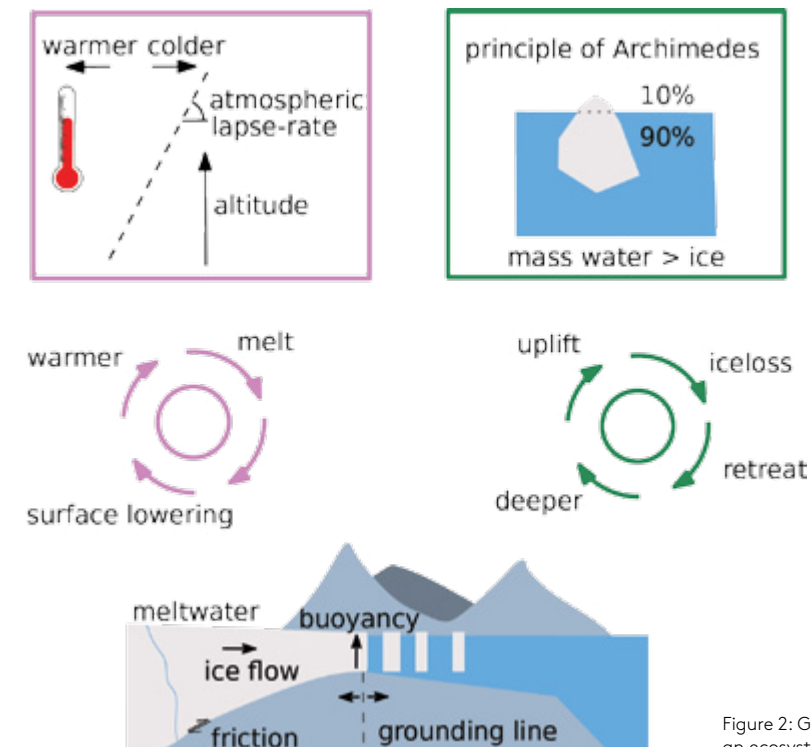


Figure 2: Gain function for the use of an ecosystem, adopted from (12)

How to wage the odds

Having an insight into the dynamics of such a complex system, and the involved stakeholders, it might be possible to decide on a favourable approach. Within this framework several views can be taken, where the greatest welfare might be the most obvious. However, its definition and calculation might be difficult. Fortunately, Scheffer has broadened his point of view and looks at the ethical and political side of interference as well. As a start, the stakeholders can be separated into two groups "affecters" and "enjoyers". Affecters have a clear benefit of the ecosystems state, but put stress on this system. While enjoyers have no significant affect or demand much of the capacity of the ecosystem, though their welfare is dependent on the ecosystem's state. This gives us the opportunity to identify an optimum, though such optimum might be situated in an unstable state. Consequently, the system might easily flip over to a different, more unfavourable state for all stakeholders. This would be a bad compromise, as maximum welfare is reached on the edge of a cliff.

Another approach could be a more liberal point of view, where the pursuing of personal gain is leading. Here, free market thinking is believed to reach an optimum for society when individual decisions are made without regulations. However, in this case affecters benefit as much as enjoyers, but through the influence of the affecters to the systems wellbeing a disruption of the system might reduce the total welfare. Unfortunately, this free market problem is the state we are in for Greenland, the Arctic ecosystem is put under pressure, though coordinated action is lacking. Such coordinated action is difficult, as the involved groups are largely scattered and have competing interests within themselves.

Far sight

The problem of the venerability of Greenland and its potential havoc creates an important dilemma and forces us to think through our role within the Earth's system. Reaction is needed, but this should be done with great consideration of the involved ecosystems. From a dynamical systems point of view, we need to promote good transitions. Furthermore, we should try to strengthen the ecosystems by making them more resilient. This can be done by introducing more diversity and redundancy. This makes the system less venerable to change, as one species can take over the domination position of another. In addition, one needs to react in an adaptive fashion. Thus, a hard engineering approach which places dams just on the outlet is not favourable, as the transition is hard and variables working long term are neglected. The interference should be gradual, so stakeholders get time to adjust to a new situation, where certain roles might change, but extinction is limited.

Such an adaptive approach might for example be the natural building of a moraine by transported debris. This already occurs under a calving ice front, but there might be ways to promote this process. Consequently, a natural barrier emerges that might slow down the iceberg discharge. Such a strategy is beneficial over a hard dam, as it takes more time to establish. Consequently, species are able to adjust, and we are also able to gain more insight in the process. More importantly, if perception changes, we are flexible enough to change our strategy. Hence, it might be a good idea to send Hans Brinker to Greenland. He should put his finger on the weak spot, though steadily and humbly.



“it might be a good idea to send Hans Brinker to Greenland. He should put his finger on the weak spot, though steadily and humbly.”



Notes:

[i] For more information on this interview see: <http://www.npowetenschap.nl/programmes/hoezo-radio/Kettingvraag/2013/april/23-04-2013-superdijk-tegen-smeltende-poolkap.html>

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Temporary rivers, are we too thirsty to protect them?

Pablo Rodríguez-Lozano

Until the 90s, nearly all the scientific research about rivers and its conceptual models were focused on rivers that flow permanently. This research shaped the content of textbooks and influenced subsequent generations of water and ecosystem managers. Consequently, current paradigms in river science and management have emerged and developed from and for perennial rivers, which have likely biased our perceptions about temporary rivers and their ecological importance.

We currently know that about half of the global river network is formed by temporary rivers and that their numerical importance is projected to increase due to climate change and water abstraction for human use.^{1,2} These ecosystems are present worldwide, and are the dominant river typology in Mediterranean and arid climate areas. For instance, in the Southeast of Spain (Murcia province) about the 98% of the mapped watercourses are temporary rivers.³ Although the number of research studies about

these ecosystems has grown exponentially since 1990,² the principles of biodiversity conservation, integrated water resource management, and water quality control, still neglect temporary rivers. Questions emerge of: why have scientists, managers, and policymakers focused their efforts on perennial rivers even in those areas where temporary rivers are predominant? And, maybe more important, are temporary rivers considered equally worthy of conservation as permanent rivers?

Córcoles River
Photo: Pablo Rodríguez-Lozano



“Are temporary rivers considered equally worthy of conservation as permanent rivers?”

The ecology of temporary rivers

First, we should highlight that temporary rivers form a heterogeneous category that includes all rivers and streams in which surface flow cease at some point. Some temporary streams, usually called ephemeral, can be dry most of the time, presenting running water only after heavy rains, while other temporary rivers flow most of the year and are reduced to disconnected pools during some months, but never dry completely. Some temporary rivers present a seasonal hydrological pattern, others have an unpredictable hydrological behavior, and some can present a high variability among years. Moreover, most temporary rivers are not just characterized by the lack of surface flow during dry periods, but also by their heavy floods during wet periods.

The wetting-drying cycle in temporary rivers generates shifting habitat mosaics of running waters, non-flowing aquatic habitats (isolated pools), and terrestrial habitats (dry riverbeds) that support aquatic, semi-aquatic, and terrestrial life. These organisms present different morphological, physiological, and behavioral adaptations to deal with the hydrological variability of temporary rivers. For instance, several organisms can survive for months or years in dry riverbeds waiting for the rewetting of the river channel, and some terrestrial species have developed the ability to float or to store air so they can survive in the terrestrial-aquatic mosaic. Some fish species inhabiting temporary rivers refuge in isolated pools during the dry season, presenting a high

tolerance to the extreme climate and water quality conditions that can occur in isolated pools (e.g. high temperatures, low dissolved oxygen availability). Other aquatic species are not adapted to survive during the dry phase or the flood events, but have developed other strategies to inhabit these ecosystems, such as a high dispersal capacity. These organisms leave temporary rivers when conditions are too harsh, and recolonize them once disturbances have finished.

Because aquatic, semi-aquatic, and terrestrial life inhabiting temporary rivers are adapted to the natural hydrological variability of these systems, the conservation value of temporary rivers does not lie in the lack of flow per se, but in the naturalness of their intermittent flow. Therefore, what we should protect is the natural hydrological variability of temporary rivers. Unfortunately, temporary rivers are impacted by flow alteration due to anthropogenic activities. Water abstraction due to increasing human demands, together with climate change, is increasing the duration of the zero-flow periods and also altering their frequency and timing in several temporary rivers. In the opposite direction, the addition of water to temporary rivers, usually the effluent of wastewater treatment plants, can transform natural temporary rivers into perennial rivers, a process known as a perennialization. Dam construction and flow regulation are also among the main causes of human flow alteration of temporary rivers.

Temporary rivers in current legislation

We could expect temporary rivers to be protected by current water and environmental legislation at the same level as other ecosystems. However, policymakers have generally overlooked these ecosystems compared to their perennial counterparts. The European Water Framework Directive⁴ (WFD) sets the objectives for water protection in the European Union. This European Directive radically changed water resource management through the incorporation of ecological and hydrological criteria in determining the status of aquatic systems, but it is unclear about the protection of temporary rivers. Each EU Member State should define the water body types under its jurisdiction and, therefore, which type of aquatic systems are affected by the WFD. As a result, most temporary rivers in the EU are excluded from the water legislation and, therefore, from achieving the goal of good ecological status. In Spain, for instance, small headwater streams as well as rivers with low flow ($< 0.1 \text{ m}^3 \text{ s}^{-1}$ mean annual discharge)

are not considered water bodies, so most Spanish temporary rivers are excluded from the application of the WFD. While the EU fails in the inclusion of temporary rivers in the water legislation, the European Habitats Directive⁵ explicitly protects some habitat-types formed by Mediterranean temporary rivers.

In the United States, the US Federal Water Pollution Control Act (known as the Clean Water Act) is ambiguous about the regulation of temporary rivers. Despite of the recent efforts of the US Environmental Protection Agency and the US Army Corps of Engineers to clarify if temporary rivers are considered jurisdictional waters, it remains unclear, and US states differ in the inclusion/exclusion of temporary rivers in their water quality standards.⁶ In contrast, other countries, such as Argentina, Brazil, and parts of Australia, have legally defined temporary rivers within their water legislation and have established management implications for these ecosystems referred to water use and quality.

“policymakers have generally overlooked these ecosystems compared to their perennial counterparts”

Social perceptions of temporary rivers

Contrasting to the extensive overlook of temporary rivers by policymakers, these systems are well known in human societies, which are reflected in languages. Several societies have not just one word to name temporary rivers, but different terminologies to discern among temporary rivers with different levels of flow intermittency, from words to designate intermittent rivers that flow most of the year, to names for ephemeral rivers that carry surface water only after heavy rains. Some examples of the words used in different countries around the world are: barrancos, torrentes, and ramblas in Spain, ribeiras in Portugal, ravines in France, torrenti, rii and fiumare in Italy, himaros and xeropotamos in Greece, nallah and rau in India, wadi and oued in Northern Africa and Middle East, lugga in Kenya, donga in South Africa, balka and ovrag in Russia, kare-sawa in Japan, and dharrang and koornong in Australia.

