



OPINION PIECE

Combining love and knowledge to heal the ocean

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ABSTRACT: Despite decades of management and conservation efforts, we have seen only limited success in rebuilding marine life and restoring ocean ecosystems from human-inflicted damage on a global scale. I suggest that we need to harness both our emotional (love) and rational (knowledge) sides to create a more powerful movement to heal the ocean and rebuild its abundance and diversity. Love and compassion fuel our desire and urge for change and provide a compass that can guide our actions. Science and knowledge provide ways for collecting and interpreting data and information that can enhance our understanding and support our decisions and actions. Combining our emotional and rational sides can inspire our thinking and transform our actions in new, creative ways. In order to affect wide-ranging and long-lasting change, love and knowledge need to work together to transform our collective relationship with the ocean.

KEY WORDS: Emotions · Rationality · Ocean degradation · Marine life · Biodiversity · Conservation · Recovery · Rebuilding

1. PREFACE

'In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught.'
[Baba Dioum, Senegalese conservationist; Dioum 1968 as cited in Valenti & Taviana 2005]

For centuries, people around the world have inflicted environmental damage on the ocean without much consideration of the wide-ranging impacts on marine species and habitats, ecosystem structure and functioning, and the goods and services they provide for human well-being (Jackson et al. 2001, Lotze et al. 2006, Worm et al. 2006, McCauley et al. 2015). Many conservationists themselves have been engaged in the hunting and fishing of wild animals, as — for most of history — this was considered the norm, and most people could not imagine that our individual actions

would add up to global consequences for the survival of species (Dulvy et al. 2003, Bearzi 2009, Harnik et al. 2012). In the face of increasing resource depletion, a range of local or regional management efforts have been introduced over time, aimed at halting or reversing observed declines (Lotze et al. 2014). Also, a growing appreciation of the natural world and desire for its protection has spurred a conservation movement on land over the past century and in the sea over past decades (Kittinger et al. 2015). Overall, however, only some negative trends have been successfully reversed while others continue to decline (Worm et al. 2009, Lotze et al. 2011, Aburto-Oropeza et al. 2011, Duarte et al. 2020).

In the face of the current environmental crisis (Ripple et al. 2017, IPBES 2019, IPCC 2019, this Theme Section <https://www.int-res.com/journals/esepp/theme-sections/wow/>), a pressing question, therefore, is why the increased appreciation towards marine life

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has so far only resulted in few conservation results that matter at a global level. Based on current knowledge, we could, in principle, scale existing conservation and management efforts to rebuild large parts of marine life over the next 30 yr (Duarte et al. 2020). We generally know what to do and how it works and, although concerted global action would require a large-scale investment, the return on that investment would be extraordinary (Duarte et al. 2020). In light of these circumstances, the general question remains whether we are willing to move this ahead—or are we missing something to make a globalized ocean conservation plan a reality?

In the following, I suggest that we need to combine our knowledge of the ocean with our love for the marine realm to create a more powerful movement to help heal the ocean on a global scale. Too often we split the rational and emotional sides in our individual lives as well as in society (Verweij et al. 2015, Mull 2019, Pavco-Giaccia et al. 2019). In terms of marine conservation, this split is often framed as science and management being rational, compared to private individuals and environmental activism as being largely emotional. However, we are all citizens (MacLennan 2015). All of us experience love and compassion, and it can guide us towards why we care for each other and the blue planet we call home (Nelson & Vucetich 2009). Our rational side helps us to understand how best to apply our knowledge and abilities and where to invest our limited resources. A good example where these sides came together and created long-lasting change in the ocean was the moratorium on all commercial whaling by the International Whaling Commission (IWC) in 1986 (<https://iwc.int/commercial>). Leading up to this decision was a long history of overexploitation, decades of concerns by scientists and politicians of different nations, and a public 'save the whales' movement that gained momentum after the release of Roger Payne's recordings of 'Songs of the Humpback Whale' (Payne 1970). There are not many such global success stories in the environmental realm (Duarte et al. 2020). However, the global response to the SARS-CoV-2 (Gorbalenya et al. 2020) pandemic and human health crisis could give us some hope and direction for how quickly, efficiently, and powerfully our individual and global responses can be if we combine our concern for our fellow (human) beings with scientific knowledge about the disease and how it spreads. Could a similar combined force help heal the ocean? Can we stay connected to both our love and knowledge to affect long-lasting and wide-ranging change for the global benefit of the blue planet?

