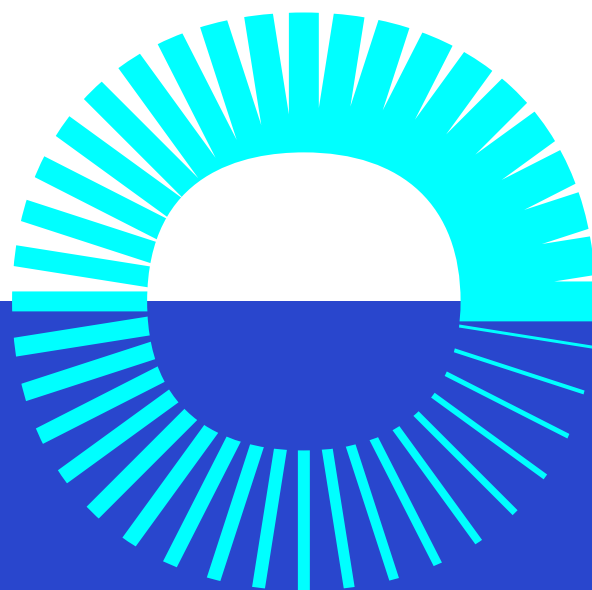


Ocean Completeness

beyond resilience

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CREDITS

The word “completeness” was first mentioned by **Chema Herrera** in 2020 and ultimately led to the term “ocean completeness” in a joint working session with **Linda Neugebauer**. The concept was given its final form two years later in discussions with **Carlos M. Duarte**.

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“It is that range of biodiversity that we must care for – the whole thing – rather than just one or two stars.”

Sir David Attenborough

Ocean Completeness beyond resilience

**Linda Neugebauer,
Carlos M. Duarte,
Chema Herrera**

SUMMARY: The current focus on resilience alone is not enough as a goal for ocean biodiversity, because the foundation of an intact ocean is biodiversity. And it is precisely this biodiversity that does not necessarily need to be present in a resilient ecosystem. The new goal must therefore be much more ambitious. It must focus on restoring the functional completeness of the ocean, which is the outcome of this diversity. Every part, whether living or non-living, whether small or large, is necessary for the maintenance of the whole. It is the richness of the ocean that ultimately guarantees ecological stability. To achieve ocean completeness, three generations must work hand in hand with determination and vigor.

RESILIENCE ALONE IS NOT ENOUGH

Resilience is on everyone's lips. Everything should become resilient, including our ocean. But what does this actually mean? Put simply, resilience is the ability of a system to return to the state it had prior to a disturbance. It also takes into account the time it takes to return to a stable state of equilibrium. The search for resilience makes one thing clear: we will face such severe disturbances in the future, and we will continue to intervene massively in the marine ecosystem, that we need for this ecosystem to be "resilient."

However, the concept of resilience does not go far enough unless its reference state is that of a fully functioning ecosystem. Even Crawford Stanley Holling, who developed the concept of ecological resilience,¹ warned early on that ecological resilience is not necessarily a trait of healthy ecosystems. For example, he pointed out that a eutrophic lake may be resilient but have very little biodiversity. Ultimately, this means that resilient ecosystems are not necessarily the desirable state for ecosystems. Moreover, the concept of resilience must include the reference state to which the ecosystem should return, and that can only be a healthy and functionally complete marine ecosystem. The assumption is that the disturbance is the massive depletion of the ocean caused by a combination of hunting, overfishing, pollution, habitat destruction, and climate change, and that the task of restoring resilience is to rebuild marine life.²

THE NEW GOAL: OCEAN COMPLETENESS

We humans have always admired and celebrated the diversity of life. Edward O. Wilson said that we should preserve every little bit of biodiversity as a priceless value,³ while learning to understand its importance to the whole. So every bit of biodiversity in the ocean is invaluable.

