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A VISION FOR OCEAN HEALTH IN CALIFORNIA

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ABSTRACT

The ongoing degradation of the world's oceans demands swift, effective response and action. Scientists and policymakers in California have begun a process for visioning "ocean health" to inform and prioritize ocean protection strategies. Drawing from these efforts, as well as from literature reviews and an Earth Law Center-sponsored convening of scientists in September 2015, this report suggests that a healthy ocean is one that exhibits "normal form and function"; that is, it demonstrates sufficient organization, vigor and resilience to allow marine ecosystems and species to exist, thrive and evolve as natural systems within the context of their expected natural life spans. The report further provides recommendations with regard to monitoring, tracking and implementing this (or a similar) vision of ocean health, and offers law and policy observations and proposals that will help advance this goal. By implementing these and related strategies, we may begin to finally reverse the accelerating trend of marine system decline.

EXECUTIVE SUMMARY

Despite the existence of numerous laws that assert a goal of ocean health, our coastal and marine ecosystems face ongoing degradation. This occurs in part because our laws have failed to define a healthy ocean or commit to measureable objectives for achieving it. Such a definition has been the topic of increasing discussion among California marine policymakers and scientists, including at a September 2015 workshop organized by Earth Law Center.

This report proposes a vision of a healthy ocean as one that exhibits "normal form and function"; that is, demonstrates sufficient organization, vigor and resilience to allow

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ecosystems and species to exist, thrive and evolve as natural systems within the context of their expected natural life spans. “Normal” need not necessarily be “pristine” to allow for natural functioning. Conversely, “normal” refers to a higher level of functioning than merely the “absence of disease or infirmity,” which unfortunately appears to be the goal of many marine protection laws today.

Additional findings and conclusions include the following:

- Ocean health must be considered and achieved from the context of the ocean’s own, intrinsic well-being, rather than primarily from the context of the ocean’s utility to humans.
- A definition of ocean health is ultimately a policy decision, but it must be based in the best science in order to effectively guide policy that protects and conserves the ocean.
- Scientific research is needed to advance progress toward realizing healthy ocean and coastal ecosystems, particularly with regard to: assessing and tracking system vigor and resilience, tracking impacts and interactions over time, monitoring changes in the rate of change of ecosystem processes, and filling data gaps using local pilot projects.
- Monitoring and reporting (*e.g.*, in the form of a report card) are necessary to track progress toward ocean health and to adjust its definition – associated targets, indicators and thresholds – as needed.
- Modern science describes the ocean environment as a complex web of relationships with significant temporal and spatial variability. By contrast, management agencies and laws isolate elements of the ocean systems and minimize the significance of relationships and variability. A shared, holistic vision of ocean health will help integrate agency operations toward “ecological policymaking,” to better reflect the complexity of marine systems.

With a new vision of ocean health, grounded in a re-examination of societal values, we can develop and adopt appropriately protective ocean laws and policies. Approaches include:

- adopting and implementing the precautionary principle and reversing the burden of proof, so that potential ocean users must first show no harm;
- enhancing the application of the Public Trust Doctrine to fully advance ocean and coastal health;
- strengthening the role of the Ocean Protection Council to integrate agency actions, ensure agency consideration of the ocean in decisionmaking processes, and recommend changes in state law needed to achieve a healthy ocean; and
- formally recognizing the fundamental rights of nature to exist, thrive and evolve, and in particular the inherent rights of ocean systems to be healthy for their own sake.

Only by recognizing our interconnectedness with nature, and shifting to holistic insight and action, can we ensure our environmental laws adequately protect the Earth’s natural systems and address the growing challenges facing our society and ocean.

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HUMAN ACTIONS ARE INCREASINGLY STRESSING MARINE ECOSYSTEMS AND SPECIES

Though regulatory and restoration programs have improved ocean conditions in some areas, an increasing number of scientific reports are "document[ing] degraded ocean values."[2] For example, the International Programme on the State of the Ocean (IPSO), in partnership with the International Union for Conservation of Nature (IUCN), brought together a select group of world science leaders on ocean stresses and impacts in 2011. They concluded that:

- we have underestimated the overall risks
- the whole of marine degradation is greater than the sum of its parts
- degradation is now happening at a faster rate than predicted
- the speeds of many negative changes to the ocean are near to or are tracking the worst-case scenarios from IPCC and other predictions
- ecosystem collapse is occurring as a result of both current and emerging stressors
- we now face losing marine species and entire marine ecosystems, such as coral reefs, within a single generation.[3]

Climate change is posing especially serious threats.[4] Humans have caused a 30 percent increase in ocean acidification since the Industrial Revolution, and seawater acidity will increase an additional 150 percent by the end of the century under business-as-usual scenarios.[5] More acidic environments will dramatically affect species such as oysters, clams, sea urchins, corals and others, indeed threatening the entire food web.[6]

As shown by Halpern *et al*., 40 percent of the global oceans are "heavily impacted," "most areas of the oceans are impacted by multiple drivers . . . and less than 4 percent of the oceans remain relatively unimpacted, mostly in polar regions." Not unsurprisingly, the "highest cumulative impacts occur in heavily populated areas." Further, this analysis "may yet be conservative" as it did not include such stressors as "coastal hypoxia, marine debris, and illegal or unreported fishing," and also did not include synergistic effects.[7]

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[2] Pub. Res. Code § 35505(b).

[3] A.D. Rogers & D.d'A Laffoley, "International Earth System Expert Workshop on Ocean Stresses and Impacts, Summary report," pp. 6-7 (IPSO Oxford 2011), at: https://cmsdata.iucn.org/downloads/ipso_workshop_report_june_2011.pdf (IPSO Report).

[4] *See, e.g.*, Damian Carrington and Michael Slezak, "February breaks global temperature records by 'shocking' amount," *The Guardian* (March 14, 2016), at: http://bit.ly/1Llv4Fx (scientists call new global warming increase "completely unprecedented" and a "climate emergency")

[5] Fiorenza Micheli *et al*., "Ocean Health," in *Routledge Handbook of Ocean Resources and Management*, Hance D. Smith *et al*., eds., p. 114 (Routledge, NY, NY 2015) (Ocean Health).

[6] National Oceanic and Atmospheric Administration, "What Is Ocean Acidification?" (March 30, 2015), at: http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F.

[7] Ocean Health, *supra*, p. 112 (referencing Halpern *et al*., "A global map of human impact on marine ecosystems," *Science* 319: 948-952, at: ww.nceas.ucsb.edu/globalmarine).

Even those systems doing better than others due to their comparative distance from negative human impacts are suffering. A 2012 report describes the California Current Ecosystem (CCS) in "relatively" good shape as compared with other marine systems, but then observes that the CCS is at the "35-45% level," a "2.5 on scale of 1-5," "depleted," and likely not in "good shape."[8] In fact, marine scientists warn our actions have "*high risk of causing . . . the next globally significant extinction event in the ocean*" – and soon.[9]

LAWS CALL FOR HEALTHY ECOSYSTEMS AND SPECIES, BUT HEALTH REMAINS UNDEFINED

A healthy ocean is an attractive vision. We tend to inherently prefer healthy ecosystems and reject environmental degradation. The challenge emerges in determining the meaning of "healthy" and deciding how to best adjust our actions to achieve it.

"Health" is often cited as a goal of current environmental law and policy. Examples in California include the following:

- The California Ocean Protection Act (COPA) states that California decisions affecting the coastal and ocean environment "should be designed and implemented to conserve the *health* and diversity of ocean life and ecosystems"[10] and "conducted in a manner consistent with protection, conservation, and maintenance of *healthy* coastal and ocean ecosystems . . . . [11] COPA further finds that "[a] *healthy* ocean is part of the state's legacy," and is necessary to support the state's human and wildlife populations."[12] Accordingly, ocean governance "should be guided by principles of . . . *ecosystem health*" and "recognition of the interconnectedness between land and ocean."[13]
  - This approach informs the mission statement of the California Ocean Protection Council established by COPA, which similarly calls for "healthy, resilient and productive ecosystems."
- The Marine Life Management Act (MLMA) lists its top objective to "Conserve the *health* and diversity of marine ecosystems and marine living resources."[14]
- The California Coastal Act states that "Uses of the marine environment shall … maintain *healthy* populations of all species of marine organisms."[15]

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[8] California Environmental Associates, "California Current Ecosystem Assessment: Summary of current condition, pressures, and opportunities for the conservation community – January-July 2012," pp. 17-20 (2012) (CEA Report).
[9] IPSO Report, *supra*, p. 7 (emphasis added).
[10] Pub. Res. Code § 35510(b)(1) (emphasis added).
[11] Pub. Res. Code § 35510(b)(5) (emphasis added).
[12] Pub. Res. Code § 35505(a) (emphasis added).
[13] Pub. Res. Code § 35505(c) (emphasis added).
[14] Fish and Game Code § 7050(b)(1) (emphasis added).
[15] Pub. Res. Code § 30230 (emphasis added).

- The Marine Life Protection Act (MLPA) advances protection of the ocean and coast generally, aiming for overall ocean ecosystem health. For example, Fish and Game Code § 2853(b)(1) describes the MLPA's intent as to "protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems." The MLPA Master Plan reinforces this goal as protecting the "*health* of marine ecosystems."[16]
    - The MLPA specifically recognizes the importance of protecting marine habitats for their own "intrinsic value."[17] In other words, health in the MLPA context refers to health from the perspective of the affected ecosystems, as opposed to an anthropocentric perspective of the ocean's utility to humans.
    - The MLPA also recognizes the broad geographic reach of threats to MPAs and marine systems. It notes that inland activities impact MPAs and so should be addressed as well, as part of a wider effort to protect marine systems.
- The Fish and Game Code establishes California wildlife policy as "perpetuat[ing] all species of wildlife *for their intrinsic and ecological values*, as well as for their direct benefits to all persons." The section adds that "management shall be consistent with the maintenance of *healthy* and thriving wildlife resources . . . ."[18]
- The Porter-Cologne Water Quality Control Act (Porter-Cologne) mandates tracking of the effectiveness of water quality projects based on their success in "achieving clean water and *healthy* ecosystems."[19]
- The federal Marine Mammal Protection Act (MMPA) states that the primary objective of marine mammal management "should be to maintain the health and stability of the marine ecosystem."[20]

Despite these broad calls for a healthy coast and ocean, "healthy" is defined nowhere in statute, leaving policymakers in need of guidance for effective implementation. Scientists last debated the concept of ocean health roughly 20 years ago, in part to help advance the evolving movement toward ecosystem-based management.[21] However, there remains today no single, agreed-upon definition of a "healthy" ocean.