Although there are practically no studies on the social perception of temporary rivers, environmental psychology literature has shown that people find landscapes containing water more aesthetically pleasant compared to those ones lacking this element, and, within waterscapes, people tend to prefer waterfalls and running waters rather than stagnant water⁷. However, not all running waters are equally aesthetically pleasant. The perceived scenic beauty of riverscapes was showed to increase with stream flow, but to be low for high flow levels. When videos of flowing

rivers, instead of pictures, were used to study this relationship, people's preference for rivers with intermediate flow levels was stronger, suggesting that the motion and sound of flowing rivers affect the public perception of their scenic beauty.⁸ The same relationship was found between river flow and perceived recreational value: anglers and shoreline recreationists were willing to pay for an increase in river flow up to a point, but were not interested in higher flow levels.⁹ The negative perception of high flow levels showed in these studies can be also caused by the risk associated to storm events, heavy precipitation, and floods. Riparian landowners with a perennial stream adjacent to their property valued the stream more and were more concerned about its water quality compared to landowners with properties near temporary rivers.¹⁰ Hence, the available literature suggests that people prefer permanent rivers rather than temporary rivers, which can be partially explained by the lower aesthetic and recreational value assigned to zero, low, and high flow levels compared to rivers with an intermediate flow.

On the other hand, some citizens living near a human-induced temporary river (i.e. a natural perennial river that became temporary due to anthropogenic impacts) valued dry riverbeds as places to walk, explore or drive off-highway vehicles, and described dry river reaches as safer places for kids to play, rather than flowing reaches with potentially polluted water.¹¹



Coyote Creek
Photo: Pablo Rodríguez-Lozano



Coyote Creek
Photo: Pablo Rodríguez-Lozano

What can we expect and what should we do?

In Mediterranean and arid climate areas where temporary rivers are the main river typology, water availability is scarce, and water demands are increasing, most people would probably not advocate for the protection of temporary rivers, but for their transformation into perennial rivers. The literature about the environmental impacts of the perennialization of temporary rivers is very limited and, indeed, one of the first scientific papers published on this topic described the benefits of the perennialization of a natural temporary river to create new fish habitats with the primary goal of increasing recreational fishing opportunities.¹² It shows that not only the general public, but also aquatic ecologists and managers, may perceive the perennialization of temporary rivers not as an anthropogenic impact, but as an “improvement” of these ecosystems.

Therefore, I think it is necessary to highlight the ecological importance of temporary rivers. For instance, ephemeral streams can play an essential role in the recharge of alluvial aquifers. Due to the vertical connection between dry riverbeds and the groundwater, temporary rivers can govern many of the provisioning, supporting and regulating services provided by aquifers.¹³ Temporary rivers are inhabited by several aquatic, semi-aquatic, and terrestrial species, as I explained before, but dry riverbeds are also important movement corridors for a wide range of terrestrial vertebrates, being a key element for the natural connectivity among ecosystems.¹⁴ Although our knowledge about the ecological importance of these systems is still limited compared to our understanding of perennial river ecology, we will learn more about it as the scientific research advance in this field that has been historically overlooked.

To conclude, from an anthropocentric perspective, we could question if temporary rivers are worthy of conservation, basing our decision on the ecosystem services they provide to human societies. Most likely, the answer is that we must conserve these ecosystems. However, if we look deeper in our relationship with nature, from a non-anthropocentric paradigm such as the Arne Næss’ ethics, we should ask ourselves: why are we not caring about our impact on the aquatic, semi-aquatic, and terrestrial organisms inhabiting these ecosystems? Why are we not protecting the ecological integrity of temporary rivers?



“In Mediterranean and arid climate areas where temporary rivers are the main river typology, water availability is scarce, and water demands are increasing, most people would probably not advocate for the protection of temporary rivers, but for their transformation into perennial rivers.”

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A Waste of Water

Paula Victoria Capodistrias

This article explores how the issue of food waste is intrinsically related to water waste, and raises concerns over the growing unsustainability of the food industry.

In recent years, food waste has become a hot topic. The FAO has set up a global initiative on food waste reduction, the EU has launched a resource efficiency framework for reducing food waste, and the UN has included a commitment to global food waste reduction in the point 12.3 of its Sustainable Development Goals (SDG's). By now, most of us know that the problem of food waste is a big deal, and that we need to do something about it. But why? While there is an obvious ethical conflict tied to throwing away food due to the fact that so many people are still suffering from hunger, the reason why food waste is such a concern is because behind food waste there is a waste of resources. In order to make the food that we need, we use resources such as land, energy and water. When we throw food to waste, we are basically wasting those resources. With 70% of our freshwater resources destined to agriculture, it is easy to see how food waste is also water waste¹.

Up to 24% of water used in agriculture is used to produce food that never makes it to a plate². Whether it is fruits and/or vegetables that don't meet commercial standards, or food products reaching their "best before date" at the supermarket, or leftovers we didn't manage to eat at home, food is wasted from farm to fork and with it, water is wasted too.

When we think about water waste in relation to food production, there are many things to take into consideration. For example, in the US, food waste accounts for 10.5 trillion gallons of water waste a year³. If you were to grow all the country's food that goes to waste in one place, you would need a mega-farm that would not only take the whole State of New Mexico, but also consume all the water resources of California, Texas, and Ohio combined⁴.

Furthermore, the water footprint of a food product depends on many factors. In meat production, one needs to take into account

"Food is wasted
from farm to fork
and with it, water
is wasted too."



the water used to grow the animal's feed and maintain the farm, as well as the animal's drinking water. Another example can be dark chocolate, which requires large amounts of water since all the water used in the production of the cocoa paste, the cocoa butter, and the sugar cane need to be accounted for. These are facts that many people ignore.

The link between food waste prevention and water conservation is clear. For example, for every egg produced and not consumed in Norway, 50 liters of water go to waste⁵. The 13 million eggs we throw away every year account for 650 million liters of water waste⁶. By using food waste prevention strategies in production and transportation systems, as well as by changing to sustainable consumer behaviour, we can take pressure off from the demand of water used for food production, and have a more sustainable use of our water resources.

The food and water nexus is central to sustainable development. The rising global population, dietary changes, urbanization, and economic growth put a lot of pressure on food and water resources. This requires an integrated approach to ensure water and food security, as well as sustainable development⁷. Efficiency measures along the agri-food chain to reduce food waste at every stage could lessen the need for food production, and thus, contribute to water conservation. Conservation measures should include prevention approaches such as waste tracking and consumer education



Photo: Samara Doole

campaigns. In addition, reducing meat and dairy waste, which have a much larger water footprint compared to grain products, fruits, and vegetables, can also provide substantial benefits.

The problem of food waste is not just about food. It is about land, energy and water too. In a world where these resources are under pressure, reducing food waste gives us the opportunity to ease some of that stress and build a more sustainable food system.



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Fiksjon og dagsaktualitet

Maja Lundes *BLÅ*

Karolina Eriksen

I 2015 satte hun søkelyset på verdens raskt krympende bie-bestand med sin debutroman Bienes historie. Nå er Maja Lunde tilbake med Blå. Handlingen tar for seg de katastrofale virkningene som følger når det blir mangel på verdens mest dyrebare ressurs: vann. Problematikken er ikke vanskelig å overføre til det virkelige liv, ettersom flere storbyer er midt i en vannkrise i dag.



I sin nyeste roman ved navn *Blå* utforsker Maja Lunde hvordan et tørkerammet Europa leder innbyggerne inn i en ressurskrise. Romanen varsler om at scenarioet kan inntreffe i en ikke så fjern framtid.

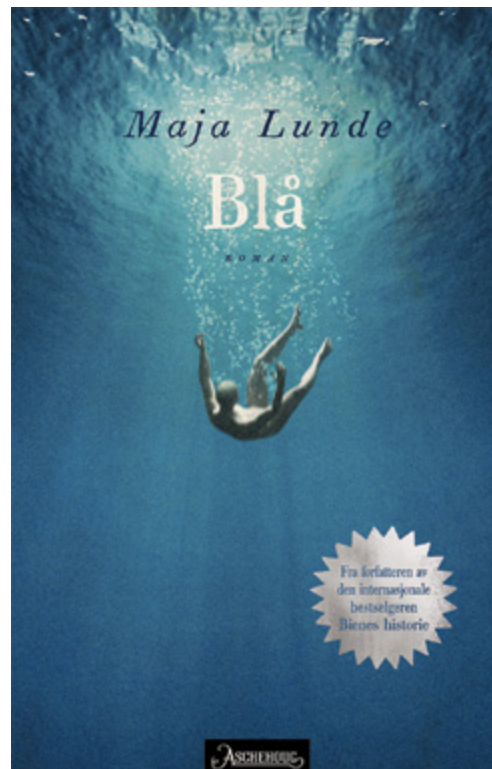
Maja Lundes roman *Blå* tar for seg to separate historier. Den første er satt til nåtiden og kretser rundt Signe som tar opp kampen mot utnyttelsen av naturen i sin norske hjembygd. Den andre foregår i 2041 i et Frankrike rammet av tørke, og framsetter et dystopisk skrekksenario der vannmangel driver mennesker på flukt. På veien mot de fruktbare områdene i nord søker hovedpersonen David og datteren ly i en flyktningleir. Men kampen om vann og forsyninger pågår like mye innad som utenfor leiren, og det fører raskt til kaos.

En situasjon der deler av Sør-Europa blir ubeboelig som følge av ekstrem tørke er vanskelig å forestille seg. I det minste for europeere. Romanens problematikk har lenge vært en realitet som blir stadig mer tvingende i andre deler av verden. Allerede i 2018 ser vi tegn til at flere byer begynner å gå tomme for vann. I storbyen Cape Town i Sør-Afrika teller man ned til «Day Zero», dagen når myndighetene skruer av kranene.¹ Datoen har blitt forskjøvet flere ganger. Området har vært utsatt for tørke i lang tid, og det har ført til at hver innbygger er begrenset til å bruke maks 50 liter vann per dag.² Til sammenlikning bruker hver person i Norge 190 liter vann i døgnet.³

Rio de Janeiro er i likhet med Cape Town også en millionby som har opplevd vannmangel. I 2015 kunne Aftenposten opplyse om at tørken forårsaket dårlige avlinger og strømbrydd, i og med at Brasil produserer mye strøm via vannkraftverk.⁴

Både klimaendringer, rask befolkningsvekst og hard utnyttelse av dyrkbar jord har hatt sin effekt på vannforsyningen i de kriserammede områdene. Det er dermed ikke så virkelighetsfernt at historien til David er

plassert knappe 20 år fram i tid. Leseren får ikke mulighet til å betrakte problemet på trygg avstand, men blir advart om at vannmangel også kan oppstå i vedkommendes levetid og del av verden. Slik er forfatteren like aktuell som det hun var med suksessdebuten *Bienes* historie (2015). I tillegg knytter hun omtanken for lokalmiljøet opp mot det globale. Ved å binde sammen historiene til Signe og David setter hun Norge i sammenheng med resten av kontinentet, og får fram at klimaendringer og menneskenes dårlige planlegging i utnyttelsen av naturressursene er et felles problem. De nordligste landene, som blant annet på grunn av sin geografiske plassering har blitt spart for naturkatastrofer av større skala, vil nå kjenne virkningene av krisen. *Blå* har tette bånd til dagens vannutfordringer, og det gjør det umulig å avfeie problematikken som overdramatisert fiksjon.