1. Crawford Stanley Holling, "Resilience and Stability in Ecological Systems," *Ann Rev Ecol Sys* 4(1973): 1–23

2. C.M. Duarte, S. Agusti, E. Barbier, G.L. Britten, J.C. Castilla, J.P. Gattuso, R.W. Fulweiler, T.P. Hughes, N. Knowlton, C.E. Lovelock, H.K. Lotze, M. Predragovic, E. Poloczanska, C. Roberts and B. Worm, "Rebuilding Marine Life," *Nature* 580(2020): 39–51.

3. Edward O. Wilson, *The Diversity of Life*, New York and London: W.W. Norton, 1992.

A key tenet of ecology is the role of biodiversity in supporting healthy ecosystems through a web of interactions that support essential ecological processes and provide redundancy to counteract the pressures that arise. So, each part of the marine system is necessary to support all other parts. Biodiversity is therefore key not only to ecological richness, but also to ecological stability. But that's not all. We need to go one step further. The most important result is the realization that there is unity in diversity. Alexander von Humboldt conceptualized this many years ago.⁴ All of its parts are important and necessary for maintaining the functioning of the ocean as a whole. We call this "completeness," referring to the fully functional ecosystems that emanate from unity in ecological diversity. This functional completeness is what must be restored.

We strongly oppose the idea that the solution lies solely in conserving what little is left, or in maintaining the status quo of an ocean in a depleted state by creating resilience in the current configuration of marine ecosystems. The goal must be "ocean completeness," the restoration of all the living components that together form the basis of an intact marine ecosystem. And because we still know so little about the ocean, it is all the more important to protect what we do not yet know about its existence and importance. Nothing else makes sense.

But how, then, can this new goal of ocean completeness be defined? Well, a complete ocean can be defined as one that has all the necessary life processes to be fully functional and provide essential ecosystem services on which society depends. It supports efficient flows of carbon and nutrients through its food webs, sequesters carbon, protects coastlines, ensures safe material cycles, sustains populations, and is resilient to change and impacts. A depleted ocean, like today's, is in many ways incomplete and empty: dead zones are expanding, ecosystems are being lost, and the life that remains is more vulnerable to future changes, whether man-made or natural.

Ocean completeness is about increasing the abundance of key habitats and species and restoring the three-dimensional complexity of benthic ecosystems. "Success should be measured by the restoration of marine ecological structure, function, resilience and ecosystem services to enhance the ability of marine communities to meet the growing needs of 2–3 billion people by 2050. To achieve this goal, restoration of depleted populations and ecosystems must replace the goal of maintaining and preserving the status quo."⁵

OCEAN COMPLETENESS TAKES THREE HUMAN GENERATIONS

The restoration of the ocean to a healthy state will require the combined efforts of three generations of people living at the same time.