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[16] CA Dep't of Fish and Wildlife, "Master Plan for Marine Protected Areas," p. vi (Nov. 2015); at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=112486&inline (emphasis added). In developing its marine protected areas program, California relied on a National Academy of Sciences report that found that "[i]n designing MPAs . . . it is important to recognize that the *goal is to maintain the health of marine ecosystems* beyond the relatively small area protected within protected areas." CA Dep't of Fish and Game, "Master Plan for Marine Protected Areas," p. 12 (Jan. 2008), at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=113006&inline (citing National Academy of Sciences, "Marine Protected Areas: Tools for Sustaining Ocean Ecosystems" (2001)) (emphasis added).

[17] Fish and Game Code § 2853(b)(4).

[18] Fish and Game Code § 1801 (emphasis added).

[19] Water Code § 13181(a) (emphasis added).

[20] 16 U.S.C. § 1361, Sec. 2(6).

[21] *See, e.g.*, a review of past discussions at Scrimgeour and Wicklum, "Aquatic ecosystem health and integrity: problems and potential solutions." *J. N. Am. Benthol. Soc*. 15(2):254-261 (1996).

The time is ripe to reinvigorate this discussion. Ocean management "has failed to achieve sustainability, failed to adequately conserve resources, and resulted in more problems than are solved."[22] Continuing ocean degradation and associated expansion of management challenges together urge heightened regulatory and stewardship initiatives towards achieving ocean health. Recent advancements in modeling technology and better understanding of ecosystem processes and dynamics[23] – including ecosystems' nature as co-evolutionary webs of ecological interactions, or *evosystems*[24] – create a fertile field now for discussion and advancement of such ocean health goals.

VALUES UNDERLIE OUR SHARED VISION FOR OCEAN HEALTH

The absence of a clear definition and vision of ocean health has left us with competing recommendations that reflect different perspectives, are often at odds, and do not necessarily reflect the most recent science. An initiative to achieve ocean health must begin by disentangling the assumptions underlying competing recommendations; deciding upon the assumptions, science and goals behind a vision for ocean health; and agreeing upon that shared vision.

As observed recently by marine scientists,

> health is a normative concept that implies *judgment on the desirable state for an ecosystem*. Such judgment is *influenced by human values and needs*, and thus definitions of OH have varied from human-centric views that focus primarily on the benefits that oceans provide to people (e.g. Halpern *et al*. 2012), to nature-centric views that would rate ecosystems with the fewest human pressures as the healthiest (e.g., McCauley *et al*. 2013).[25]

The definition of ocean health is ultimately a policy decision, but it is one that must be informed closely by the best science. Moreover, values are integral to this discussion. "Science can elucidate how the system works [but] values inform us about what's desired. *Without an explicit consideration of values, health is devoid of meaning*."[26] In light of the escalating threats

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[22] C.W. Fowler and L. Hobbs, "Are We Asking the Right Questions in Science and Management?" NOAA Technical Memorandum NMFS-AFSC-202, p. 2 (Dec. 2009) (Fowler (2009)).
[23] For example, when the earlier discussions were being held, scientists had only a limited understanding of what El Niño involved and meant.
[24] C.W. Fowler *et al.,* "Pattern-Based Control Rules for Fisheries Management," NOAA Technical Memorandum NMFS-AFSC-268, n. 3 (Jan. 2014) (Fowler (2014)).
[25] Ocean Health, *supra*, p. 108 (emphasis added).
[26] David Rapport *et al*., eds., *Ecosystem Health*, pp. 14, 25-26, 42 (Blackwell Science, Malden, MA 1998) (emphasis added) (Ecosystem Health).

to the integrity of ocean ecosystems, and the call for ocean health in our laws and policies, we must examine our shared values and choose our immediate and long-term goals accordingly.[27]

Systems scientist Donella Meadows concisely notes the conundrum we often create for ourselves when tackling management problems. She notes that there is a "tendency . . . to go immediately to implementation, and talk first and primarily in that arena. How do we get governments to work better together? How do we get the money raised?"[28] The problem with this is that if we act without taking the needed time to examine our values and goals, we create mixed policy messages and motives that fail to bring about expected results. "

Whenever choices must be made, ethical considerations must be taken into account."[29] Ignoring the role of ethics and values in decisionmaking does not make the resultant policy decision scientifically objective. It merely creates a decision grounded unconsciously in the dominant values and ethics of the time, whether or not people actually prefer those values and ethics (or realize they hold them).

The dominant, but often unexamined, societal goal today is infinite economic growth, fueled in large part by the consumption of natural "resources." Given that we live on a finite planet, this societal goal will continue to degrade our ocean systems. Marine scientists worldwide agree that this economic goal, and the values on which it is built, is simply "not sustainable."[30] However, current environmental laws accept this goal implicitly. They thus cannot reverse the slide toward degradation; at best, they can only slow it.

The values underlying this dominant goal illustrate the importance of carefully examining our values and ethics before acting, as recommended by Meadows. A dominant system that treats nature as a "resource" for short-term profit marginalizes nature's intrinsic significance by using it up until it is no longer economically viable to do so. Environmental laws can help prevent the worst abuses, such as species extinctions and widespread toxic pollution. But the situation remains that despite their stated goals to the contrary, our laws and policies push many species toward extinction, allow degradation up past adopted standards (many of which have not been updated in decades), and fail to combat climate change, which is now pushing natural systems to the brink.

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[27] *See, e.g.*, *id*., p. 49 (achieving ecosystem health requires us to "identify the societal goals that are compatible with sustainable life systems, to identify and validate indicators of ecosystem function that are essential to its evolution and perpetuation, and to merge goals (societal values) with biophysical realities).
[28] Donella Meadows, "Envisioning a Sustainable World" (Costa Rica 1994; published Oct. 8, 2012); at: http://donellameadows.org/envisioning-a-sustainable-world/. *See also* Ecosystem Health, *supra*, pp. 255-57.
[29] Ecosystem Health, *supra*, p. 93.
[30] IPSO Report, *supra*, p. 5.

As just one example, greenhouse gases released by the economically and politically powerful fossil fuel industry are causing the melting of Arctic ice, which will accelerate climate change and its impacts. Rather than swiftly and decisively acting to halt the emissions, governments and industries instead are fighting over the new navigation routes (and oil and gas sources) previously unavailable due to the ice. These new actions, of course, will create more greenhouse gas emissions that will further exacerbate climate change worldwide. The values underlying these policy decisions – *i.e.*, greed and desire for short-term profits and more economic growth – are trumping other values that the public might prefer, including respect and love for natural systems and a yearning for thriving relationships with them.[31]

The neoclassic economic model driving our governance systems today may or may not be the goal society desires. It will, however, be the goal society gets, at least "until a credible and desirable alternative becomes available."[32] Accordingly, a number of ecosystem scientists believe that *the primary impediment to achieving environmental health is not implementation challenges, but instead is a "lack of a coherent, relatively detailed, shared vision of a sustainable society*." [33] Adopting this shared vision may seem an impossible task given competing interests, but with the right forum, the process of developing it can actually "help to mediate many short-term conflicts that will otherwise remain unresolved."[34]

Importantly, the process for visioning a healthy ocean, and our human relationship with it, should be based on *what we want* rather than what seems immediately possible or what we would settle for. The vision should be judged by the "clarity of its values," not the "clarity of its implementation path."[35] As reflected by Meadows, "the vision reveals the path and there's no need to judge the vision by whether the path is apparent."[36] Indeed, our dominant vision today of infinite economic growth on a finite planet is by definition unachievable. Presumably, a far greater potential for success will arise from a thoughtfully and broadly developed vision for a healthy ocean, grounded in deeply-held values and ethics and in the science of our interconnectedness with the world around us.

In sum, we are currently struggling with how to change our actions to address the continued degradation of the marine environment. Before we jump to the actions themselves, we must bring forth not only our best science but also our best values; these are essential to develop and implement an effective path toward shared well-being.

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[31] *See, e.g.*, E. O. Wilson, *Biophilia* (Harvard Univ. Press 1984) (Wilson describes the deep "connections that human beings subconsciously seek with the rest of life" and decries the fact that "we are killing the thing we love").
[32] Ecosystem Health, p. 255.
[33] *Id.* (emphasis added).
[34] *Id.*
[35] *Id.*, p. 256.
[36] Meadows, *supra*.

EXISTING VISIONS OF OCEAN HEALTH PROVIDE IMPORTANT LESSONS

In the absence of a formally adopted definition of "ocean health," we have *de facto* defined the term through our laws and their implementation strategies. These, however, slow but do not reverse degradation. That is in part because our current *de facto* ocean health definition assumes ecosystems and species are healthy if they are not degraded. Our laws and implementation strategies then try to avoid those system states.

In other words, our laws and actions do not decide when fish populations, or water quality, or coastal habitats are *thriving* or *flourishing.* Instead, they avoid such discussions and primarily focus on deciding when ecosystems and species have become so degraded that we cannot use them effectively. We have chosen to look down toward degradation, rather than forward toward thriving relationships between humans and natural systems. A measureable vision of "healthy" is needed to improve ecosystem states, rather than continue to observe their decline.

The last twenty years have brought varying articulations of ocean health. There have been at least three basic approaches to examining ocean health during this time. Becoming clear on which approach we are using is important to defining effective implementation strategies.

One approach is to define health as relative to humans' continued use of the oceans; that is, health in the context of ecosystems' services to humans. An example of this anthropocentric perspective is the Ocean Health Index (OHI),[37] for which "[n]ine out of ten . . . . attributes directly describe ecosystems services, or benefits to humans."[38] Nature here is seen as separate from humans, a "resource" for our use. Its value lies chiefly in its ability to continue to service humans, as opposed to its own intrinsic value. This approach has gained some favor; many assessment methodologies today focus on measuring not ecosystems own, intrinsic well-being, but their relative "services" to humans for our needs and desires. However, this model accepts the "traditional [neoclassical] economic and consumer values" that ocean scientists have already asserted "are not sustainable."[39] Scientists' characterization of this model as unsustainable raises serious questions about its utility in improving marine well-being.

At the other end of the spectrum, ocean health could be considered as essentially pristine conditions; that is, unaffected by humans. In this perspective, healthy is seen as untouched by humans, or very close to that condition. This approach can be useful for comparison purposes (*e.g*. in establishing a reference site) and on occasion, in limited geographic areas, as a policy goal. This approach also can come into play in prioritizing actions or setting targets for restoration. However, it is not broadly applicable as a management goal. Not only can "pristine"

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[37] http://www.oceanhealthindex.org/.
[38] Ocean Health, *supra*, p. 110.
[39] IPSO Report, *supra*, p. 5.

be challenging to define in this human-impacted world, the term leaves little room for a practical definition of health that includes humans as sustainable, respectful partners with natural systems. We can derive guidance from the numerous examples of humans adopting harmonious, "social-ecological interactions" with the natural world, from interactions with coral reefs in the Northwest Hawaiian Islands to herring populations in British Columbia.[40] We are inextricably connected with the natural world, and we must adjust our actions to achieve ocean health in light of that indisputable fact.