Det er lite håp å skimte i forfatterens nye roman. Og godt er det. Romanens overbevisende kraft ville druknet i eventuelle løfter om en lykkelig slutt. Til tross for dette kan det framstå som en svakhet at forfatteren ikke omtaler de videre ettervirkningene av krisen. Fortellingen om David finner bare sted i Frankrike. Hvordan takler vertslandene den massive tilstrømmingen av migranter? Hvordan blir man behandlet over grensen som en av flere millioner klimaflyktninger? Hvilke utfordringer oppstår knyttet til kultur og identitet? En slik parallell til flyktningedebattene vi kjenner igjen fra samtiden kunne bidratt ytterligere til å overføre romanens problematikk til virkeligheten.

Romanen gir seg ikke ut for å inneha løsningene på det globale vannproblemet. Den er først og fremst en underholdningsroman bygget på «hva-hvis»-spørsmålet. Det må likevel ikke undervurderes at den kan påvirke måten mediene omtaler klimaendringer på samt hvilke holdninger hver enkelt har overfor temaet. Det er mer sannsynlig at den gjennomsnittlige innbygger tar seg en tur innom bokhandelen og kjøper en bok av en populær forfatter enn at vedkommende leser en forskningsrapport som er rettet mot fagfolk. *Bienes* historie, som ble solgt til flere land, var utvilsomt med på å lede oppmerksomheten mot biene som forsvinner og hvilke konsekvenser det har for mennesket. I *Blå* spår Lunde en annen katastrofe, og med sin mangel på svar forlater teksten leseren med en betimelig følelse av uro.



En situasjon der deler av Sør-Europa blir ubeboelig som følge av ekstrem tørke er vanskelig å forestille seg. I det minste for europeere.



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Cultivating a Healing Biotope

Exploring a Parascientific Perspective
on Water and Consciousness

Imre van Kraalingen

Water is a major part of our lives and the world that we live in. This piece delves into parascientific ideas about the nature of water. It explores some of the alternative research and ideas about water, and the possibility of the consciousness carrying capacity that some studies argue it may hold. Thus, this article aims to introduce the readers into this fascinating possibility and reflect upon the impacts it would have.

Water is the driving force of Nature and essential to sustaining life on this planet. Water issues are far-ranging, from water quality and pollution, water-borne contaminants and hormonal toxicity, to droughts, floods, major water shortages and disenfranchisement. While these issues are widely known, little attention is paid to what the potential of Water is at its essence.

Without taking a deep ontological dive, some argue that everything is made up of information: with energy and matter as central components. Magnetic and electronic fields are made up of radiating energy, existing of an innumerable amount of possibilities of atomic compounds and distribution of electron configurations. With this reasoning, living beings can be seen as the most complex form of information in the universe.

Although research into water is just beginning, it is tricky to deal with research on the fringes of the science of water, intimately entangled with questions on Nature itself. Perhaps for some, the whole idea of water is seemingly an obvious matter. However, it is increasingly being contested through metaphysics and *parascience*.

One of the more recent discussions is on the response of water to energy, by means of consciousness and intention. To date, there have been different researchers looking into these ideas and theories. In Japan, Dr. Masaru Emoto, studies the molecular structure of water through high speed photography of water crystals.¹ He is interested in the influence of the vibrations of thoughts on the crystallization of water. Masaru researched the difference in the aesthetic rating of ice crystals of water particles that have been exposed to positive thoughts and sounds, compared to those exposed to negative ones. Furthermore, he compared the molecular structure of clear and clean spring water to polluted water sources. The results suggest that the polluted water crystals having

incomplete and asymmetric patterns, whereas the fresh spring water showed symmetric and complex structures. Moreover, Konstantin Korotkov, a Russian researcher, is looking into this area as well, focussing more specifically on the influence of human emotions on water during different sacred, healing and musical rituals.² These studies seem not merely New Age concepts, as there exists a longer history within homeopathy regarding memory carrying and healing capacities of water.³

Though it may seem unlikely, there are more practical examples of this idea of movement of information that are easier to comprehend. For example, when you knock on wood the previously discussed information moves as kinetic energy in wave-form that temporarily rearranges the matter as it travels; in some way, the energy of your knock becomes undefined information. The whole matter of travelling energy waves is contested per se.

Whether or not water has the potential to respond to consciousness or even has consciousness to some extent, it at least has been shown to respond to vibrations of energetic fields. While present research on water and energy is facing a fair amount of scientific criticism, it does open a new discourse when it comes to how we think about water. Now if you imagine, in accordance to the accepted notion that human bodies exist of about 70% - and human brains about 90% - of water, you can imagine the essential part water takes up in all human life on Earth. Following the logic, the consciousness carrying capacity of water could indicate a potential of thoughts to profoundly affect our own well-being and that of the planet. The embeddedness of water is infinite, and lays at the heart of life on Earth. Thus, it is worth considering not just the influence clean, pure and symmetric water has on us human beings, but also how we can influence our environment by adopting a positive mindset.