2. LOVE

Almost all marine biologists—and many other people—start out as kids loving the ocean. They may be captivated encountering an individual ocean creature, whether a jellyfish, a sea star, or a whale, or they may be drawn to a charismatic group of animals such as dolphins, sharks, or sea turtles. They may be thrilled by the feeling of jumping into the water at the beach or be amazed when snorkeling on a coral reef. They may hear music in the sound of the waves and winds at the ocean's edge or be in awe with the vastness of the sea beyond the horizon. They may be curious about all the discoveries that have been made in the oceans around the world or wonder about the unknowns still hidden in its depths.

For many of us, there is a very deep-rooted and inspiring love of the ocean that lasts a lifetime. It may be built into the ancestral genetic, emotional, and spiritual makeup that connects us to where we came from as land mammals: our ocean origin and salty home (Carson 1951, Lotze & Worm 2008). It may be linked to our cells and bodies that are largely made of saltwater (Earle 1995, Safina 1998), or it may be rooted in our psychological being that connects us to a much larger, incomprehensible universe (Helmreich 2010). It may be instilled in us through personal experiences in or near the ocean (see above), or through environmental education with ocean-themed stories, songs, images, or other means of learning that spark our love and wonder (Guest et al. 2015, Otto & Pensini 2017, Ganzevoort & van den Born 2019).

Whatever we fall in love with and how, it stays with us. Our love for the marine realm fuels the desire to know more, to learn more, to understand more about the marine realm. And so, many of us start to study it. This love or passion per se does not change anything, but it has a lot of drive, energy, desire and urge for change. Whenever my graduate or undergraduate students get lost on their way, I try to re-connect them to their underlying love and passion for the ocean and marine life, which often brought them into university in the first place. And I have observed that when they re-connect to their love for the ocean, their eyes light up, the burden on their shoulders lifts a bit, and their drive comes back—they re-discover why they are doing this and why they care. Thus, I have come to believe that love and passion is a critical ally and an essential power needed if we want to heal the ocean on a global scale.

3. KNOWLEDGE

Learning about ocean life enables us to appreciate its uniqueness, its richness and diversity, with many forms of life only existing in the marine realm (Lotze & Worm 2008, Knowlton 2010). We also learn about the abundance and productivity of marine life that supports ocean ecosystems around the world and the societies that depend on it (Blanchard et al. 2017, Boyce et al. 2020). We learn about complex interactions within and across food webs, connecting all creatures from plankton to whales and humans (Lotze & Milewski 2004, Christensen et al. 2015). And we learn about the ocean's interconnectedness with the atmosphere and the land through global biogeochemical cycles that together sustain life on planet Earth (Bopp et al. 2013, Lotze et al. 2019). All that we learn adds to our individual and collective body of knowledge and understanding of how the blue planet functions and sustains us, and it can serve as a source of wonder, spark our curiosity, and raise more questions. Hence, we keep learning and studying, as there is still so much that remains to be discovered. Yet all this accumulated knowledge by itself does not change anything unless we use it in meaningful ways (Bearzi 2020).