This brings us to the third approach, which defines health in terms of harmonious, thriving relationships between humans and nature, with respect for nature's own, intrinsic well-being. This broader, more holistic perspective assumes that it is possible for humans to live in an integrated and interdependent way with nature. The one-way relationship we assume by default treats nature as corpus and services for human economic benefit, over and above basic human needs. By contrast, defining ocean health in terms of thriving relationships with nature necessarily includes nature's own need to maintain its "normal form and function" (described further below).

Respect for nature's needs is fundamental to nature's long-term support for humans' needs. It also sets a higher bar for human existence by considering not just what ecosystems and species can provide to humans, but also what services we can and should provide to ecosystems and species over and above simply trying to fix our mistakes.

The potential for a successful relationship with the ocean has been under-examined in part because relatively little work has been done to explore ocean health from the perspective of the ocean itself. The European Union's Marine Strategy Framework Directive (MSFD), which "aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020," can provide some guidance in this regard.[41] The EU's MSFD recognizes the importance of nature's intrinsic well-being by including, among other provisions, "the explicit regulatory objective that 'biodiversity is maintained by 2020', as the cornerstone for achieving GES."[42]

The MSFD defines "good" status as "ecologically diverse and dynamic oceans and seas which are clean, healthy and productive,"[43] assessing it (in contrast with the anthropogenic

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[40] Ocean Health, *supra*, p. 113.

[41] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008, Establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive, or MSFD), at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056.

[42] http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm; *see also* Ocean Health, *supra*, p. 110.

[43] http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm.

approaches) primarily using biological and physical attributes.[44] The MSFD explains further that GES means that:

> (a) the structure, functions and processes of the constituent marine ecosystems, together with the associated physiographic, geographic, geological and climatic factors, allow those ecosystems to *function fully and to maintain their resilience* to human-induced environmental change. Marine species and habitats are protected, human-induced decline of biodiversity is prevented and diverse biological components function in balance; [and]
> (b) hydro-morphological, physical and chemical properties of the ecosystems, including those properties which result from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy, including noise, into the marine environment *do not cause pollution effects*.[45]

With regard to implementation, the MSFD further directs that "[a]daptive management on the basis of the ecosystem approach shall be applied to achieve GES."[46] The MSFD's focus on ocean health from the perspective of ecosystems, and the value it places on the ecosystems' own ability to function fully and not suffer effects from human harm, informs a vision of ocean health that encompasses more than just the ocean's utility to humans.

Our ocean policy must reflect ocean system dynamics, including evolution toward increasing complexity, dynamism on a range of temporal and spatial scales, and thriving interrelationships. However, the best science is insufficient to achieve our ocean health goals. We also must "overcom[e] our tendency to undermine sustainability and health with values, such as economics, that we believe trump sustainability . . . – even to the point of assuming that there is sustainability in the unsustainable (*e.g.*, 'sustainable' economic growth or development)."[47]

It is with this background that we turn to recent, initial efforts to define ocean health in California.

[44] Ocean Health, *supra*, p. 110.
[45] MSFD, *supra*, Art. 3(5) (emphasis added).
[46] *Id.*
[47] Fowler (2009), *supra*, p. 27.

CALIFORNIANS ARE CREATING A VISION OF OCEAN HEALTH

California ocean law and policy has for the most part defined health by default as "slower degradation," and the ocean is suffering as a result.[48] Even the California Current Ecosystem, largely viewed as doing better than similar systems worldwide, has "changed dramatically in … terms of biological diversity" in recent years, prompting scientists to describe it as a "system that is not healthy."[49]

Stream Science Helps Inform the Ocean Health Discussion

Recent work by California aquatic scientists examining stream health have provided important lessons for explorations into marine health. Examples include California's Healthy Streams Partnership[50] (and associated pilot efforts in San Diego[51] and along the Central Coast[52]), Heal the Bay's Malibu Creek Watershed Stream Health Index,[53] and U.S. EPA's recent report on California integrated watershed assessment.[54] As to the last, U.S. EPA found that:

> the biological, chemical, and physical health of a stream are fundamentally connected to one another and to the maintenance of natural watershed processes… [By] integrating information on multiple ecological attributes at several spatial and temporal scales, a systems perspective on watershed health is provided.

These evolving forms of integrated aquatic ecosystem assessments can provide important tools to help policymakers and scientists define and track ocean health in California.

OPC and OPC Science Advisory Team Take up Ocean Health in 2014

The advancements of stream scientists studying stream health, combined with the mission of the state's Ocean Protection Council (OPC) to advance "healthy, resilient and productive ecosystems," led the OPC and its Science Advisory Team (OPC-SAT) to begin a public process to examine the meaning and implementation of ocean health in California.

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[48] "Our ocean-based and land-based activities together are… literally changing the chemistry, the physical structure and the biology of our oceans in unprecedented ways . . . [a]nd we are suffering the consequences." Dr. Jane Lubchenco, Testimony before the U.S. Commission Ocean Policy (Wash. D.C., Nov. 13, 2001).

[49] CEA Report, *supra*.

[50] http://www.mywaterquality.ca.gov/monitoring_council/healthy_streams/.

[51] http://www.mywaterquality.ca.gov/monitoring_council/healthy_streams/docs/sdrw_reportcard.pdf.

[52] http://www.mywaterquality.ca.gov/monitoring_council/healthy_streams/docs/healthywatersheds_krw.pdf.

[53] Heal the Bay, "Malibu Creek Watershed: System on the Brink," pp. 21, 124-130 (2013), at: http://bit.ly/1ptG01P.

[54] The Cadmus Group, for U.S. EPA, "California Integrated Assessment of Watershed Health: A Report on the Status and Vulnerability of Watershed Health in California" (Nov. 2013), at: http://www.mywaterquality.ca.gov/monitoring_council/healthy_streams/docs/ca_hw_report_111213.pdf.

The OPC-SAT took up the effort to begin to define ocean health with two 2014 workshops, in June[55] and August[56] 2014.[57] As observed by one agency representative at the June 2014 OPC-SAT workshop, "*[w]hat we need is a broad, conceptual, aspirational goal and statement that we could all point to and drive towards as a shared vision for ocean health*, even in the context of our own agency mandates, jurisdictions and policies."[58] While these were just initial conversations, the full hearing room at the August 2014 OPC-SAT workshop[59] attests to the broad interest in this conversation.

Further, as noted by August workshop panelist Dr. Brendan Kelly of the Monterey Bay Aquarium, the substance of the ocean health discussions was not the only benefit of the workshops. In addition, they provided a valuable role in illustrating the mismatch between holistic ecosystems and siloed regulatory systems and agencies. This discontinuity between form and function is one of the reasons that the OPC was created; that is, to help "integrate and coordinate" the "laws and institutions responsible for protecting and conserving [the] ocean."[60] The act of developing an ocean health definition itself thus provides an opportunity to help bring agencies together, through the joint creation of a new perspective that assumes planning and action must occur across existing management boundaries. Given its mandate for ecosystem-based management, the OPC could play a significant role in leading an effort toward "a set of guiding principles for all state agencies to follow."[61]

Scientists Advance Ocean Health Discussion at September 2015 Workshop

To advance this discussion of ocean health, Earth Law Center, and its consultant and marine scientist Dr. Brock Bernstein, convened an all-day meeting of top marine and aquatic scientists from around the state in September 2015. Participants focused on both development of a consistent definition of ocean health that could help guide ocean policy, and recommendations for strategies to measure, track and report on ocean health. Participants agreed that such a definition could be applied to improve implementation of laws protecting the coast and ocean, create a consistent vision for needed legislative mandates, enhance the effectiveness of restoration efforts, and direct scientific research toward holistic regulatory and restorative

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[55] http://www.opc.ca.gov/2014/05/california-ocean-protection-council-scientific-advisory-team-meeting-opc-sat-topic-ocean-health/.
[56] http://www.opc.ca.gov/2014/07/ocean-protection-council-meeting-and-ocean-health-workshop-august-27th-2014/.
[57] *See* Comment Letter from Earth Law Center to California Ocean Science Trust (June 5, 2014); at: http://www.opc.ca.gov/webmaster/_media_library/2014/05/OPC-SAT-Ocean-Health-cmts-ELC.pdf.
[58] Ocean Protection Council Science Advisory Team (OPC-SAT) "Exploring Ocean Health as a Scientific Concept and Management Goal (June 11, 2014) – Workshop Proceedings," at: http://www.opc.ca.gov/webmaster/ftp/pdf/SAT/OPC-SAT%20FULL%20Workshop%20Proceedings%206.11.14.pdf.
[59] For detailed agenda, see: http://www.cal-span.org/cgi-bin/archive.php?owner=COPC&date=2014-08-27.
[60] Pub. Resources Code § 35515.
[61] *Id.*

management strategies that more closely reflect the complexities of marine ecosystems. The intended audience for the discussion included all marine professionals – scientists, policymakers, decisionmakers – as well as the interested public.

Workshop participants noted that a holistic understanding of the dynamic and interconnected behavior of ocean systems has yet to fully penetrate policymaking and management decisionmaking. They added that this occurs in part because scientists cannot always articulate clearly this fundamental scientific understanding of complex ecosystems to policymakers. One outcome of a more refined definition of ocean health would therefore be a clearer rationale for more holistic policymaking, grounded in current scientific understanding of the nature of ocean systems. This would in turn lead to clarified policy priorities, more integrated agency operations, better metrics by which to resolve conflicts among interest groups and overcome agency silos, enhanced scientific bases for setting policy and research goals, closer tracking of successes and setbacks, and improved strategies to protect natural systems.

Participants particularly noted that ocean policy today is generally not ecological policy, which considers humans as part of natural systems rather than separate users of such systems. As observed by NOAA fisheries scientist Chuck Fowler, "[a]ll species are confined by the limits imposed by their environments and empirical patterns display the balance among the systemic forces involved."[62] Humans are no exception. This "balance" between humans and the natural world needs to be better tracked and managed to ensure that we live sustainably within the limits of marine systems.

As to this last point, workshop participants discussed the need to develop objectives to assess our progress toward our adopted vision of ocean health. Without clarity in our goals and objectives, we may once again rationalize our actions in favor of short-term economic gain, leading us astray from a higher vision for ocean health.[63] While numeric objectives provide the most clarity, the challenges of developing truly holistic, numeric metrics should not limit our efforts. Workshop participants felt that a narrative health objective, with associated scientific guidance to be developed later, would provide a meaningful start. Further insights from this workshop are integrated into the discussion below.

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[62] Fowler (2009), p. 28.
[63] *Id*., p. 27.

A PROPOSED VISION OF OCEAN HEALTH

Defining a healthy ocean as one that excludes humans is impractical. Defining it as one that exists to serve humans is unrealistic. We must accept our inherent interconnectedness with the natural world and respect its own, intrinsic right to struggle for health. Defining ocean health in terms of thriving, harmonious relationships with it best advances this goal.