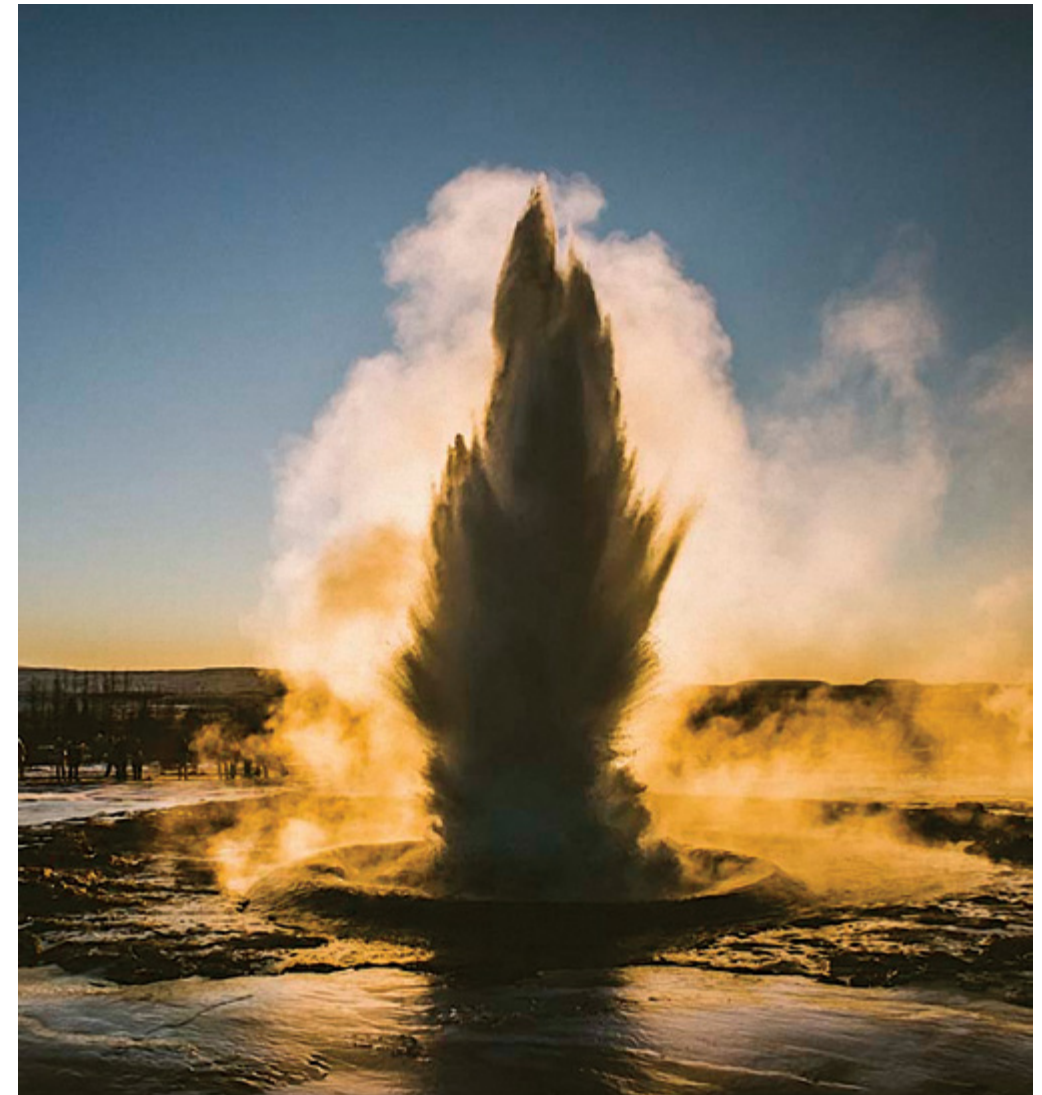


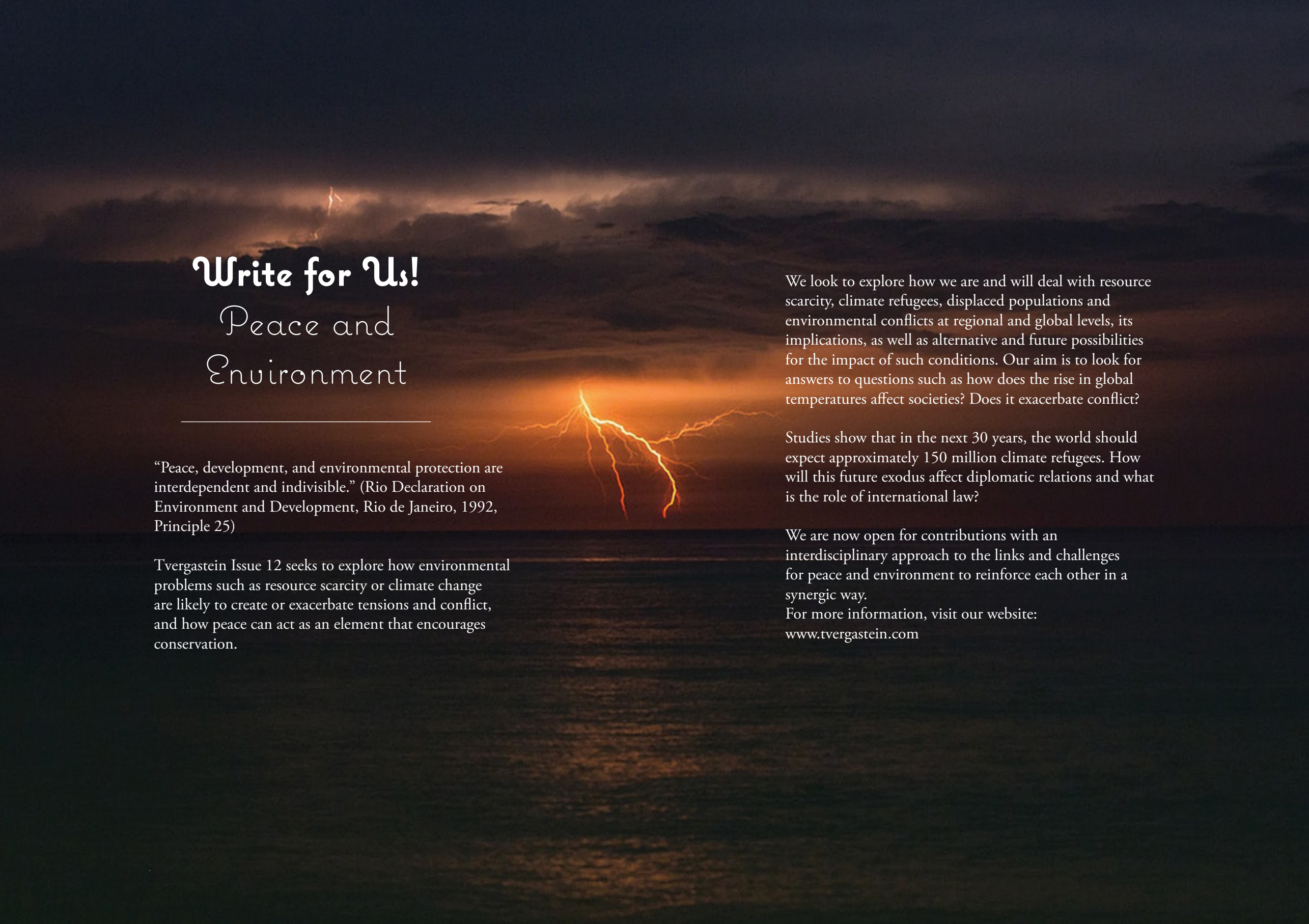
Photo: Matteo Redaelli

“The embeddedness of water is infinite, and lays at the heart of life on Earth.”



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Write for Us!

Peace and Environment

“Peace, development, and environmental protection are interdependent and indivisible.” (Rio Declaration on Environment and Development, Rio de Janeiro, 1992, Principle 25)

Tvergastein Issue 12 seeks to explore how environmental problems such as resource scarcity or climate change are likely to create or exacerbate tensions and conflict, and how peace can act as an element that encourages conservation.

We look to explore how we are and will deal with resource scarcity, climate refugees, displaced populations and environmental conflicts at regional and global levels, its implications, as well as alternative and future possibilities for the impact of such conditions. Our aim is to look for answers to questions such as how does the rise in global temperatures affect societies? Does it exacerbate conflict?

Studies show that in the next 30 years, the world should expect approximately 150 million climate refugees. How will this future exodus affect diplomatic relations and what is the role of international law?

We are now open for contributions with an interdisciplinary approach to the links and challenges for peace and environment to reinforce each other in a synergic way.

For more information, visit our website:
www.tvergastein.com

A Fish Out of Water

An interview with artist,
Kirsty Kross

Sarah Shrestha-Howlett

Sarah Shrestha-Howlett talks with artist, Kirsty Kross, about communicating environmental issues, dressing-up as a coral trout, and being a local scandal.



Tell us a bit about you, what you do and your connection with water.

I am an artist and I grew up in Australia, where I spent a lot of time at the beach and swimming. I feel very connected to water and am concerned about the ocean and waterways. I moved to Norway in 2015 and fell in love with Norwegian water. In Australia we often have water shortages, whereas in Norway this resource is abundant. It's interesting that Norway is very involved in the promotion of fossil fuels which contribute to climate change, yet Norwegians are unlikely to experience water shortages in the future. This is unlike poorer nations that contribute less to global warming, yet are more likely to be affected by climate change.

What was the initial inspiration behind your art?

I create performances about climate change and the attention economy where I am dressed as a coral trout- a neon orange and blue fish from the Great Barrier Reef. I make performative

stunts which aim to get attention, and the costume has "tit flaps" so I can expose my breasts and get more attention. I feel that play, improvisation and imperfection are key elements of my work. It is also often very funny, but nonetheless sharply critical. The message of the performances is ambiguous, as it is not clear whether I am promoting an environmental cause or myself as an artist- or maybe both at the same time. I feel that this reflects the current times- people care about the environment, but are also fiercely attached to maintaining/improving their affluent lifestyles. For example, I am very sad about the demise of the Great Barrier Reef and sea life worldwide, yet at the same time, I'm involved in promoting my work as an artist and living an international lifestyle where I travel at least once a year between Europe and Australia. The internet and social media is making this situation even more complicated as people are continually distracted- either by the constant flow of information or the need to make themselves noticed online.

"I feel that play, improvisation and imperfection are key elements of my work. It is also often very funny, but nonetheless sharply critical."



Right: Coral Trout.
Photo: Miguel Lopes



Tell us a bit about some of the projects you've been involved with (specifically the ones for which you've sent us pictures).

What were some of your highlights?

"Falling Down the Stairs in A#Major" was at Kunstneres Hus in March 2017. I fell down the giant marble staircase in the middle of Kunstneres Hus carrying an oversized golden sculpture, a golden palm tree and a very hot stage light to the score of Beethoven's 7th Symphony in A#Major. I did not hurt myself, but feel that I captured the sense of looming environmental disaster.

In 2016, I was awarded the Dusk till Dawn Art Prize by the PNEK and Vandaler Forening for a performance called "Blue Christmas", where I sat in a hot shower in my coral trout costume playing a very mournful experimental ballad on the recorder. It was on the night of the Winter Solstice, which in some Christian religions is known as Blue Christmas and it is a night to remember those who have died in the previous year. In addition, the Great Barrier Reef was declared dead that year.



Blue Christmas.
Photo: Zane Cerpina

In November 2017, I had a residency in a small fishing town called Berlevåg in Finnmark. The town is centred on the fishing industry and I took a series of photographs in the landscape around the town. I also created an intervention at the town's 1980's brass band performance, where I appeared during the band's rendition of "The Final Countdown". The performance was a local scandal and was written about in Finnmark's biggest newspaper, Finnmarken.

Rousing some attention in Berlevåg.
Photo: Thine Sanne Dalseg



In 2017, I worked on the project “Cocktails & Dreams” with Tenthaus in collaboration with a class of students from Hersleb VGS who had all arrived not so long ago as refugees to Norway. I wanted to focus on the youthful energy and possibilities that these refugee teens embody rather than presenting them as problematic victims.

The project dealt with how new immigrants perceive and relate to the Norwegian landscape and in doing so, we looked at the paintings of Knud Bull – a Norwegian painter who was sent to Tasmania as a convict in the mid-1800s. Bull was allowed to paint during his sentence and he painted a number of landscapes in Tasmania, which look a lot like the Norwegian landscape. This was a common occurrence in the first 100 years of European settlement in Australia—the Australian landscape was painted to look like the European homelands of the artists and in many ways these paintings are a visual representation of homesickness. From these examples, I explained that the students would be seeing Norway through the beauty ideals of their original cultures and possibly they could hybridise these notions with Norwegian ideals

to innovate and grow within a Norwegian context.

We did an experiment in Ekeberg Park in which the students made masks and posed in the forest. Months later I asked them to download an image from the internet of what they find beautiful. It was interesting to see how their masks and how they portrayed themselves in the photos was similar to the images they chose. The tough rapper guy chose a rap band as his image and the student from Somalia chose a Somalian landscape with plants similar to her headdress. These images show that the student’s identities are developing and growing into a Norwegian context. It is unknown how they will re-shape their identities just yet, but perhaps these images of what they find beautiful and how they like to be represented alludes to future possibilities. At the same time, the images could be seen as relating to the forest monsters of Norwegian folklore such as trolls which represent “the other”. Nevertheless, this experiment showed that the students’ hybridised identities and magical potentialities are emerging.



Grønske Landscape Experiment.
Photo: Leia Centioni

I also asked the students what they found beautiful about Norway and they agreed that it was the water. I found it highly interesting that the students all came from countries experiencing problems with water due to climate change and/or conflict. At the same time, water is becoming a precious resource worldwide as seen with exclusive, boutique water bars opening in drought ridden Los

Angeles. So, as a result, I created a water cocktail bar in which the aesthetic relates somewhat to my tropical Queensland origins, as it looks quite like a beach bar. During the exhibition, the students had a disco in the bar where they just drank water. They had a great time and really experienced being in an art gallery in a completely different and memorable way!



A Water Cocktail Bar.
Photo: Øystein Thorvaldsen

Water is taken for granted in Norway, yet it is so desired in other parts of the world. In many ways, water and the abundance of it in Norway could be seen as a metaphor of what Norway represents to many refugees- a rich place which enables people to grow and prosper. In the installation, I created a cocktail glass pyramid evocative of a Norwegian mountain with the bottom glasses being green and the summit being white. Only the top glass, the white glass, contained water for the guests to drink, which represented the global inequality of resource distribution. In the installation, I also used green as the dominant colour, symbolising the Islamic roots of many of the students, but also growth, hope and new beginnings as well as the search for greener pastures. Despite many reactionary fears surrounding refugees in Norway, there is undoubtedly immense potential and this is what I was hoping to present in “Cocktails & Dreams”.



Cocktails and Dreams.
Photo: Øystein Thorvaldsen

You’ve worked a lot with kids; do you find a difference between the way kids and adults engage with environmental issues? Or the way they interact with your artwork?

In terms of the environment, I guess kids are idealistic still, whilst adults think they are being realistic in wanting to have the best for their kids. Yet what many adults want for their kids might not be so environmentally sustainable. I think if people learn to do more with less we would be on a better track globally. I wish that richer nations could learn to live more simply. I think a simple life does make people happier and our global ecological situation would be a hell of a lot happier too.

What’s up next for Kirsty Kross?

I will be performing at Meta.Morf 2018, the 5th Trondheim Biennial for Art and Technology in early May. It will be a Coral Trout show in a cocktail lounge. Later in May I will be performing during the Sunday Mass at Sagene Kirke in Oslo in a show about the spiritual in art and my identity as an artist. I was raised very religious, but am now comfortably agnostic. This performance is a very unique and exciting challenge for me!