In addition to all the facts about marine life, we may also learn about the many threats to the ocean, including natural or man-made impacts such as over-fishing and seafloor destruction, oil and gas extraction and deep-sea mining, the manifold forms of pollution, and climate change, among others (Halpern et al. 2008, 2015, McCauley et al. 2015, Worm et al. 2017, Lotze et al. 2019). We learn how cumulative human activities have endangered and continue to threaten many marine species, communities, habitats, and entire ocean ecosystems (Lotze et al. 2006, Harnik et al. 2012, Halpern et al. 2015). And we learn how human impacts alter the functioning of the ocean and global ecosystem thereby threatening our well-being and livelihoods (Worm et al. 2006, Blanchard et al. 2017, Bratman et al. 2019, Boyce et al. 2020). As a result, many ocean lovers are saddened or shocked and develop a growing sense of urgency and desire to help.

As emerging scientists, however, we are quickly drawn into an institutional culture that requires us to become more rational and objective, only working with the mind, sticking to facts and numbers, following the scientific method, and only conveying logical arguments (Simis et al. 2016, Bearzi 2020). Many scientists also feel they should not engage in advocacy for conservation or welfare but rather just pro-

vide their scientific information to decision makers (Nelson & Vucetich 2009, Wright 2015). Consequently, we often risk losing or suppressing our emotional drive, our wonder and curiosity, or our sense urgency and despair. This certainly was a struggle for me, particularly during the earlier stages of my scientific career, when so much of our professional recognition and success depends on how our work is perceived by our peers. I vividly recall when—after being trained and working in experimental community ecology for a decade—I entered the field of marine historical ecology, which rarely relies on statistical significance tests due to the nature of historical data and information. Many times, I asked myself whether I was still doing science—or just story-telling? To my surprise, however, my historical research became successful; in part, I believe, because it brought together multiple scientific disciplines and sources of historical records, including images, maps, and stories that are often dismissed as non-objective or anecdotal sources of information (e.g. Lotze & Milewski 2004, Lotze et al. 2006, Lotze & Worm 2009, Lotze & McClenachan 2014). In most of the ocean sciences, however, we aim to use rational scientific data, hypothesis testing, and statistical significance levels in our research and training. We design our research projects based on existing knowledge and priority areas of funding, and largely communicate our ever-increasing knowledge based on data and facts, where it often remains abstract and theoretical (Dudo & Besley 2016). All of this is highly valuable, of course, and has an important role to play in informing science-based advice and decision-making. Yet it is often deprived of the passion and power that can fuel a broader movement of societal change.

4. COMBINING LOVE AND KNOWLEDGE

Combining love and knowledge requires an open and balanced connection between the emotional side of being an 'ocean lover' and the rational side of being an 'ocean scientist':

- As an 'ocean lover', I can feel that every entangled whale is an unbearable yet preventable tragedy. Every sea turtle swallowing a plastic bag represents senseless suffering. Every seabird starving with a stomach full of garbage is a cause of pain. Every fish suffocating in fishing gear is fuelling compassion. Every lobster held with tied-up claws or cooked alive hurts. Every smothered seagrass meadow and trawled kelp forest is an irreplaceable loss of an underwater home and habitat. Every mined seamount or deep-sea

plain represents the destruction of an invaluable ecosystem. These environmental tragedies happen daily and in all corners of the world, and the ensuing loss of marine biodiversity and global ocean health is unfathomable. Our compassion towards this suffering can inspire us to help, take action, and be a positive force for change (Park et al. 2020), but it can also overwhelm us, make us numb or fall into despair, unable to decide what to do or where to start. As individuals, it can be difficult to imagine that we can make a difference, or how to scale up individual and local actions to affect global change and conservation successes. Yet in my work on marine recoveries (e.g. Lotze et al. 2011, Lotze 2015), I have witnessed again and again that it is individuals—whether activists, conservationists, or leaders—who make the difference, who have the drive, urge, and courage to take a step in a different direction and then inspire larger movements for positive change. This is also what Margaret Mead said in her famous quote: ‘Never doubt that a small group of thoughtful, committed citizens can change the world: indeed, it’s the only thing that ever has’ (Keys 1982, but also see <https://quoteinvestigator.com/2017/11/12/change-world/>).