A vision of a healthy ocean that includes humans will incorporate not only an understanding of what we can take from the ocean for our needs, but also what we can affirmatively give the ocean to ensure its own needs are met. That is, part of our policymaking needs to involve uncovering what we need to do *above and beyond* regulating and mitigating the impacts of our new ocean uses. In undertaking this task, we need to be careful to avoid conflating human "needs" with "desires," as they are not often the same thing. Our laws tend now to feed human desires and barely meet ocean needs. This unbalanced relationship needs to change. Debating and adopting a vision of ocean health that includes a sound relationship with humans is a key step in this process.

This paper accordingly proposes a vision of ocean health that seeks "normal form and function" for the ocean, where "normal" at a minimum reflects a higher level of system form and functioning than merely the absence of disease or infirmity. Ocean systems should enjoy sufficient, continued organization, vigor and resilience to evolve and perpetuate as natural systems within the context of their expected natural life spans. Support for and further details on this proposed vision are addressed next.

Analogies with Human Health and Well-Being

We intuitively accept the idea of human health and have a general understanding of what it might entail. The Constitution of the World Health Organization (WHO) recognizes "enjoyment of the highest attainable standard of health" as **"**one of the fundamental rights of every human being . . . ."[64] It defines human health as "*a state of complete physical, mental and social well-being* and *not merely the absence of disease or infirmity*."[65]

Integration of Physical, Mental and Social Well-Being

Though the WHO human health definition arguably raises more questions than it answers, some useful lessons can be applied toward the task of defining ocean health. The WHO

[64] http://www.who.int/governance/eb/who_constitution_en.pdf (emphasis added).

[65] As a side note, some experts have taken issue with the goal of "complete" health across physical, mental, and social dimensions because this appear essentially unachievable, resulting in virtually all people being classified as unhealthy.

Constitution considers health as the *integration* of the "physical, mental and social" states. "Well-being," in turn, is the parameter by which each state is judged before being integrated into the measure of overall health. In other words, well-being refers to separate *components* (*e.g*., physical well-being, social well-being), while health refers to the *aggregate* across all the physical, mental and social metrics. The observation that human health is a holistic concept can be readily applied to the examination of ocean health.

The structure of separate components (or *attributes*) aggregated into an overall measure of health is one familiar to marine scientists. Though the specific components of the WHO definition of human health do not always map neatly onto ocean ecosystems,[66] useful analogies to all three components can be drawn. The complex web of interactions among humans and natural systems reach beyond simple cause-and-effect, physical impacts. Humans are a part of this network of relationships, not outside of it, and we glean both social and mental benefits from our interactions with the ocean.[67] Arguably, ocean species and systems themselves can glean related benefits through evolutionary shifts in cognition and consciousness affected in part by our interactions with them. In sum, our actions towards the oceans can have more than physical impacts, and our visioning process should consider that broader perspective.

Physical, mental and social well-being (and ultimately, health) as achieved through care for *relationships* aligns with the modern scientific understanding of ecology, which includes humans as part of the natural world. The "ecosystem services to humans" perspective ignores the interconnections between humans and the ocean, and our responsibility to give back through affirmative contributions to the well-being of the network of relationships to which we belong. For example, we should conduct significantly more restorative activities than currently and on a more proactive basis (*i.e*., restoration not tied to a recent destructive activity). We also should affirmatively prioritize environmentally friendly actions over those that do harm, even where our balance sheets highlight different profit preferences.[68] Indeed, we can and should reevaluate our financial and economic systems in light of this evolved vision of thriving relationships, much as a number of ecological economists are doing now. Just as with healthy

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[66] For example, humans' acceptable range of physical conditions tends to be narrower than those under which an ecosystem might be considered healthy. Comparative mental and social well-being also merits deeper examination as they apply to the marine context. On this last point, important work has started in the area of cetacean emotional and social intelligence and associated well-being.

[67] *See, e.g*., Wallace J. Nichols, *Blue Mind: The Surprising Science That Shows How Being Near, In, On, or Under Water Can Make You Happier, Healthier, More Connected, and Better at What You Do* (Little, Brown and Co., Boston, MA 2015). *See also* Fowler (2014), n. 4 ("Advice to seek more holism is common in the literature, not only with specific reference to fisheries [citations], but also more generally regarding our (human) interactions with the nonhuman [citations]").

[68] For example, we could support water-friendly permaculture over industrial agriculture that drains inland waterways needed to support both anadromous fish and marine mammals. *See* NOAA-NMFS, "NOAA Biological Opinion Finds California Water Projects Jeopardize Listed Species; Recommends Alternatives" (June 4, 2009), at: http://www.noaanews.noaa.gov/stories2009/20090604_biological.html.

relationships with other humans, *we will achieve a healthy relationship with the ocean only if we strive to give back at least as much (or more) than we receive*.

"Not Merely the Absence of Disease or Infirmity"

The WHO definition importantly suggests that human health is a state that is more positive and less limited than merely the "absence of disease or infirmity," a point on which September 2015 workshop participants agreed. Unfortunately, "absence of disease or infirmity" is often the default concept for a healthy ecosystem today. Our environmental laws presume that flourishing ecosystems are a goal only in special circumstances (*e.g.*, Wild and Scenic Rivers,[69] Outstanding National Resource Waters[70]). The overwhelming default is avoiding degradation of ecosystems to the point that they can no longer be used. We must switch this policy presumption if we are to achieve a higher goal of thriving ecosystems, which is essential to our own well-being.[71]

The Importance of Context

Natural Variability: Consideration of Temporal and Spatial Fluctuations

Like human health, ecosystem health exists within the context of a complex network of local to global relationships. It also exists within the context of time and space: ecosystems and species evolve, and the concepts of health and sustainability must be considered over a time frame "consistent with the system's time and space scale."[72] "Health" is not necessarily a static concept.

September 2015 workshop participants similarly noted that "equilibrium" concepts of health are outmoded, particularly as they relate to theories of ecological climax (*i.e.*, steady state) communities and stability. Scientists now understand that ecosystems are dynamic and characterized by a variety of disturbances, as well as by complex, nonlinear interactions that can lead to alternative conditions potentially quite different from the original state. Fluctuations or cycles in status are a normal part of natural ocean conditions, and not all species can do well at the same place or time because of competing physical and biological requirements. Examples include the cycles of the California Current System, the warm and cold phases of the Bering Sea ecosystem, and cycles in sea urchin population abundance in Nova Scotia. Each of these systems, and similar spatially or temporally heterogeneous systems, can

[69] 16 U.S.C. §§ 1271 *et seq*.
[70] 40 C.F.R. § 131.12(a)(3).
[71] *See, e.g.*, Ecosystem Health, *supra*, p. 49 ("The articulation of ecosystem health goals and indicators of performance to achieve these goals is a necessity if the future for humankind is to be viable").
[72] *Id*., p. 236.

include states that could be considered unhealthy from the perspective of species or communities in the impacted state(s) if viewed in isolation or as a snapshot.

Accordingly, workshop participants noted, expected change over time should be considered when defining and acting to achieve ocean health.[73] Change in the *rate* of change can provide important information and should be tracked and considered in developing policy and preventive actions. However, participants strongly emphasized that acknowledgement of natural disturbances, cycles, or other shifts in system state should *not* be used to rationalize destructive human practices or subvert the goal of minimizing human impacts on ocean health. Climate change is the most obvious example of this type of rationalization, with policymakers avoiding needed action in the face of clear scientific evidence that far more is at play than natural variability. The human tendency to rationalize calls for even more attention to clarity in defining and tracking ocean health, in order to better distinguish between natural and human disturbances and their effects.

Given the gaps in needed marine science research to date, workshop participants proffered that a useful starting point in the near term could be examination of well-being under a range of local conditions, to limit the variability that challenges current research. Researchers and policymakers would select metrics for local measurement that could be consistently aggregated to present a holistic assessment of ecosystem status, which could inform strategies to define ecosystem health. Strategies for measurement are discussed further below.

<u>Effects of the Existing Economic System</u>

Given the interplay of physical, biological, and social sciences[74] in determining and acting on ocean health, we must consider more than just the physical and biological complexities of the ocean system. Defining and acting to achieve ocean health also requires that we consider the *societal context* within which we make our decisions. A major societal driver today is our economic system, which injures ecosystems and species in the pursuit of short-term profit and infinite economic growth. As observed by the United Nations:

> Since the industrial age, the economic system that has been developed has not been determined by what is good for people, much less for nature, but rather by what is good for the growth of the economic system. In such a system, nature, our source and the sustenance of our existence, has been ignored and exploited . . . . a socio-economic

[73] *See, e.g.,* M.J. Allen, R.W. Smith, E.T. Jarvis, V. Raco-Rands, B.B. Bernstein, and K.T. Herbinson, "Temporal trends in southern California coastal fish populations relative to 30-year trends in oceanic condition," *Southern California Coastal Water Research Project Biennial Report 2003-2004*, pp. 264-285 (2004).
[74] Ocean Health, *supra*, p. 122.

> system based on material growth is not sustainable, just as striving for infinite growth in a world of finite resources is contradictory.[75]

The strength of the economic system today is such that we often hold its tenets unconsciously, and we act without questioning its assumptions. The trend to monetize and privatize ecosystems and species in order to "save" them from the same system causing their destruction is one example of this phenomenon. In light of the potential for continued damage to the natural world, we must pay particular attention to the economic assumptions we make and avoid letting them drive what is possible for ocean health.[76]

"Normal Form and Function" as a Descriptor of Ocean Health

As described above, the process of defining ocean health requires us to integrate variables within physical, biological, and social realms, towards a bar higher than "absence of disease or infirmity," with consideration of space, time and societal context. It "challenges us to identify the societal goals that are compatible with sustainable life systems" and "identify and validate indicators of ecosystem function that are essential to its evolution and perpetuation."[77]

Developing and operationalizing a definition of ocean health that encompasses the dynamic nature of ocean systems across multiple spatial and temporal scales – and that considers and provides input to evolving human policies – undeniably presents significant challenges. However, the default is to continue with assumptions that are already defined for us, and often in ways that fail to provide for well-being.

One starting approach discussed by September 2015 workshop participants was to define a healthy ocean system to be one that exhibits "normal form and function,"[78] or "what works in natural systems."[79] Fowler describes "sustainability" as "doing what is possible to ensure that all systems (e.g., ecosystems, evosystems,[80] and fisheries) exhibit normal form and function (Fowler 2003, 2009)."[81] Stream ecologists use the analogous concept of normal or intact structure and function. Both sets of concepts refer to features expected to be present in a

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[75] United Nations General Assembly, "Harmony with Nature: Report of the Secretary-General," A/66/302, p. 17 (15 Aug. 2011), at: http://www.un.org/ga/search/view_doc.asp?symbol=A/66/302.