For more information on Kirsty Kross, check out her website: www.kirstykross.com

“I think if people learnt to do more with less we would be on a better track globally.”

Water Governance in Brazil River Basin Committees

Maria Luiza Machado Granziera,
Alcindo Gonçalves and
Danielle Mendes Thame Denny

In this article, Brazilian River Basin Committees are discussed as a legal innovation in water resources management. The committees are an interesting example of how water can be better managed at local and national levels.





Piracicaba River.
Photo: Authors' Own

The Committees and their Role

River Basin Committees¹ are an innovation in water resources management in Brazil. They involve broad participation, including voting rights for many stakeholders, such as Municipalities, civil society, water users, technical associations and universities, as well as the Federal and State Government who are the water domain holders², and those responsible for the protection and control of hydric resources. The formation of committees occurs in all areas where there is intense use of water's resources, so that the issues associated with this are defined in a negotiated way,

ensuring the sustainability of all decisions.

The committees act as collegiate bodies with advisory and deliberative functions. They are arguably the most important instance of participatory and integrated planning of water resources, and are a core actor in Brazilian water governance. Federal Law n° 9433/1997³ instituted the Brazilian Water Policy and the respective Management System, which allows the River Basin Committees to act in three areas: the whole river basin; a sub-basin of the main watercourse, such as a tributary river; or a group of contiguous river basins.

Despite the fact that river basin committees

are not a legal entity in Brazil, they are recognized as collegiate bodies of water resource management systems. They are linked to the federal and state government, and so are parts of Public Administration. As a result, their operation observes Administrative principles, formal procedures, administrative processes and their actions must stem from the law. Institutional acts (a kind of Brazilian ruling) should be provided for the committees in order to represent all interests in the river basin.

Therefore, the participation of several segments of society is a necessary condition for the formulation of a committee, and the Public Power is responsible for its formal institution (a decree of the President of the Republic), with the approval of the National Council of Water Resources. Although the Committee does not have the direct ability to implement water policies, the competent bodies and entities with this power also participate in the committees. The river basin committees are linked to the respective Water Resources Councils, which are administrative bodies of the same nature, but of a higher hierarchical level. Some water planning decisions taken by the committees need to be confirmed by the councils to have legal effect.

At the committee's meetings, all the stakeholders work with the legal attribution to deliberate water management in a communal manner, which increases the legitimacy of decisions⁴. Municipalities have an important role, as they are legally responsible for drinking water and sanitation services. Municipal policies can therefore impact the quality of water, especially in the urban stretches of rivers.

Norberto Bobbio states that "the goals that are sought to be achieved by the policies are those that, in each situation, are considered priorities for the group"⁵. The Brazilian water policy follows the idea of "service to society", allowing decisions in the scope of planning which not only emanate from the public

power that holds the water domain, but from all the sectors represented in the river basin committees.

The Brazilian Water Policy⁶, among other innovative principles, established that "the river basin is the territorial unit for the implementation of the national water policy and performance of the national water resources management system" (art. 1º, V) and that "the management of water resources must be decentralized and have the participation of the government, users and communities" (art. 1º, VI). These topics provide the necessary legal basis for the River Basin Committees.



River Basin Committee Illustration.⁷
Credit: Ana Unesco

Committee Competency

Brazilian Water Policy establishes that it is the Committee's responsibility to promote the discussion of issues related to water resources, including the arbitration of conflicts related to water resources in the first administrative instance. The Committees are also responsible for approving the Basin Water Resources

Plan. This assignment, as a guarantee of the effectiveness of the plan elaboration process, is directly related to the decision system adopted in each committee at the time of its formation. In other words, it is necessary that the Committee's decision-making system be established in such a way that the decisions emanating represent the predominant desire of its members.

The Plan outlines the treatment to be given to water resources with the following minimum content: i) diagnosis of the current state of water resources; ii) analysis of demographic growth alternatives, evolution of productive activities and changes in patterns of land occupation; iii) balance between availability and future demands of water resources, in quantity and quality, with identification of potential conflicts; iv) goals of rationalizing use, increasing the quantity, and improving the quality of available water resources; v) measures to be taken, programs to be developed, and projects to be implemented to meet the targets; vi) priorities for granting rights to use water resources; vii) guidelines and criteria for charging for the use of water resources; viii) proposals for the creation of areas subject to restrictions of use, regarding the protection of water resources.

In addition, the Committees establish which water services users should pay for and at what price. The plan should also set goals for rationalization of use, as well as quality and quantity of resources in the river basin.

Committee Representation

According to Brazilian Water Policy, the Committees are composed of representatives of the Union, the States, the Federal District, and the Municipalities located in their area of activity, as well as water users and civil entities with proven water resources in the basin.

The participation of the Municipalities in the river basin committees deserves special

mention, although they do not hold the domain of water resources. The Municipalities are the owners of basic sanitation services governed by Law 11.455/2007⁸, and it is in the urban environment that: i) there is more demand for the resource, either for the public supply or for the industry; ii) there are negative impacts of importance in the channeling of streams, clandestine subdivisions, invasions, release of urban solid waste and untreated sewage in the bodies of water; iii) climate change causes more relevant impacts to the population, for example the so-called harmful effects of water, such as floods, which annually cause serious losses, deaths, and water shortages.

The participation of municipalities in decisions on the use of water resources and other topics related to river basin planning is therefore fundamental. According to Estela Neves:

No further analysis is needed to identify the importance of local governments as protagonists in water management, which is under federal and state responsibility because the municipality is the only government entity capable of integrating water management, sanitation and land use management for the protection of waters. The municipality is responsible for sanitation, which includes in its definition, the management of domestic and urban solid waste, water supply, sewage disposal, urban cleaning, drainage and management of rainwater⁹.

It should also be noted that there is participation of bodies and entities that have competencies both in environmental matters and in the control of water resources. These entities are responsible for the exercise of police power, such as environmental licensing, grants of water use rights and authorizations for the suppression of vegetation, as well as the location of the legal reserve on rural properties,

and compliance with current standards. Thus, it is essential that concrete institutional relations be established between the participation of these entities in the committees and their performance as a State.

With regard to the users, the existence of the River Basin Committees changed an old relationship between the Public Power in the exercise of police power and the private sector. Before the committees, obtaining environmental licensing and being granted the right to use water was an interaction only with the Controlling Power. Now the applicants make commitments to the competent body, and also to those who develop activities in the same watershed and are interested in it and now are part of the committees as well.

It is also worth noting that in the Border and Cross-Border River Basin Committees, the representation of the Union should include representatives of the National Indian Foundation - FUNAI and their respective indigenous communities when the territories cover indigenous lands.

Governance and River Basin Committees


Governance as defined by the Commission on Global Governance (established by the United Nations in the early 1990s) is the sum of many ways individuals and institutions, public and private, manage their common affairs in a continuous process through which conflicting or diverse interests may be accommodated and co-operative action can be taken.

Governance is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that


people and institutions either have agreed to or perceive to be in their interest¹⁰.

Governance is not limited to institutional arrangements within an organization, or to internal mechanisms that produce more effective results in several respects, such as transparency, control and oversight. Although these aspects are relevant, governance goes beyond and comprises three essential points: governance is the means and processes capable of producing effective results; it is fundamental to expand participation between state, companies, non-governmental organizations, subnational entities, scientific community; their actions develop the search for consensus and persuasion and eventually effective actions, sometimes much more impactful than coercion or legal obligations are¹¹.

“...it is fundamental to expand participation between state, companies, non-governmental organizations, subnational entities, scientific community; their actions develop the search for consensus and persuasion and eventually effective actions, sometimes much more impactful than coercion or legal obligations are.”



“It is necessary to go further, and to ensure effective mechanisms for the functioning of the committees, in order to translate the will and aspirations of the different actors involved in the policies and management of water resources and materialize them into actions.”



In the case of river basin committees, there is no doubt that they are part of the Public Administration, being linked to the federal or state Public Power. The committee's operation must observe the principles of the formal procedure and the administrative legal process. However, in order for them to carry out their functions and actually manage water resources, it is essential that segments and actors of civil society form part of their composition. Such a characteristic reinforces the committee's strength and legitimacy, even if they do not have the power to exercise the water administrative policing power. The presence of subnational entities, as is the case with representatives of states and municipalities, further reinforces this characteristic.

The competence to promote the debate on issues related to water resources and to

articulate the actions of the intervening entities is therefore essential to establish governance mechanisms in the committees, especially with regard to the dialogue and persuasion of the parties, which should be practiced not only on the formal agenda of the meetings, but on a permanent basis involving different actors in their practices of everyday life. The committees thus have a clear political function, which goes beyond administrative dimensions, arbitrating conflicts, approving the Resource Plan of the respective basin, and monitoring their execution, so that their goals are met.

Brazilian Water Policy establishes the composition of committees, indicating that they should include representatives of the Federal, States, municipalities' government (located in all or part of their area of activity), as well as water users and civil society acting in the area. CNRH Resolution nº 05/2000¹² established the proportion of this representation: 40% for users, 40% considering federal, state and municipal governments, and 20% for organized civil society. Broad participation is therefore assured, but it alone does not guarantee effective governance.

It is necessary to go further, and to ensure effective mechanisms for the functioning of the committees, in order to translate the will and aspirations of the different actors involved in the policies and management of water resources and materialize them into actions. It is therefore worth mentioning the fact that governance is concerned "not only with decisions, but also with its consequences, that is, allocation effects, programs and projects, effectiveness, acceptance and implementation¹³".

Governance is not a mere theoretical exercise, or practice without results. Rather, it is aimed at conflict resolution and policy implementation. In the case of river basin committees, it is a concrete way of bringing together different actors who are all involved in

the issue. The expanded participation translates into decisions emanating from the organs, which are, in fact, implemented, complied with, and monitored.

Conclusion

River Basin Committees are an innovation in the governance of public goods, because it is not only the legal holders of water, in Brazil namely the - Union, the States and the Federal District that can participate in the process of planning, but many stakeholders. This broader participation inspires joint responsibility which is established when public authorities, including municipalities, participate in the same negotiation table with technical associations, non-governmental organizations and universities, as well as the users of water resources - industrial, electricity generators, water and sewage services, fishermen, irrigators etc.

However, the effectiveness of committees depends on representativeness and institutional articulation. There is only legitimacy in the decisions if representatives of all interested segments actively participate at the committee meetings. A relevant factor is that good faith is a basic condition in the negotiations, under the custody of the agents responsible for the exercise of police power, whose mission is to avoid damage to water resources (in terms of quantity and quality).

The practice of negotiation and the participation of various sectors of society in terms of public policies (on the river basin) are a novelty in the Brazilian legal system. This rich experience, as it is consolidating, can be used with due adaptations in other countries and to other matters whose decisions require the legitimacy of various actors.