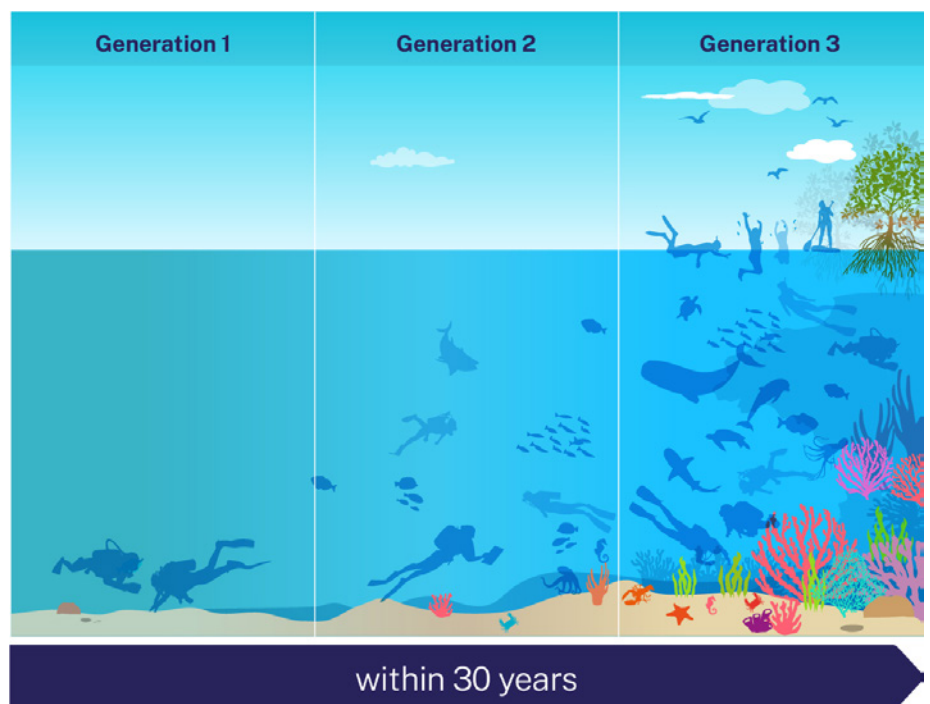
The first generation of this joint reconstruction are the grandparents of today. They are the ones who still have the image of a complete ocean in their minds, whether it be in terms of their scientific knowledge or simply in their childhood memories. This generation also knows best the pressures that have led to the impoverished state of the oceans today. The so-called "elders" also belong to this generation. These indigenous tribal elders have an extraordinary knowledge of the ocean with a long history and tradition. The Polynesians, for example, were the first people to sail the oceans as the farthest traveling of their navigators. They were able to navigate guided by the stars and the migratory paths of humpback whales. The knowledge of these tribal elders, and the older generation as a

4. Alexander von Humboldt, *Kosmos*, [1845–1862 (6 vols.)]. Reprinted in 2014 as *Kosmos*, Berlin: Die Andere Bibliothek.
5. Duarte et al., "Rebuilding marine life."

whole, is the foundation for the completeness of the oceans, which is defined as our new goal. Because their baseline is the image of an intact ocean that this generation still saw when they were young. For today’s adults and children, that baseline has already shifted, and that is a serious problem. Why is this? Because younger generations accept the increasing degradation of the marine ecosystem as “normal” because they never experienced a complete, marine ecosystem like their grandparents did. This shift in baseline could have profound implications for our planet, because only by using the grandparents’ baseline as a benchmark for functional ocean completeness will we be able to restore our oceans. The first and oldest generation is therefore the foundational generation on which the recovery of the ocean must be built, together and hand in hand with the two generations that succeed it.

Adults today face the dual existential planetary crises of climate change and biodiversity loss. They are the link between the other two generations. And since they are in the middle of their working lives, their efforts today will secure the knowledge and work of the older generation, while accompanying the children for a much longer time. The third and youngest generation are the beacons of hope: we are all working together to make its members the first sustainable generation. Our love for them is the driving force behind us, that inspires us to work tirelessly for their better future. But such a better life is only possible on the basis of a biodiverse and functionally complete ocean – the ocean experienced by the older generation.

Three human generations working to rebuild the ocean for a sustainable world



CONCLUSION

Functional ocean completeness is the new goal that goes beyond resilience to restore all living components that together form the basis of an intact marine ecosystem. But for the ocean ecosystem to return to this healthy, complete state, we must first curtail the pressures that have caused these disturbances and losses. Most of these pressures are being reduced and some have already been reduced significantly, but we must continue to stop negative impacts and turn them into positive ones. Of all the pressures, climate change is emerging as the most important obstacle to rebuilding marine life. Take coral reefs, for example, which are on the brink of collapse due to rising water temperatures. Without coral reefs, the ocean would no longer be complete. Therefore, all efforts are likely to fail without urgent action on climate change. Reducing the causes of loss is therefore a sine qua non for ocean completeness.



*“In the ocean, nothing can exist
on its own.”*

Foto: Francesco Ungaro. Unsplash.com



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Rebuilding marine life is still possible

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