- As ‘ocean scientists’ we can move beyond the individual tragedies and gain a broader perspective. We can use data to track how many whales, turtles, birds, and fish die like this over time, and figure out if it is getting better or worse (Lotze & Worm 2009, McCauley et al. 2015). We can track how different human impacts have changed through history and in different parts of the ocean (Halpern et al. 2008, 2015). We can figure out what people in different parts of the world have done about this, which actions have helped, and which have not (Worm et al. 2009, Lotze et al. 2011, Aburto-Oropeza et al. 2011). We can trace the history and map the current landscape of depletion and recovery (Lotze et al. 2006, Harnik et al. 2012, Duarte et al. 2020). All this information is invaluable in guiding management and conservation efforts (e.g. Agardy et al. 2003, Pikitch et al. 2004, Lotze et al. 2011). We can also project what will happen into the future under different management strategies, climate change and human development scenarios (Costello et al. 2016, Lotze et al. 2019), guiding future planning and policy (e.g. IPBES 2019, IPCC 2019). In many cases, however, our science remains in the abstract world of academia and the objective provision of scientific advice (Wright 2015). This has a very important role to play, for example, in informing fisheries management, biodiversity conservation, marine protected area networks, and climate-change mitigation (Pikitch et al. 2004, Lub-

chenco & Grorud-Culvert 2015, IPBES 2019, IPCC 2019). Yet it usually does not inspire a rapid and broad-ranging movement of change.

Both ocean love and ocean science have unique merits, strengths and weaknesses, and an important role to play. Combining the power of science and love, however, can inspire our thinking and transform our actions in new, more creative, and more powerful ways. We see this in many young people, whether environmental activists or aspiring marine researchers, who are acquiring more knowledge and understanding yet still retain the compassion and drive to change the world. Often, they may be dismissed as idealistic or naive, but perhaps that is exactly what is needed. On a global scale, the emotional and rational sides came together during the lead-up and eventual ban of commercial whaling, where concerns about the risk of extinction, evidence of low population numbers, and the love of whales and their songs urged, inspired, and pushed nations forward to sign on to the IWC moratorium (<https://iwc.int/commercial>; Payne 1970, Lotze et al. 2011, Duarte et al. 2020). Although decades in the making, this process was eventually successful. In the case of climate change, scientific evidence has also accumulated over decades, yet so far, as a global society we have not curbed global emissions (IPBES 2019, IPCC 2019) despite an also growing emotional engagement by the wider public that may push some leaders towards further commitments (e.g. <https://fridaysforfuture.org/>). In contrast, with human lives at immediate risk, leaders at all government levels were required to make wide-ranging and immediate decisions in response to the SARS-CoV-2 pandemic, despite high levels of uncertainty and limited information. The scale of the response was unprecedented, although in this case the long-term consequences on human health, livelihoods, and national and global economies are unclear.

To create and sustain a similarly sweeping force for ocean recovery requires us to connect to both our emotional and rational sides and foster their exchange and interaction. We can do this individually or by working together across professions, disciplines, ages, cultures, genders, and society at large. While being connected to the rational side is well accepted and widely practiced, staying connected to and incorporating the emotional side requires a new openness towards our love, compassion, and care in our individual and societal decision-making processes. For example, we can combine art with science to create new ways of viewing, framing, and communicating marine conservation and manage-

ment issues (Brennan 2018). We can also find new ways of generating and sharing knowledge to integrate scientific and non-scientific information and enable emotional engagement, such as through citizen or community science (Charles et al. 2020), use of traditional ecological knowledge (Tsuji & Ho 2002), anecdotal information (Paxton 2009, Lotze & McClellan 2014), interviews (Guest et al. 2015), or the development of visions for nature (Lundquist et al. 2017). Overall, we could foster a more holistic version of ourselves and our society, where our emotional and rational sides are more fully connected and working together (Verweij et al. 2015, Mull 2019, Pavco-Giaccia et al. 2019). Bringing together our emotional and rational sides, each of us and our global human community could love the ocean more, understand it better, conserve it more, and begin to heal the damage we have caused (Lundquist et al. 2017).