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The Seychelles and Their Blue Economy Approach

A story about using innovative ocean financing to transition into a more sustainable management of small-scale fisheries

Lars H. Kjøllesdal

Fishing connects people to the sea by providing food, sport and enjoyment. We humans, however, have not always been good stewards of this valuable renewable resource. By moving our attention to the Seychelles, their story will illustrate that investing in the ocean makes sound financial, social and environmental sense.

Small-scale fisheries around the world make essential contributions to their local economy in terms of employment, nutrients and trade, with over 41 million people worldwide working in the fishing industry. For many developing countries, especially small islands and coastal developing states, they rely on fisheries as the primary source of income and protein. Unfortunately, due to poor management and unsustainable practices we are currently at risk of jeopardising many local fisheries.¹ To give some context to the severity of the issue, an analysis made by United Nations Food and Agriculture Organisation (FAO) suggests that approximately 90% of global fish stocks are overfished, fully fished, depleted or slowly recovering.² Or in other words, if we continue to overfish at this alarming rate, fisheries will eventually collapse, which in turn, will knock fish off the dining plates for millions of people around the globe.

To overcome this challenge, the Republic of Seychelles issued the world's first 'Blue Bond' in late 2017, which in simple terms means that they tap into the capital markets to raise the required finance to fund ocean-related environmental projects. Similar to other small and isolated developing states that heavily rely on the ocean's resources, global issues such as overfishing, rising sea temperatures, and habitat loss pose a serious risk for the future of the ocean's resources.³ Hence, by using innovative ocean financing, the Seychelles is therefore taking a necessary leap to ensure their fisheries and livelihoods are available for tomorrow's generation.

A financial package for the Seychelles of roughly US\$20 million, which is earmarked to fund the Seychelles' marine conservation strategy, was approved by the World Bank in Washington D.C. in September 2017 and consisted of grants, loans and credit.⁴ Because fisheries account for 20 % of the country's GDP and employ 17 % of the workforce⁵, the

Blue Bond – or rather a long-term financing of their blue economy strategy - will thus be paramount for the sovereign state in the Indian Ocean to strengthen the value chain and management of their fisheries. Not only will this be a highly sought after measure to rebuild their fish stocks and push to create a healthier environment, but over time it will also generate increased revenue for the government due to better and more sustainable management of their many small-scale fisheries.⁶

Nurturing our fish stocks and investing in the ocean is critical to prevent further deterioration of our fish stocks, and it will as a result increase productivity, profitability and help to better understand other unsustainable practices.⁷ Although this type of creative financing may only be applicable to other small island and coastal development states, the Seychelles' Blue Bond is a prime example of good stewardship that will send a signal effect to the rest of the world, suggesting that it is indeed possible to make money – and do good.



Notes

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“Nurturing our fish stocks and investing in the ocean is critical to prevent further deterioration of our fish stocks, and it will as a result increase productivity, profitability and help to better understand other unsustainable practices.”⁷





To secure rich and clean oceans, people are our greatest resource

Text by Leonie Goodwin, cCHANGE, and Gro I. van der Meeren, Institute of Marine Research. Information design and narrative facilitation by InfoDesignLab.

In September 2016, around thirty eminent Norwegian researchers and leaders in marine resource management met in Bergen, Norway, to discuss how to improve collaborations to make rapid progress on ocean and marine resource management goals in the coming decade.

The participants came from leading marine research institutions and businesses around Norway and Europe, from various Norwegian ministries and government bodies, the Food and Agricultural Organisation, and the Intergovernmental Oceanographic Commission, as well as Future Earth's Ocean Knowledge-Action Network.

Many aspects of marine resource management were discussed, but the group kept coming back to the importance of building high-quality collaborations — the potential opportunities and current barriers.

What follows, are some of the highlights from those discussions.

It's commonly agreed that the ocean has fantastic potential to benefit society. Norway manages some of the world's largest marine living resources and is the world's second largest exporter of fish and fish products. It has big ambitions for the future with the government's Havsstrategi: Ny vekst, stolt historie¹ and Blue Growth for a Green Future² strategy, as well as political commitments at the global level, including participation in UN Sustainable Development Goal 14 relating to the ocean, the Food and Agriculture Organization, and the Intergovernmental Oceanographic Commission at UNESCO. At the same time, our oceans face very significant threats: climate change impacts, ecosystem change, pollution, and ocean acidification, just to name a few. Norway's Northern and Arctic ecosystems are particularly vulnerable and are experiencing the impacts of rapid climate change faster than anywhere on the planet.

So how can we balance our ambitions and the threats, and move successfully from vision to reality at the scale and speed needed?

Marine research can play a bigger role in finding solutions

Better integrating marine-related research from all domains—the natural sciences, as well as the social sciences including economics, and the humanities—into marine sector collaborations offers huge untapped potential.

Achieving rich, clean oceans is much more than a series of problems that can be addressed through technical solutions and top-down directives. It is an adaptive challenge. Adaptive challenges can be messy, unclear and difficult to deal with. They are closely linked to beliefs, habits, and values, as well as power and politics, and the solutions to these types of challenges lie in harnessing collective and collaborative power.³

Many **social and marine researchers** are eager to collaborate more in finding solutions—either **with other researchers** or

with people from the public and private sector, as well as **community groups**. There are many inspiring examples where it's happening already. But we need many more.

More well-functioning, cross-sectoral collaborations would benefit many aspects of marine resource management in Norway, for example:

- by improving our knowledge of the value and role of coastal ecosystems;
- by improving integrated ecosystem assessments;
- by building stronger long-term scenario and visualisation capabilities so that we can better describe and model the development and future state of marine life and values;
- and by helping us to deal more effectively with economic, social, and environmental trade-offs and uncertainties.

Such collaborations would ensure our efforts are targeted and effective.

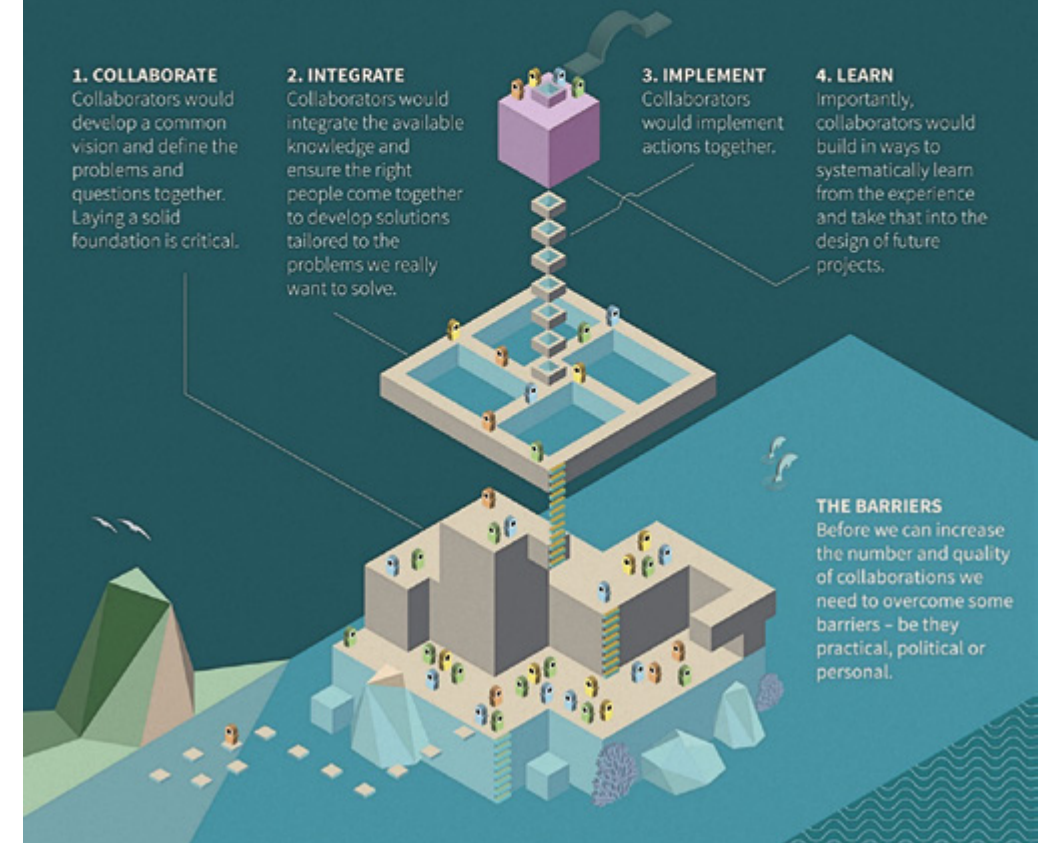
Collaborators **would develop a common vision** and define the problems and relevant questions together.

They would **integrate the available knowledge** and ensure the right people come together to develop insights and solutions that are tailored to the problems and questions we really want to solve.

They would **implement actions together** and build in ways to **systematically learn** from the experience and take that into the design of the next project.

TO SECURE RICH AND CLEAN OCEANS, PEOPLE ARE OUR GREATEST RESOURCE

Integrating research from all domains offers huge untapped potential to secure rich and clean oceans. Many social and marine researchers 🧑🏫 are eager to collaborate more in finding solutions—either with other researchers 🧑🏫 or with people from the public 🧑🏠 and private 🏢 sector, as well as community groups. 🧑🏫 Here is a blueprint for building more successful and responsive collaborations.



A blueprint for building more successful and responsive collaborations to secure clean and rich oceans. Integrating research from all domains offers huge untapped potential to secure rich and clean oceans, but there are a number of barriers currently holding us back.

Design: InfoDesignLab

The untapped potential of social science and humanities research

Social science including economics, and humanities research could be utilised by the sector to a far greater extent. Such research offers insights into communities and individuals—into their decision-making processes, values, behaviour and motivations. Among other things, these insights can be used to give guidance on ways to deal with uncertainty in models and projections, on how to communicate challenging findings, on improving collaborations and their essential processes, and on how institutions can innovate and evolve to adapt to the rapidly changing environments and societal needs they are likely to face in the coming decades.

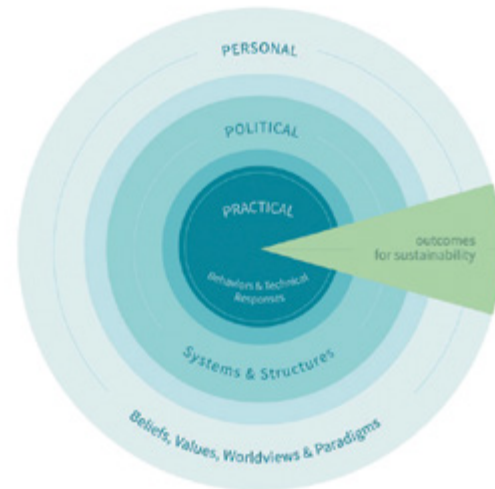
When we talk about managing marine ecosystems, we are really talking about managing the way humans interact with marine ecosystems. When we don't include the human dimension, or only include part of this, we lose the potential to capitalize on sustainable solutions. Bringing in more qualitative research would be an effective way to bring in the human dimension.