[76] As observed by cultural and Earth historian and geologian Thomas Berry, the universe is the only text without a context. Thomas Berry, *The Sacred Universe: Earth, Spirituality and Religion in the Twenty-First Century*, p. 94 (Columbia Univ. Press 2009). Our economic system, only about 200 years old in its current context, is a human creation, and humans themselves are embedded in the Earth. An environmental policy that serves the economic system is upside down. The economic system should be viewed as a tool to advance flourishing relationships between humans and the natural world.

[77] Ecosystem Health, *supra*, p. 49 (emphasis added).

[78] Fowler (2014), p. 1.

[79] Fowler (2009), pp. 12, 26.

[80] As per Fowler, "evosystems" refer to co-evolutionary webs of ecological interactions.

[81] Fowler (2014), p. 1 (emphasis added).

natural state; they further include the sorts of complex dynamism and interactions described earlier.

Stream ecologists have made substantial progress in defining "normal form and function,"[82] and much can be learned from their efforts to date. However, defining "normal" is a more noteworthy challenge for the ocean because of the ocean's significantly greater spatial and temporal variability (typically characterized poorly), and the complexity of its interrelationships at a number of scales and time periods.

These challenges need not prevent movement forward, however. Defining "normal" could start with what it is not – for example, *not* merely the "absence of disease or infirmity," as discussed above. Adoption of this initial approach would immediately prompt action to improve current environmental laws, which generally permit degradation to a point just before (and often past) disease or infirmity. Our current environmental laws aim too low, and fail to seek the higher state of well-being that is the goal for human health policy. For example, federal Clean Water Act regulations allow pollutant discharges with comparatively little controls as long as they do not have a "reasonable potential" to violate individual standards.[83] Similarly, the federal Endangered Species Act is commonly viewed as one of the most protective laws for species. But at its core, it is not about protecting the *health* of species populations; rather, it does not activate until species are poised to blink out of existence. By that time, human pressures against species have become too well-established to easily shift, and the inevitable push-back from stakeholders can delay action until it is too late. Numerous other examples abound of environmental laws' structural failure to reach past the absence of disease or infirmity and toward health. We can and should begin to correct these failures right now.

How high, then, should our environmental laws aim above "absence of disease or infirmity"? We can draw initial lessons from the recent work of stream ecologists, who have formalized "distance from reference[84] state or condition" as the *observed vs. expected (O/E) ratio*. The O/E ratio measures how close any particular stream is to its expected ("normal") structure and function. September 2015 workshop participants agreed on the value of similarly measuring

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[82] *See, e.g.*, A.M. Milner *et al*., "Detecting Significant Change in Stream Benthic Macroinvertebrate Communities in Wilderness Areas," *Ecological Indicators* 60: 524-537 (2016); *see also* Charles Hawkins *et al*., "The reference condition: predicting benchmarks for ecological and water-quality assessments," *J. N. Amer. Benthol. Soc.* 29(1): 312-343 (2010).

[83] 40 CFR § 122.44. The standards themselves also fail to reflect "healthy" waterways, and instead straddle the border of "healthy" and "contaminated."

[84] "Reference" is frequently used to benchmark assessments of ecosystem condition, but offers at least two important differences from normal form and function. First, in practice reference sites or conditions typically capture only a snapshot in time. They thus do not always or necessarily reflect ecosystems' normal range of temporal heterogeneity. Second, reference sites or conditions generally refer only to specific attributes or metrics, rather than the larger and more complete set of ecosystem features encompassed by the more holistic concept of normal form and function.

O/E for marine ecosystems – even if the expected is no longer attainable everywhere – and using that data to inform the meaning of ocean health.[85]

Another lesson from stream ecologists is that an operational definition of ocean health should account for "abnormal" circumstances, in which incomplete knowledge can prevent full description of the expected system state. Stream ecologists have observed, for example, that natural events such as floods and wildland fires can create conditions for which it is not possible to set expectations or to separate human and natural impacts. In such instances, stream ecologists and managers have suspended assessment of natural versus anthropocentric impacts until a certain amount of recovery has occurred. The expected recovery condition over time will vary depending on the context and the state of the system before the event. As discussed next, this observation calls to mind the significance of considering the key attributes that offer information on system health: organization, vigor and resilience.

Three Attributes of Healthy Ecosystems: Organization, Vigor and Resilience

Costanza and Mageau offer that a healthy ecosystem is one that is "sustainable – that is, it has the ability to *maintain its structure (organization) and function (vigor) over time in the face of external stress (resilience)*."[86] A sustainable system can be viewed simply as "one that survives,"[87] or more specifically as one that is able to continue to maintain its normal form and function over time – that is, to evolve and perpetuate within the context of its expected natural life span.

As with the WHO Constitution, which folded physical, social and mental well-being into an integrated understanding of human health, Costanza and Mageau propose folding the attributes of system organization, vigor and resilience into a single comprehensive assessment of ecosystem health.[88] *Organization*, or ecosystem complexity (species richness, intricacy of interactions, etc.),[89] is currently the focus of most ecosystem studies and monitoring activities, with relatively little attention to *vigor* (the energy, productivity or activity of a system)[90] or

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[85] One example of this process as applied to coastal waters is the recently-developed PERSE model (Procedure to Establish a Reference State for Ecosystems), which assessed changes in French coastal waters in light of decades of nitrate and phosphate additions. The model calculates the probability that an observed attribute lies outside the determined reference state. A probability close to zero indicates the system is different from its normal form and function. Application of the model concluded that the contaminants had indeed altered the coastal waters, moving them away from normal form and function. Isabelle Rombouts *et al.*, "Evaluating marine ecosystem health: Case studies of indicators using direst observations and modelling methods," *Ecological Indicators* 25:353-365, 355-356, 362 (2013) (Rombouts).
[86] Robert Costanza and Michael Mageau, "What Is a Healthy Ecosystem," *Aquatic Ecology* 33:105-115, 105 (1999) (emphasis added) (Costanza and Mageau). *See also* Ecosystem Health*, supra*, p. 232.
[87] Ecosystem Health*, supra*, p. 234.
[88] Costanza and Mageau, *supra*, p. 112.
[89] Ecosystem Health*, supra,* pp. 26, 29.
[90] *Id*., pp. 26, 28.

resilience (the capacity of a system to cope with and bounce back from stress; that is, to "maintain its structure and pattern of behavior").[91]

The September 2015 workshop participants agreed that an ideal monitoring approach would include all three attributes of ecosystem health, even if the monitoring program could not be fully implemented immediately. They noted the example of the first Heinz Center report on the nation's coastal ecosystems, which identified needed indicators even in cases where data were lacking or could not be accessed and integrated at a national scale.[92] Rather than being moot, these recommendations helped stimulate a new U.S. EPA program to create periodic national reports on the nation's ecosystems containing the missing information.[93] Similar recommendations on monitoring needs for ocean health could spur needed research in the areas of system vigor and resilience.

Summary

A holistic and ecologically appropriate definition of ocean health should aim at least for "normal form and function." "Normal" need not necessarily be pristine, but it should reflect a higher level of form and functioning than merely the absence of disease or infirmity (the default of many environmental laws). More specifically, we should modulate our use of ocean systems to ensure they enjoy sufficient, continued organization, vigor and resilience to evolve and perpetuate as natural systems within the context of their expected natural life spans. For the moment, this relatively broad observation is sufficient to guide us toward new laws and policies that will enable higher system functioning than currently exists, while research[94] and discussions over values and goals continue.

The fact that ocean systems are dynamic over space and time, enhancing the significance of long-term patterns, need not prevent action in the short term. At a minimum, this fact should guide us not only toward expanded scientific research, but also toward enactment of additional precautionary actions and other policy-based buffers. A heightened focus on the precautionary principle in ocean policy is needed now to avoid continued harm through ignorance of the future impacts of our actions.

[91] *Id*.
[92] The Heinz Center, *The State of the Nation's Ecosystems* (Cambridge Univ. Press 2002).
[93] U.S. EPA, "Report on the Environment," at: http://cfpub.epa.gov/roe/index.cfm.
[94] Needed research is not limited to simply the physical and biological aspects of ocean functioning. Referring back to the WHO constructs for human health, additional research and analysis is needed to enhance understanding of the integrated social and mental well-being of both humans and ocean species and systems.

Operationalizing a Vision of Ocean Health

Once established, a vision of ocean health needs to be implemented to become real. Governance systems and managers will require clear targets, indicators and thresholds to guide action, measure progress, and course-correct as needed. Ecosystem complexity, the current lack of guideposts that reflect this complexity, and the difficulty of predicting and interpreting the outcomes of different management strategies will create implementation challenges. However, the existence of these complexities and challenges should not prevent work to characterize well-being and link its appearances to probable cause.[95] Through "adaptive, ongoing definition and assessment,"[96] scientists and managers can build on a baseline of information and strategies toward realizing an adopted vision of ocean health.

Categorizing the Attributes of Healthy Ecosystems

Managers prioritize measurement of attributes essential to ecosystem health in order to evaluate ecosystem condition and assess progress towards ocean health. Attributes divide up the universe of ecological information into a logical framework of ecological patterns and processes.

As noted earlier, Costanza and Mageau offer three overarching attributes for assessing ecosystem health: vigor, resilience and organization.[97] September 2015 workshop participants discussed application of these attributes toward developing information useful for ecosystem managers. In doing so, they built on Fowler's (2009) question, "What kind of ecological data are required for ecosystem health assessment?"[98] Examples of criteria (and by extension, necessary data) that will help inform the status of these three attributes include:[99]

- Organization: Ratio of r-selected species to K-selected species; ratio of short-lived species to long-lived species; ratio of exotic to endemic species; degree of mutualism; rate of extinction of habitat specialists
- Vigor: Primary productivity; nutrient cycling

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[95] *See, e.g.,* Ecosystem Health, *supra*, p. 43.
[96] Costanza and Mageau, *supra*, p. 105.
[97] Another example of "essential ecological attributes" was developed for the Great Lakes region. These attributes were categorized based on whether they are an ecological "pattern" (biotic condition, landscape condition, and chemical and physical condition) or "process" (energy and material production, cycles and flows; hydrology and geomorphology; and natural disturbance regimes). "Ecological processes create and maintain patterns of habitat and ecological structure. The patterns in turn influence other ecological processes." Great Lakes Inform, "Essential Ecological Attributes of Ecosystems," at: http://greatlakesinform.org/knowledge-network/497#sect2.
[98] Fowler (2009), *supra*, p. 47. Fowler answered this question as follows: "In systemic management this involves measuring ecosystem-level properties (e.g., biodiversity, mean trophic level, mean population variability, size selectivity as a function of body size, or total productivity)." *Id.*
[99] Ecosystem Health, *supra*, p. 27, Table 2.2.