There are some positive examples, where such a 'staying connected and working together' approach has created conservation successes. For example, in Monterey Bay, California, the marine ecosystem was heavily degraded, many marine species (e.g. sea otters, sea lions, halibut, and whales) depleted, and the human community devastated after decades of overexploitation and the collapse of the sardine fishing and processing industry in the 1970s (Palumbi 2010). Yet guided by the vision of a diverse group of people, from ordinary residents to an eccentric mayor, the marine ecosystem came back to life and with it, the human community around it (Palumbi 2010). Today, it has a well-established marine protected area, a thriving marine research station, sustainable fishing operations, nature tourism and whale watching enterprises, and a world-class aquarium that inspires millions of visitors each year (see below). To me, visiting Monterey Bay again and again has been a beacon of hope that—if we allow our passions and knowledge come and work together—we can restore and rebuild entire ocean ecosystems (Duarte et al. 2020).

The Monterey Bay Aquarium (<https://www.montereybayaquarium.org/>) is a great example of how we can inspire and communicate this combination of love and knowledge to others, particularly in its special exhibits that aim at educating people through different lenses, such as arts and culture. For example, in the exhibition 'Sharks: Myth and Mystery' (www.museumspot.com/exhibits/sharks.htm), information on the ecology of sharks has been intertwined with their roles in human cultures around the world, such as in religions, creation myths, rituals, medicine, arts, and popular culture. In the exhibition

'Jellies: Living Art' (Connor & Deans 2002), the aquarium used a museum-like display of live jellyfish together with pieces of art, including poetry, painting, photography, dance videos, glass art, and music to inspire our senses and educate visitors on the shapes, motions, colors, and biology of jellyfish. These ways of bringing together the rational (information, knowledge) and emotional (culture, arts) sides have been very powerful in informing and inspiring visitors, including myself, on ocean conservation issues. Such approaches do not necessarily need a wealth of resources, and there are many ways to help people to combine these sides, whether through experiential learning on the ocean's shores (Guest et al. 2015), engaging with marine life through dance (Gabriele 2017), creating art for conservation (<https://www.oceanartistsociety.org/>), enabling citizen-scientist discoveries of biodiversity (Ganzevoort & van den Born 2019), or nature-based environmental education (Otto & Pensini 2017), to give just a few examples.

In the process of increased awareness, knowledge, and emotional engagement in marine environmental issues and the need for recovery and rebuilding, local residents, activists, scientists, philanthropists, and leaders around the world have pushed to establish a growing network of marine protected areas, often driven by a combination of love and knowledge (Lubchenco & Grorud-Culvert 2015, Lotze et al. 2018, Duarte et al. 2020). More broadly, many individuals, resource users, conservationists, scientists, managers, and decision makers have pushed for the increasing protection and recovery of a growing number of marine species, such as whales, sea turtles, birds, and fish, as well as marine habitats and ocean ecosystems in general (Lotze et al. 2011, Lotze 2015, Duarte et al. 2020).

None of the abovementioned approaches will be sufficient for healing the ocean alone, but each can play its part and contribute to a larger movement that can increase the footprint of conservation successes around the world. Combining love and knowledge can help to touch more human hearts, affect human behaviour on a larger scale, and create societal change from the bottom-up (this Theme Section <https://www.int-res.com/journals/esept/themesections/wow/>). It can help marine scientists to re-define their research priorities to answer questions and derive strategies most urgently needed. It can help marine managers and conservationists to deploy the most effective strategies to restore depleted populations and degraded ecosystems, repair the damage being done, and achieve a broadly sustainable use of marine resources. It can help decision makers to better

articulate goals, commit to effective strategies, and work together on national and international scales to preserve the blue planet that we all depend on for our well-being and survival. Together, combining love and knowledge at all levels of society, from the bottom-up to the top-down, can be the beginning of a roadmap for the change needed to heal the ocean.

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