In addition, the human dimension can also be brought in through quantitative research delivered by the social sciences, particularly economic methods. When natural science is combined with quantitative economic science and social science, broader, richer, and more holistic research and models emerge.

Engaging heads, hearts, and hands in rapid transformations

Research into sustainability transformations reveals a lot about how rapid, large-scale changes occur and why engaging everyone's heads, hearts and hands is so important. The Three Spheres of Transformation⁴ is a framework developed by University of Oslo Professor and member of Future Earth's first Science Committee, Karen O'Brien. It provides a way to think about the enablers and barriers to change.

Transformations to sustainability can occur in three interacting domains—the practical, political and personal spheres.



The Three Spheres of Transformation
Image: Karen O'Brien and Linda Sygna, 2013; based on Monica Sharma, 2009.

The **practical** sphere often receives the most attention. This is where progress towards goals can be observed and measured. Transformations in this sphere often involve promoting innovation, improving management, enhancing knowledge and expertise, and changing people's behaviour. These are largely “technical responses”—challenging, but not impossible. Practical transformations can directly contribute to outcomes for sustainability; however, such transformations can often be held back by larger systems and structures that define the conditions for change.

The **political** sphere includes the social systems and structures that create the conditions for transformations in the practical sphere. In this sphere, both problems and solutions are identified, defined, and delimited, and conflicts of interest must be resolved. Transformations in this sphere are strongly influenced by how the system is perceived by the different actors.

The **personal** sphere includes the individual and shared beliefs, values, worldviews and paradigms that influence attitudes and actions. These shape individual and collective “views” of the system. Transformations in this sphere can be powerful because they often lead to new perspectives and narratives which can influence the framing of issues, the questions that are asked or not asked, and the solutions prioritized in the political and practical spheres. Changes in this sphere often result in people “seeing” systems and structures in new ways. But... transformations in this sphere cannot be forced.

Potential intervention points for transformation can be found within each of the spheres, but **it is the interactions across the spheres where the greatest potential for generating non-linear transformation lies.**

This means we need transformations that work from both the “outside-in” and the “inside-out”. From organisations and systems, through to individuals’ hearts and minds... and back again.

What's holding us back?

Although many researchers are keen to collaborate more effectively with each other and across the sector, the meeting participants identified a number of **barriers** currently holding us back.

Differences in culture and language both within academia and across the sectors could be one of the most significant barriers to successful cross-sectoral collaborations. The language and working styles of the different sectors vary greatly. Time and effort are required to successfully bridge these differences, to find a common language and develop trust.

We could recognise these inherent qualities more openly and systematically address them. Social scientists could help in this respect by observing us working and by helping us to rigorously reflect upon our collaborations and work consciously towards improving them.

Richer collaborations could benefit **the way we currently value marine resources**. Players from across the sector could work together to establish baseline values for all ecosystem services, particularly for the regulating, cultural and provisioning services where we currently lack information—and then determine how these are linked to community welfare.



Ecosystem services: Examples of provisioning, regulating, cultural and supporting services

Using and refining a common approach together, such as the ecosystem services framework, may help sector players collaborate more effectively and build a common language. It would also enable a common understanding of the different types of values—economic and non-monetary—to be included in future projections and scenarios.

At the *political level*, **a lack of connection and alignment** in marine resource management policies across government departments and between the local and national levels is hampering effective collaboration.

Meeting participants discussed how the interface between policy and science will need to be more flexible in the coming decades and allow for faster change and improvement. When science and policy come together over decisions where the stakes are high, the advice timescales are urgent, and the science involved is highly uncertain, this will require a different, more flexible, iterative and reflexive approach to collaboration than we have today.

Social scientists with insight in such areas could help here and support national and local government bodies and research institutions to adapt, prepare, innovate, and connect with each other more effectively.

There is a lot of working in parallel across the marine resource management sector today. To build successful, long-term collaborations which provide the solutions-oriented insights we need, there must be more continuity – **more established platforms for focused cross-sectoral collaboration.**

In addition, **limited financial resources** to engage researchers from different disciplines in projects in meaningful ways can also be a barrier to building good long-term collaborations and capability in the next generation.

Establishing a Centre(s) of Excellence to do integrated work on complex marine

resource management issues could provide a solid platform to coordinate cross-sectoral collaboration and help build skills, knowledge, and relationships for the long-term. It would also offer a place where early-career researchers could build their skill sets and contribute to ensuring Norway continues to benefit fully from its rich marine resources.

At the *personal level*, working more collaboratively with different types of researchers requires time, effort and bravery. Sometimes **people are resistant to collaborating in diverse groups with people they don't know**, but we usually get a boost to our problem-solving ability when we do. Systematically building individuals' capacity to communicate and connect more across the sectors through opportunities, support and training is another important, yet often overlooked, step to building successful and effective, long-term collaborations.

Charting a new course for the future

Just over two years ago, the global research initiative Future Earth brought together more than 20 research projects from three distinct global change research programs. The funders and architects of Future Earth recognised the complexity of addressing our sustainability challenges and that sustainability science needed to work in a more solutions-oriented, integrated, and connected way with society.

They also recognised the human dimension needed to be more integrated and so they ensured insights from the humanities and social sciences, including economics, finance, consumption, decision-making theory, and transformations theory, were given much more presence, as well as different types of knowledge, such as local, indigenous, and private sector knowledge.

Nine Knowledge-Action Networks, including one addressing oceans and another addressing transformations, were formed to

encourage engagement across society around these issues.

Over the last few years, thousands of researchers in the global Future Earth community have been reflecting on the way we have been doing sustainability research and working to connect, engage and change – striving to deliver knowledge that results in solutions and change. This is a huge task, that will require changes in quality at all levels – at the systemic and organisational – as well as at the individual level. **But as a first step, if we intentionally engage more in open dialogue and experimentation in our cross-sectoral collaborations and build in ways to reflect, learn and grow from our successes and failures, we will go a long way to transforming both the way we work, and the results.**



Notes

Ocean sustainability under global change: Top priorities for Norwegian research and prospects for collaboration, 1–2 September 2016, Bergen. Download the meeting report at: http://www.imr.no/filarkiv/2016/12/imber_future_earth_norway_workshop_report_-_final_1_dec.pdf/nb-no

This meeting was hosted by:

IMBeR (Integrated Marine Biosphere Research): An international project under the Future Earth umbrella, promotes international integrated marine research through a range of research topics, projects and initiatives. IMBeR's science plan⁵ aims to truly integrate the social and natural sciences. IMBeR is hosted by the Institute of Marine Research in Bergen, Norway.

Future Earth Norway: The Norwegian secretariat of Future Earth.

Institute of Marine Research, Norway

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“if we intentionally engage more in open dialogue and experimentation in our cross-sectoral collaborations and build in ways to reflect, learn and grow from our successes and failures, we will go a long way to transforming both the way we work, and the results.”



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A Visit to the Aquarium Catches More than Fish

Maureen Trainor

Protection of oceans and the world's other water ecosystems requires knowledge and understanding. Aquariums help to mediate this form of understanding to the public. This article reflects upon the author's experience of taking a part in this role, while discussing the significance of aquariums and their impact.

“Roll on, deep and dark blue ocean, roll. Ten thousand fleets sweep over thee in vain. Man marks the earth with ruin, but his control stops with the shore”.¹

Lord Byron appreciated the power and majesty of the ocean, knew of man's ability to destroy the land, but was confident that the ocean was more than man. As time has passed, we have grown to learn that what we do on the land has serious implications for the sea as well. This can be due to overuse of fossil fuels and the resultant increase of carbon dioxide (CO₂) in the ocean, overreliance on plastics that culminate in garbage patches and floating death traps for sea animals, or simply the combination of actions that lead to climate change and habitat loss. To keep the ocean healthy and capable of supporting the vast forms of life that inhabit it, we of the land need to change. How we grow to understand and accept this requires education.

While schools are the typical avenue for education, other approaches also exist. Institutions such as zoos and aquariums have the power to entertain, educate, enthrall, and inspire. From live animal presentations, to interactive programs and games with guests, to formal and more casual talks, zoo and aquarium staff members can provide visitors with insights into the world around them. Engaging individuals in a realistic evaluation of their potential to address the global problem of climate change and the deterioration of the ocean is challenging, especially when people arrive with many different expectations as to what their admission ticket just bought.

Working as a volunteer at the New England Aquarium, one approach we use is by playing games that highlight the roles and responsibilities of the individual and community in our changing ocean. Through these activities visitors gain insight into the causes of the earth's temperature rise and the

consequent implications of the changes in ocean temperature and acidity on the animals that live there.

One game involves visitors by letting them examine their carbon footprint: from what they eat, to how they travel, to where they live. Another game explores sources of CO₂, or processes that produce CO₂, and compares them to CO₂ sinks, or places where CO₂ is absorbed. Since the ocean is the largest carbon sink on the planet,² it is particularly relevant to the visitors at an aquarium. Still another game deals with how the warming temperature affects the sex of sea turtles; the sex of the hatchlings varies on how warm or cool the buried eggs are³. These and other games that focus on ocean related issues provide information about particular activities, but also circle back to the role of the individual and society. The aim is to help visitors identify paths to reduction of CO₂ production.

The ocean and the animals who live there are generally very important to the visitors at an aquarium and it is in assuming their roles as “stewards of the ocean” where visitors can quickly connect with the need for change. Understanding the importance of leadership is sometimes a bigger step, but fortunately children are often ready and excited to know that something can be done. For instance, while talking with a group of young girls about the moon jellies displayed in an acrylic tube, I commented that sea turtles enjoy eating them. I also explained that, unfortunately, sea turtles often swallow plastic bags floating as waste in the ocean by mistake because they look like jellies⁴. The girls understood that beyond just recycling and reusing, the actual amount of plastic used needs to be reduced, to help our ocean and spare sea life. They saw it was important and would be important for the future of their world. As they moved on to another part of the aquarium, they marched off declaring in a firm voice, “To the Future!”

“The ocean and the animals who live there are generally very important to the visitors at an aquarium and it is in assuming their roles as “stewards of the ocean” where visitors can quickly connect with the need for change.”



The Living Coral Exhibit at the New England Aquarium with one very popular resident
Photo: Maureen Trainor



Myrtle, The Green Sea Turtle who resides in the New England Aquarium Giant Ocean Tank
Photo: Maureen Trainor

It is through talking with people and educating them about the ocean that we all grow to understand our role, as individuals and as community members, in the ocean's health. Aquariums are one avenue capable of doing this due to their direct link with the ocean and the aquarium visitors. However, it will be through our collective efforts that we will be able to make the modifications in society necessary. It will be then, that once more, our future will have a deep, dark blue, and healthy ocean that will simply roll on.