- Resilience: Recovery rates from natural perturbations; resistance to natural perturbations

Workshop participants emphasized that an important challenge in responding to Fowler's question is that most ecological assessments currently focus on the organization attribute at the expense of vigor and resilience, which can in fact be more effective measures of ecosystem process or function. Opportunities exist, however, for filling these gaps. For example, scientists can track vigor through such variables as food web structure, primary production and energy flow. For example, the Continuous Plankton Recorder has been used to track abrupt shifts in ecosystems due to global warming, but this information also tells us the types and strengths of energy flows in marine ecosystems (thereby informing ecosystem function and vigor). It does so by tracking community body size; for example, in overexploited ecosystems, it could track lower trophic level species' increase in biomass.[100]

Measuring resilience could be considered somewhat analogous to stress tests in medicine, though the effort would usually be considerably more challenging for ecosystems (especially in a nonequilibrium context).[101] Both biodiversity and life history patterns can help provide insight into ability of a system to maintain its structure and pattern of behavior in the face of stress. With regard to biodiversity, "[e]cological data and theory suggest . . . that declines in diversity due to any single driver are likely to reduce resilience to other environmental changes or human activities . . . ."[102] Biodiversity is integral to an ecosystem's stability and function. High species richness (i.e., number of species in an ecosystem) is an indicator of high ecosystem stability and the ability to withstand disturbances. The relative abundance of species (evenness) may signal a disturbance and a state away from an ecosystem's normal form and function. For example, after a contamination event, more tolerant species will increase in abundance and others will die off, decreasing evenness.[103] Additionally, the presence of opportunistic diseases may indicate a shift away from resilience, because "opportunistic marine pathogens only cause disease in immune-compromised or stressed hosts."[104]

Life history patterns similarly provide information as to the resilience of a system.[105] For example, studies show that K-strategists do not perform as well in changing environments,

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[100] Rombouts, *supra*, p. 357.
[101] Ecosystem Health, *supra* pp. 28-29 (describing example of New Mexico grassland recovery after a severe drought).
[102] Ocean Health, *supra*, p. 115.
[103] Emma Johnston and David Roberts, "Contaminants reduce the richness and evenness of marine communities: A review and meta-analysis," *Environmental Pollution* 157: 1745-1752, 1748 (2009).
[104] *See, e.g.*, Colleen Burge *et al.*, "Special Issue Oceans and Humans Health: The Ecology of Marine Opportunists," *Microb. Ecol*. 65:869 (2013), at: http://www.eeb.cornell.edu/harvell/Publications_2013_files/Burge%20et%20al%202013%20OHH%20Microbial%20Ecology.pdf.
[105] Gary Griffith and Elizabeth Fulton, "New approaches to simulating the complex interactions of multiple human impacts on the marine environment," *ICES Journal of Marine Science* 1-11, at 2, 6 (2014), at: http://icesjms.oxfordjournals.org/content/early/2014/01/01/icesjms.fst196.full.pdf+html.

while r-strategists proliferate after extreme disturbances and in weakened hosts.[106] For example, K-selected fish are known to be "highly sensitive to overfishing and once depleted, recovery requires a long time."[107]

Finally, in addition to better data on such variables, better understanding of the interdependencies of *relationships* among variables will more accurately measure attribute status, and correspondingly ocean health. Such relationship variables necessarily include humans, as we are fundamentally interconnected with marine ecosystems. Scientists note that such "rigorous investigations on the human dimensions of ecosystems" is essential to understanding marine systems. Ignoring the fact that humans are integral to the marine system "is akin to ignoring basic elements of ecosystems such as upwelling, plankton productivity, and fish population dynamics."[108]

For example, fishing controls can be improved by considering humans not as detached users of the ocean, but as predators who need to be intimately cognizant of all aspects of the system around them.[109] "Predator-prey relationships and their interactions at the population, community and ecosystem levels" provide important information on the impacts of both predation and changing environmental conditions, and may prompt changes in environmental policy otherwise unconsidered.[110] Most of the literature to date has focused primarily on top predators and their interactions with prey.[111] More attention is needed on the rest of the ecosystem (*e.g.*, assessing the interactions of three or more trophic levels).[112]

Targets, Indicators and Thresholds

Managers require clear, timely, accurate information about ecological status and trends to make effective decisions relating to achievement of ocean health goals. Characterization of criteria within categories of key ecological attributes (organization, vigor, resilience) helps improve broad reporting of scientific data and conclusions to managers and decisionmakers. More detailed information, however, is needed for day-to-day decisionmaking and rule setting. Targets, indicators and thresholds can help provide this needed guidance and information.

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[106] Peter Adams, NOAA-NMFS, "Life history patterns in marine fishes and their consequences for fisheries management," *Fishery Bulletin* 78(1):1-12 (1980), at: https://swfsc.noaa.gov/publications/CR/1980/8001.PDF. K-strategists are those species whom produce few offspring, usually later in life, and invest a lot of energy in them, whereas r-strategists reproduce quickly and have large numbers of offspring. However, some species, like marine fish, show both life histories depending on the environment. *Id*., p. 1.
[107] *Id.*
[108] Jamael Samhouri *et al*., "Lessons learned from developing integrated system assessments to inform marine ecosystem-based management in the USA," *ICES Journal of Marine Science* 71(5) 1205-1215, 1209 (2014) (Samhouri (2014)).
[109] *See, e.g*., Fowler (2009) (covering this topic extensively); Fowler (2014), App. II.
[110] Griffith and Fulton, *supra*, p. 1.
[111] Rombouts, *supra*, p. 355.
[112] *Id.*, p. 360.

Targets are "point[s] of reference on the specific status or amount of benefit that equals goal achievement."[113] Targets help provide guideposts that indicate success or the need to change course. They can be based on an ideal state,[114] historical status, or "maximum possible value."[115]

Indicators represent the "physical and ecological components and processes that provide effective warning signals for changed conditions in relation to management goals."[116] A combination of "descriptive indicators related to ecosystem structure (i.e., diversity, species composition, abundance) and functional indicators that measure ecosystem activities (i.e., productivity, nutrient cycling, ecosystem metabolism)" will best capture the health of marine ecosystems.[117] Ideally, each indicator should represent a different aspect of the system and simultaneously capture the complexity of the ecosystem.[118] While it is challenging to develop indicators that represent the ecosystem at large, are easy to measure, and provide early warnings for managers, some suites of indicators are being adopted to measure ecosystem change and ocean health.[119]

Thresholds that mark meaningful change points or levels of concern are another important feature of most assessment and reporting approaches.[120] Defining ecologically meaningful thresholds can require substantial research and iterative pilot applications. In one recent example related to California streams, the state spent considerable effort defining expectations and thresholds for a number of ecoregions.[121] In light of this expenditure of effort, participants discussed an alternative to such quantitative development in the form of "best professional judgment" approaches (*e.g.*, Biological Condition Gradient).[122] September 2015 workshop participants agreed that such alternative approaches could be useful in some circumstances if carefully and rigorously applied.

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[113] Ocean Health, *supra*, p. 118.
[114] *Id*., p. 119 (discussing derivation options for calculating the "ideal state").
[115] *Id*., p. 118.
[116] *Id*., pp. 119-120.
[117] Rombouts, *supra*, p. 355.
[118] *Id*.
[119] Ocean Health, *supra*, p. 119 (citing the Puget Sound Partnership's indicators for monitoring ecosystem health in Puget Sound, Washington).
[120] *See, e.g., id*., p. 121.
[121] *See* Andrew Rehn *et al*., "The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams," SWAMP Technical Memorandum SWAMP-TM-2015-0002 (September 2015); at: http://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/csci_tech_memo.pdf.
[122] *See, e.g*., E. Shumchenia *et al*., National Health and Environmental Effects Research Laboratory, "A Biological Condition Gradient Model for Historical Assessment of Estuarine Habitat Structure" (2015), at: http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=307134.

Finally, Long Term Ecological Research (LTER) programs help establish a "normal" range of ecosystem behavior, or at least help identify clear signs and patterns that indicate degradation by differentiating between "pathological states and norms."[123] Such research links environmental data, such as air and sea temperature, with biological and ecological responses to human and other disturbances over time.[124] LTER data sets are already available for many coastal sites and some pelagic ecosystems.[125]

Historical data sources can also inform changes in ocean health over time and give insight into benchmarks for management.[126] Long-term data is stored in natural records such as ice cores, peat bogs, museum specimens and sediments. For example, through paleolimnology we can glean from lake sediments such information as historic pH, eutrophication salinity, vegetation and taxa.[127]

REPORTING ON OCEAN HEALTH

Scientific information needed to indicate and track progress toward ocean health needs to be presented to managers in a readily accessible manner. September 2015 workshop participants noted that policymakers generally welcome scientific information in summary form, such as an index or report card. An effective ocean health report card would assess progress toward ocean health, support adjustments to the definition as needed, and offer a sound scientific foundation for robust, flexible, adaptive, and holistic management philosophies and responses. Participants added, though, that initial versions of an ocean health report card might not be able to report in more than narrative terms for many metrics.

Workshop participants suggested that assessments and reporting ideally should be built around ecosystem attributes (organization, vigor, resilience) applied across all systems and habitats, with lower-level metrics appropriate to each attribute (*e.g.*, biodiversity, mean trophic level, total productivity, community structure, abundance of key species, quality of essential habitat, amount and frequency of specific disturbances, etc.) divided further by system or habitat. Participants felt that this structure would enable attributes to be rolled up across different systems and habitats if desired, allowing different systems to be compared in meaningful ways for different audiences. This approach avoids the problem of forcing all systems to be assessed with the same metrics. At the same time, though, workshop participants noted that it is

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[123] Ecosystem Health, *supra*, pp. 21, 44.
[124] *See, e.g.*, Gretchen Hofmann *et al.*, "Taking the Pulse of Marine Ecosystems: The Importance of Coupling Long-Term Physical and Biological Observations in the Context of Global Change Biology," *Oceanography* 26(3): 140 (2013). *See also* Ocean Health, *supra*, p. 119.
[125] Hofmann, *supra*, p. 146.
[126] Ocean Health, *supra*, p. 113.
[127] Ecosystem Health, *supra*, p. 210.

important to have the ability to disassemble an overall score into its component sub-scores for closer examination.

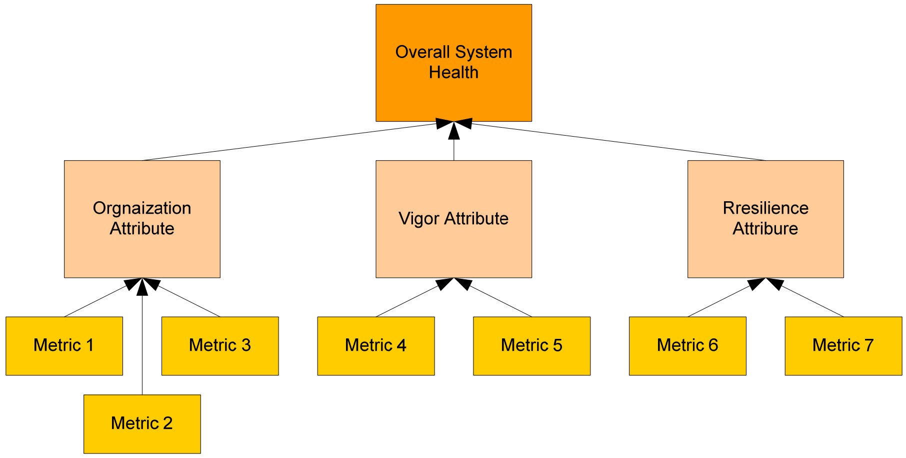

Fig. 1: Roll-up of metrics and attributes toward ocean health scores.