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“It is through talking with people and educating them about the ocean that we all grow to understand our role, as individuals and as community members, in the ocean’s health.”

The Big Blue

Pia Ve Dahlen

Pia from Passion for Ocean writes about the wonders of the ocean and how their organisation's aims to develop sustainable relationships to the ocean through knowledge and experience.

"How inappropriate to call this planet Earth when it is quite clearly Ocean."

-Arthur C. Clarke

Did you know that we have glow-in-the-dark sharks (*Etmopterus spinax*) here in Norway? Or marine snails that do photosynthesis (*Elysia viridis*)? Norway's coastline is, with its 101.000 kilometres¹, actually the world's second longest, and home to thousands upon thousands of weird and wondrous species. Eighty percent of Norway's residents² live connected to the ocean, we exported seafood for almost 100 billion NOK last year,³ and we rule over 6 times as much aquatic space as land. The ocean's presence in our lives is tremendous, but we rarely seem to think about it.

The ocean covers about 70 % of the Earth's surface, and gives rise to the nickname "the blue planet." Though merely talking in 2D is severely understating just how much water there is on this planet. Did you know that the average height on land is 840m? The average depth in the ocean, on the other hand, is around 4000 metres. That makes up an enormous three dimensional space. Not only does the ocean cover most of our surface, it actually makes up some 99 % of all the living habitat on this planet.

Let that sink in for a bit.

It's where life first started, and probably where the last remnants of life will be holding on when Earth finally draws its last breath

Sea Spider



somewhere in the distant future. And with its vast outstretch, it's actually also the lung of our planet, producing somewhere between 60 - 80 % of the oxygen we breathe. This is the work of the photosynthesis going on in the kelp forests and the microscopic algae goofing about in the surface. So if you enjoy the concept of being alive, you should definitely start every day thanking the ocean for providing you with the most essential component of that activity.



Galethea Strigosa

Along the shores of Norway you find some of the most underestimated and underexploited resources on the planet. We live in one of the richest areas in the world, enjoying the nutritious upwelling from the deep water currents and the pleasant temperatures brought up by the Gulf stream. It lays the foundation for millions of tonnes of a copepod called *Calanus*; a tiny crustacean functioning as one of the most important key species in our waters. It's being eaten by basically everyone in the sea, and is sort of the wheat of the ocean.

The shallowest and most protected areas are usually home to smaller seaweeds and vast beds of eelgrass (*Zostera marina*) where scientists have found a staggering 290.000⁴ (!) organisms in a single square metre. In the sublittoral zone (right below the low tide mark and down to ~25m) we have kelp forests covering most of our coastline, functioning as

"Not only does the ocean cover most of our surface, it actually makes up some 99 % of all the living habitat on this planet."



a food resource and nursery for a huge number of different species. This is where cod, snails and crustaceans, among others, find mates and shelter, and it greatly reduces the speed of the water passing through, reducing erosion on the nearby land. We have rocky, sandy, grainy and muddy waters, and last but not least; coral reefs. The reefs are found almost anywhere within the fjords, and Norway is actually home to the world's biggest cold water coral reef; a gigantic chunk of biodiversity located outside of Røst in Lofoten, stretching over 35 km long, with a width of about 3 kilometres⁵.

All these habitats are high on biodiversity, and host some of the weirdest creatures you can imagine. We have the Flabellina-genus; a string of flimsy looking snails that eat anemones and hydrozoans, and use their nematocysts (stinging cells) for its own protection. We have the common spider crab (Macropodia rostrata) with its daddy longlegs-look, waving its appendages around to imitate seaweed. We have the bioluminescent jellyfish Periphylla, taking over the fjords and putting on a lightshow during the long winter nights. We have discoball Ctenophores and starshaped

Bryozoans, skeleton shrimp, flesh eating sponges and transparent worms. We have seals, whales and dolphins, and every year, the world biggest cod population returns from the Barents sea to spawn in the fjords.

So not to brag, but the ocean is kind of a big deal.

Motivation through knowledge and playfulness

In Passion for Ocean, our belief is that you protect what you love, and that knowledge and positive experiences lay a strong foundation for the motivation to want to take care of something. We don't believe the will to change comes from doomsday preaching or guilt tripping, but rather from an understanding of and love for the systems at stake.

Throughout the year, we organize trips, pop ups, events and other activities, all of them focusing on fun, playfulness and the awesomeness of the sea. We try to combine activities and education, like sneaking knowledge about sea urchins and shore crabs into beach cleanings, or learn about how we can use self picked seaweed and mussels in everyday food while freediving. In this way, we give people both the knowledge and that emotional bond to the ocean that we feel is needed to have a long term motivation for change and sustainability.

Alongside countless other organizations, each doing their part on their particular field, we work towards a more sustainable future. And we do it by having fun.

THE OCEAN HAS ALWAYS TAKEN CARE OF US, LET'S RETURN THE FAVOR



If you want to learn more, check out www.passionforocean.no

“Our belief is that you protect what you love”



Flabellina

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The Sea Surrounded by Land

Moving forward from *Mare Mortum*
to *Mare Nostrum* again

Guillem Rubio

The Mediterranean region faces today an unprecedented humanitarian crisis. Thousands of asylum seekers and economic refugees from the Levant and North Africa risk their lives every year with the hope of achieving a liveable and dignified life in Europe. The contemporary connection between different countries of the Mediterranean region, nevertheless, has existed for millennia and is responsible for the rich cultural and biological diversity of many of its countries. In this article, a critique to both the cultural history of this region and to its role in the present-day refugee crisis is developed.



In 1958, Hannah Arendt published in exile *The Human Condition*. In its second chapter *The Public and the Private Realm*, she wrote that “To live together in the world means essentially that a world of things is between those who have it in common, as a table is located between those who sit around it.”¹ The table Arendt wrote about works as a metaphor for our common world. Although this common world shares some attributes with our physical planet, it is essentially human: a realm of handmade artefacts and urgent affairs. Arendt further describes that in our contemporary mass society, the difficulty relies on the fact that the people gathered around this table, see it vanish in front of their eyes, “so that two persons sitting opposite each other were no longer separated, but also would be entirely unrelated to each other by anything tangible.”²

The Mediterranean Sea could be understood as the table that has historically

both gathered and separated the peoples living on its shores: southern Europe, Northern Africa and the Levant. These regions, though perhaps perceived as heterogeneous regions, almost unrelated to one another, have traditionally shared this common table to discuss, trade and live together. It is not a coincidence that ‘Mediterranean’ comes from the Latin words: *medius* (middle) and *terra* (land), literally meaning “the sea in the middle of the earth.”³ Therefore, this sea is not only home for a rich variety of marine ecosystems and biodiversity, but also the political space that has enabled the communication and the disagreement among the peoples that surround it: *Mare Nostrum* made possible both the introduction and expansion of the Hindu-Arabic numerals, which we still use in algebra and in our groceries, and the Punic Wars, one of the largest and most bloody wars that had ever taken place at the time.

Nowadays, as Hannah Arendt described five hundred years ago, that table – understood as a common political space – seems to be slowly disappearing, leaving these neighbouring regions with nothing that separates them. At the same time, they are seemingly unrelated to each other. On top of that, the Mediterranean marine biotope is both one of the most biodiverse and endangered ecosystems of the planet⁴ and it will probably experience dramatic changes attributed to the undergoing anthropogenic climate disruption⁵. Thus, we can see how this quasi mythical sea, witness of both the fall of Troy and the rise for democracy and freedom in North Africa and the Middle East, is slowly disappearing as a political common place and being environmentally degraded by global warming, overfishing⁶ and air pollution.⁷

In addition to the environmental degradation denounced by various organizations such as Greenpeace,⁸ the political distinction and cultural separation between regions of the Mediterranean shores has recently expanded. As a matter of fact, the relationship between the countries that had traditionally shared a common place to trade, travel and live together, has become a fact almost relegated to dusty history books. Both the extreme toughening of the maritime frontiers of the European Union with the Frontex programme⁹ and the EU-Turkey refugee deal from 2016 are paradigmatic examples of the North-South division that the Mediterranean region has experienced during the last decades. For instance, while the flow of people between Spain and North Africa had historically been an insurance for the preservation of Iberian cultural diversity, now we see how this flow of people is being criminalised and politically framed as criminal and illegal¹⁰. Furthermore, the fact that Turkey

“The Mediterranean Sea could be understood as the table that has historically both gathered and separated the peoples living on its shores: southern Europe, Northern Africa and the Levant”



(Left)
Nautical chart of the Mediterranean Sea, 1600 A.D.
Photo: Luís Teixeira

keeps receiving thousands of asylum seekers, travelling to Greece and coming from all around the Mediterranean regions such as the Levant or North Africa, in exchange of political privileges and financial aid, becomes an obscure confirmation of the political vanishing of the once diverse and vibrant Mediterranean common political space.

In the same direction of this political disappearance and environmental degradation, what was once considered our sea, the Mare Nostrum, has slowly been transformed into the sea of death, the Mare Mortum; more than

30,000 people since 2002¹¹ have drowned in the Mediterranean Sea when trying to reach its European shores. In the light of this, a new political horizon, a new table, should be cooperatively built. The philosopher Marina Garcés writes in *New Radical Enlightenment*: “the more emblematic heroes of our contemporary times are those people saving lives in the Mediterranean (...) they express the most radical action in our times: ‘Saving life’, even if this life has no other meaning than reaffirming itself.”¹² The emergence of organizations, such as the Union for the

Mediterranean, which for the last decade have been trying to enhance the regional dialogue and cooperation between the Mediterranean countries, or organizations such as Proactiva Open Arms, a Catalan NGO devoted to search and rescue refugees at sea, could become a turning point for Mediterranean nations to gather around a paradoxically old and new table to discuss the crises that drift rudderless across this recently fenced sea. Briefly said, this table should have the potential to enable them to talk about saving life, and –most importantly– bring back the future for this life in all its forms.



“In the same direction of this political disappearance and environmental degradation, what was once considered our sea, the Mare Nostrum, has slowly been transformed into the sea of death, the Mare Mortum”



“Let’s open the borders” in Catalan. Europe’s biggest demonstration to call for the reception of refugees in Barcelona (2017).
Photo: Ajuntament de Barcelona

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TVERGASTEIN bears the name of Arne Næss' cabin retreat in the mountains of Hallingskarvet. It was there that Næss, an activist and one of the most wide ranging philosophers of the last century, wrote the majority of his work. These writings, his unique ecophilosophy, and his life of activism continue to inspire environmentalists and scholars in Norway and abroad. In making this journal its namesake, we aim to similarly join academia with advocacy for the environment. We aspire to the "enormous open views at Tvergastein" and the perspective Næss found there.