With regard to report card structure, September 2015 workshop participants recommended that organization, vigor, resilience be presented on a separate axis, with stressors, vulnerability, uses, and other interactions with the human system on other axes. They felt that this structure would prevent the confounding that can stem from integrating stressors and vulnerability with health, and thus would make it easier to separate out human impacts.

Developing a report card that avoids conflation of ocean health with other factors also would allow researchers to better identify and examine different situations with similar levels of human activity/stress but different conditions or health. For instance, high stress could result in higher or lower levels of vulnerability depending on system resilience. Embedding services or stressors in the core health index can therefore lead to artificially lower or higher results not reflective of health. As one example, the Santa Monica Bay Restoration Commission report card[128] includes vulnerability as a part of the overall measure of health, while California's Integrated Assessments of Watersheds[129] measures vulnerability on a separate axis. The separation allows for results that include: healthy and not vulnerable, healthy and vulnerable, unhealthy and vulnerable, etc. These help define targets for protection, restoration, and other management actions. The Healthy Reefs Initiative report card[130] also separates health and stressor axes, as does the Australia Great Barrier Reef Outlook report.[131]

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[128] Santa Monica Bay Restoration Commission, "State of the Bay 2010, at: http://www.smbrc.ca.gov/docs/sotb_report.pdf.

[129] http://www.epa.gov/sites/production/files/2015-11/documents/ca_hw_report_111213_0.pdf.

[130] Healthy Reefs Initiative, "Mesoamerican Reef: An Evaluation of Ecosystem Health" (2015); at: http://www.healthyreefs.org/cms/wp-content/uploads/2015/05/MAR-EN-small.pdf.

[131] Australian Great Barrier Reef Marine Park Authority, Great Barrier Reef Outlook Report (2009); at: http://www.gbrmpa.gov.au/managing-the-reef/great-barrier-reef-outlook-report/outlook-report-2009. *See also*

Finally, when reporting on ecosystem health, decisions will need to be made about how to weigh various ecosystem components to come up with a final assessment of health.[132] This involves deciding on the relative importance of each component to the functioning of the system as a whole – a process that involves *both* science and values.

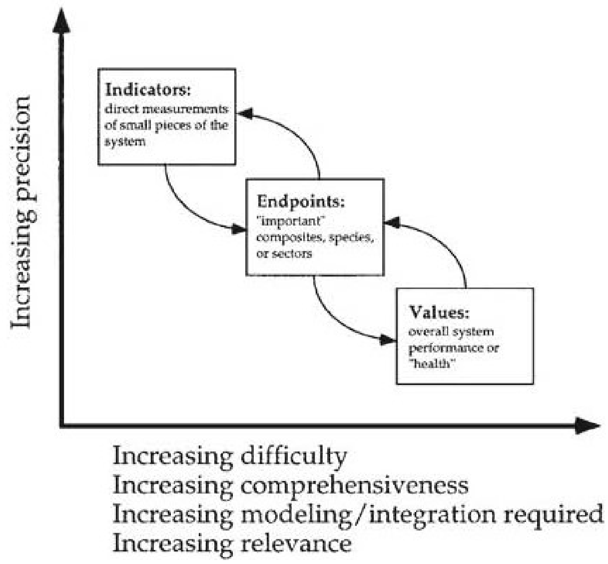

Fig. 2: Relationship between indicators, endpoints and values (Costanza and Mageau (1999))

Figure 2 above shows the progression from directly measured "indicators" of a component's status, through "endpoints" that are composites of these indicators, to an assessment of "health" with the help of "values."[133] For example, the Ocean Health Index prioritizes economic values in weighing the various components of ecosystem health (*e.g*. fishing and aquaculture industry health, versus the health of fish and habitats). As reported in the OHI's 2013 Summary results, the OHI grades down nations that "underuse ocean benefits ... to protect resources against future uncertainty." Weighting factors are often policy decisions, and so should be considered in the development of the vision and goals for ocean health.

Great Barrier Reef Outlook Report (2014); at: http://www.gbrmpa.gov.au/managing-the-reef/great-barrier-reef-outlook-report.

[132] *See, e.g*, Ecosystem Health, *supra*, pp, 232-233; *see also* Costanza and Mageau, *supra*.

[133] Costanza and Mageau, *supra*, p. 106.

ADVANCING OCEAN HEALTH THROUGH SCIENTIFIC RESEARCH

Scientific Research Is Needed to Help Inform and Implement Policy

The public can elucidate its values and help develop policy in light of scientific data summaries. Managers require additional scientific data to inform their application of these values and policies. Incomplete information should not create decisionmaking paralysis, however. Researchers can develop tools to help identify the "crucial properties of a system that determine its dynamics and the strategic points for experimentation, measurement and intervention."[134]

Nonetheless, a lack of sufficiently comprehensive scientific information remains a significant challenge to the implementation of directives to achieve ocean health. Heightened attention needs to be paid to scientific research now in order to course-correct the oceans' slide toward degradation. While this process continues, damage must be prevented and mitigated through more and stronger precautionary measures in law and policy, as discussed in the next section.

The European Union has adopted a Strategy for Marine and Maritime Research[135] to help implement its Marine Strategy Framework Directive. This Strategy may help inform additional needed research in California and worldwide. Examples of the EU's priority areas of inquiry include:

- Processes and functioning of the marine environment;
- The functional role, evolution, protection and exploitation of marine biodiversity;
- The impact of human activities (land-based and marine) on coastal and marine ecosystems and how to manage these (including via eco-efficient technologies);
- How to apply an ecosystem approach to resource management and spatial planning . . . .; [and]
- Many elements related to the deep-sea. . . .[136]

Other potential research areas, including areas recommended by the participants in the September 2015 workshop, are outlined below (this list is not exhaustive).

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[134] Ecosystem Health, *supra*, p. 120.

[135] Commission of the European Communities, COM(2008) 534 final, "A European Strategy for Marine and Maritime Research A coherent European Research Area framework in support of a sustainable use of oceans and seas," at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008DC0534.

[136] http://ec.europa.eu/environment/marine/research/index_en.htm.

Evaluation of Patterns Helps Account for the Complex Nature of Ecosystems

One challenge to tracking progress toward ocean health involves accounting for how species and habitats react to stressors given the complexity of *systemic interactions over time*; that is, considering the ecosystem as an integrated system, rather than simply combining multiple separate elements of a system in an additive way. This effort incorporates integrated science, which is a "rarity in many regions" even though it is key to the evolution of comprehensive management.[137] This effort also must necessarily incorporate cumulative impacts and interactions.[138]

Examination of systemic interactions over time further includes attempts to untangle the contributions from humans as opposed to natural fluctuations, in order to most effectively target our preventative and restorative actions. For example, the California Current system exhibits normal shifts on multi-year and decadal scales related to El Niño and the Pacific Decadal Oscillation, respectively. During different phases of these processes, some species will rise and others will fall in abundance, and their distributions will shift sometimes dramatically. As a result, information on single species in isolation will be difficult to interpret; this is particularly true where we have only a few replicates for ecosystem trends (such as El Niños).

Characterizing the *rate and process of change over time*, rather than only at single points of time, helps build important, missing datasets that can help managers track progress and spot (or even predict) system turning points. Changes in the expected (*i.e*., natural) rates and processes of change can provide critical clues and should be considered in policymaking and preventive action. For example, "increased spatial and temporal variance, and a phenomenon known as 'critical slowing down' . . . where ecosystems take longer to recover from a disturbance, are thought to be robust early warning indicators of ecosystem shifts."[139] Such information can help develop better early warning indicators and thresholds for managers.

Another, related area of research related to systemic changes over time involves the fact that *impacts lag and last*. We push this fact aside in our regulatory and planning programs, which manage primarily within the context of the current generation of stakeholders. A more holistic ocean health policy would consider the impacts of our actions on both current and future generations of systems and people. For example, Australia's Environment Protection and

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[137] Samhouri (2014), *supra*, p. 1206. NOAA Is developing an Integrated Ecosystem Assessment (IEA) model to deliver "integrated, cross-sectoral science to support EBM." NOAA selected the California Current ecosystem for the first full IEA development. *Id.*, p.1207.
[138] For instance, there are "very few examples of reference points that delineate an acceptable level of cumulative stressors or changes to ecological structure, composition, or functions from those stressors . . . ." Ocean Health, *supra*, p. 121.
[139] *Id.*, p. 203.

Biodiversity Conservation Act 1999 calls for intergenerational equity.[140] The rates of change in marine systems are faster now than previously seen in recorded human history, but we still have not established a clear place in our governance systems to account for such changes. As discussed further in the next section, our laws and agencies place numerous impediments on the making of needed policy adjustments in the face of unanticipated rates of change. Climate change in particular provides an important example of this. September 2015 workshop participants accordingly identified *improved understanding of natural temporal and spatial variability in ocean systems* as a key area for both future scientific research funding and ocean policy action.

Focusing on *patterns in space and time*, and *patterns among ecosystem components*, will help with this task and also provide a practical additional area of research into understanding existing, extraordinarily complex information. The large spatial and variability scales make this a daunting task, however. Scientists currently understand processes across this range of scales only in smaller and more well-studied systems. Spatial heterogeneity in particular can be a critically important factor that can be addressed relatively well on the local level, but is more challenging on a wider scale. For example, spatial variability and connectivity in the ocean is much larger than what is captured by the state's network of marine protected areas. Because all spatial and temporal scales cannot be covered without a large expenditure of effort, participants suggested prioritizing study of spatial and temporal scales most relevant to management audiences.

One note of caution mentioned earlier that bears repeating is that there is a particular danger in using the observed range of natural variability to set specific, local expectations of "normal form and function." Rationalization is a common human trait, and it is important to be aware of when that might be happening in policymaking. As noted by the September 2015 workshop participants, if policymakers select the lower end of the range of natural variability as the expectation (the "normal" state of being), they could continue or even accelerate the current slide toward degradation.

Local Pilot Projects

Characterizing integrated change over time can provide critical decisionmaking information, perhaps more useful than capturing numerous isolated aspects of ecosystem condition. Sites with little variability are good for this purpose, but the tradeoff in studying such sites is losing the potential for understanding local variability. This argues for development of well thought-out, hybrid monitoring designs that measure both local variability and longer-term trends and

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[140] Environment Protection and Biodiversity Conservation Act 1999, Ch. 1, Part 1, Sec. 3A(c), at: https://www.legislation.gov.au/Details/C2015C00422 ("the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations").

signals in areas with low local variability. For example, one model specifically used off the coast of Australia to evaluate various fishery management strategies may be applied to assess the effects of pollution, habitat loss, species invasion and climate change in other ecosystems around the world.[141]

Many models to date used to assess ocean health are either regional/long-term or local/short-term.[142] This further argues for combining multiple models or expanding spatial and temporal data to gain a holistic view of ocean health. September 2015 workshop participants agreed that significant attention needs to be paid to conducting research that will better articulate the temporal and spatial variability associated with marine ecosystems, beginning with those ecosystems most critical to policy decisions. Given the scope of this task, they reflected that pilot projects on a localized level may be a useful first step. In accomplishing this effort, workshop participants noted the increasing development and value of historical ecology in filling data gaps and/or extending expectations of condition further back in time. They offered that a pilot project or proof of concept linked to marine protected areas might provide a key study option by allowing for consideration of network and connectivity effects over larger scales.

An additional use for pilot projects is to better understand the terrestrial-marine interface and begin to predict when land-based restoration efforts can improve marine ecosystem health. For example, reforestation in the Erimo National Forest in Hokkaido, Japan led to significantly improved nearshore marine habitat adjacent to the forest.[143] Similar phenomena in California and elsewhere could generate additional support for land-based coastal restoration efforts that might also benefit ocean health.

Other Research Needs

<u>Baseline Information and Protected Areas</u>

To assess the attributes of ocean health, baselines should be established. One way to establish baselines is to determine the ideal state of an ecosystem, which is derived from the functional relationship between the indicator and the natural or human pressure. There is limited data on

[141] *Id.,* p. 361 (discussing the "Atlantis" model).

[142] Rombouts, *supra*, p. 356. For example, indicator species and functional groups can provide useful tools in determining population abundance and community structure and composition, but may be limited to local scales and short time spans. *Id*. Determining ecological attributes on a regional scale and in the long term may require such tools end-to-end (E2E) models, mass-balanced models and isotope profile analysis*. Id.*

[143] Jan Walls and Masao Kunihiro, "Mountains, Water, Wood, and Fish: Chinese and Japanese Perspectives on Nature and Ecology," in *Traditional and modern approaches to the environment on the Pacific Rim: tensions and values,* Harold Coward (ed.), 125-134, 129-30 (State Univ. of NY Press, Albany 1998). *See also* "Restoration of coastal forest for the purpose of recovery of marine resources and improvement of living environment in Cape Erimo, Hokkaido Prefecture, Japan," at: https://www.env.go.jp/nature/satoyama/syuhourei/pdf/cje_5.pdf.

these relationships to date, however.[144] Research is accordingly needed into developing modeling, historical data, and other tools to inform understanding of these relationships. Sites free of human disturbance in the same or similar habitat can also provide useful information; examples could include well-enforced marine protected areas (MPAs).[145] Given the impacts of land-based stressors on the ocean, information from well-enforced terrestrial protected areas adjacent to MPAs should also be considered in this research effort.

Long-term Data

Setting expectations for ocean health in context requires adequate data or models. In other words, long-term data is important to fully understanding what is "normal." Because species and conditions are not static over time, information needed to set expectations will require investigation into long-term datasets, historical data, and historical ecology studies.

One approach discussed at the September 2015 workshop might be to look at longer time frames (*e.g.*, 50-year increments) and ask, "What it is across all of these snapshots that is consistent?" This might be possible in some cases. For instance, data extending back several hundred years are available for some pelagic species, and longer-term history for some systems can be generated with other methods (*e.g.*, fish scales preserved in anoxic sediments in deep basins off the California coast).

Another suggestion is to expand existing Long-Term Ecological Research[146] programs under the auspices of the National Science Foundation. These currently only highlight sites with "critical ecosystem services."[147] This research should be expanded to include more sites important to predicting responses of species and communities to stressors such as climate change, thereby more effectively guiding policy decisions in those areas.[148]

Social and Mental Well-Being of Marine Systems

While September 2015 workshop participants discussed at some length the potential lessons to be learned from the WHO Constitution definition of human health, they felt that the definition of human health was only partially related to that for ocean health. Nonetheless, the participants recognized value in additional research and analysis on defining the social and mental well-being of marine systems in addition to physical well-being, reflecting on inclusion of these elements in the definition of human health. These are little-studied areas that may

[144] Ocean Health, *supra*, p. 118.
[145] *Id.*, p. 113.
[146] https://www.lternet.edu/.
[147] Hofmann, *supra*, p. 145.
[148] *Id.*

provide important clues about relationships among humans and marine species, which then may warrant heightened law and policy action.[149]

Enhancement of the Utility of Existing Data

Another strategy for improving on data accessibility is evaluating data gaps and prioritizing opportunities to fill those gaps by synthesizing new regional data. For example, the West Coast Data Portal[150] recently recommended filling data gaps through regional synthesis of data on fish and shellfish richness, invertebrate richness, and seabird richness. The West Coast Data Portal also works to integrate priority data catalogs, such as ScienceBase, NOAA Digital Coast, California Coastal Atlas, and numerous others to ensure the information in these datasets is readily usable by the planning and decisionmaking community. Additional support for such efforts to glean information from existing data can provide more immediate, cost-effective information while research in other areas continues.

Miscellaneous Research Needs

Finally, September 2015 workshop participants identified additional measurement challenges and opportunities related to achieving ocean health. One area of additional needed research identified was assessment of all three potential attributes of ocean health – organization, vigor and resilience. Participants noted in particular the dearth of information on vigor and resilience to date and emphasized that metrics for understanding and evaluating vigor and resilience are particularly important areas for further scientific inquiry.[151]

Other research areas that September 2015 workshop participants recommended for further research included the following:

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[149] For example, cetacean scientists at the 2012 AAAS conference presented a "Declaration of Rights for Cetaceans: Whales and Dolphins" that called for rights for whales and dolphins to "basic needs." Legal rights cited included rights "to stay alive, to not be confined, to make choices and travel, and … to engage in social interaction." The scientists added that it is "ethically indefensible" to kill, injure, or keep cetaceans in captivity in light of their high emotional and social intelligence. "Declaration of Rights for Cetaceans: Ethical and Policy Implications of Intelligence" (AAAS Annual Meeting, Vancouver, Feb. 19, 2012), at: https://aaas.confex.com/aaas/2012/webprogram/Session4617.html.

[150] http://portal.westcoastoceans.org

[151] Most research to date has focused on how the diversity of one species changes as a response to an external stressor. *See, e.g*., William Cheung *et al.,* Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems, *Nature* (2012), at: www.nature.com/natureclimatechange (examining 600 species of marine fish). To increase knowledge of ecosystem resilience, more research is needed to determine ecosystem richness and evenness and how such factors change with multiple human and natural disturbances. Further, indices that "consider taxonomic relatedness and multivariate analyses of community structure" detect ecological impacts better than single indicators. However, research needs to focus on expanding taxonomic clarity in order to develop such indices, because such data is lacking in most marine ecosystems. *See, e.g*., Emma Johnston and David Roberts, "Contaminants reduce the richness and evenness of marine communities: A review and meta- analysis," *Environmental Pollution* 157: 1745-1752**,** 1749 (2009).

- Defining temporal and spatial scales, given the importance of natural variability at multiple scales in ocean systems;
- Defining trajectories, given that similar outward appearances can actually be different system states;
- Deciding whether or not to combine scoring across habitats;
- Assessing the validity of assumptions of linearity in response;
- Addressing different scales of response;
- Applying metrics on different scales;
- Establishing thresholds; and
- Deciding whether to use best professional judgment (BPJ) in cases where no thresholds exist or no quantitative metrics are available (warning here that humans can tend to see the patterns they want to see rather than those that exist).

ADVANCING OCEAN HEALTH THROUGH LAW AND POLICY

As described above, existing environmental laws have largely failed to stop and reverse the trend of ocean degradation. This is in part due to their implicit acceptance of an overarching economic model that characterizes the natural world as a "resource" for consumption and profit. We have yet to meaningfully examine and begin to adjust the destructive values underlying this economic system.

Ocean experts around the world similarly note that "[t]echnical means to achieve the solutions to many [ocean] problems already exist," but

> current societal values prevent humankind from addressing them effectively. Overcoming these barriers is core to the fundamental changes needed to achieve a sustainable and equitable future for the generations to come and which preserves the natural ecosystems of the Earth that we benefit from and enjoy today.[152]

A process for reexamining societal values is discussed in some detail in the next section. Assuming that values do begin to shift to allow for stronger ocean protection laws and policies, a suite of approaches for changing such laws is described below.

Building Precaution into Decisionmaking

Most immediately, we must build enhanced precautionary approaches into all of our environmental governance systems. IPSO/IUCN marine experts recommend "[p]roper and

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[152] IPSO Report, *supra,* p. 7.

universal implementation of the precautionary principle by reversing the burden of proof so activities proceed only if they are shown not to harm the ocean singly or in combination with other activities."[153] The California Ocean Protection Act itself states that the

> governance of ocean resources should be guided by principles of sustainability, ecosystem health, *precaution*, recognition of the interconnectedness between land and ocean, decisions informed by good science and improved understanding of coastal and ocean ecosystems, and public participation in decisionmaking.[154]

In light of the identified gaps in knowledge about ocean systems, September 2015 workshop participants noted that precautionary approaches should be enhanced throughout marine law and policy, to help avoid further degradation and potentially allow for a reversal of condition toward health.[155] Additional precautionary steps built into decisionmaking will also help buy the time needed to create and implement improved management strategies, and to identify emerging patterns of degradation that need to be swiftly addressed.

Accordingly, new laws and policies should be advanced to apply the precautionary principle[156] in all relevant agency decisionmaking processes (*i.e*., beyond simple CEQA review). Further, wherever possible the burden of proof should be shifted from the public (who now generally must show harm to prevent injurious action) to those that would use the ocean to show "no net harm."

Directing Agencies to "Consider" COPA in Regulatory and Management Processes

The California Ocean Protection Act (COPA) recognizes the importance of a healthy ocean and the need to manage it through integrated agency action that reflects the interconnected nature of the ocean itself. Careful review of COPA provides insights into potential opportunities for more thoroughly implementing its provisions, and for advancing news laws and policies that actually improve the health of the ocean (*i.e*., as opposed to merely "avoiding disease or infirmity").

With regard to the responsibilities of agencies with coastal and ocean authority, COPA declares:

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[153] *Id.*, p. 8.
[154] Pub. Res. Code § 35505(c).
[155] *See, e.g*., Fowler (2014), *supra*, pp. 12-19.
[156] The Wingspread Statement on the Precautionary Principle (January 1998) states that: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. The process of applying the precautionary principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action." At: http://www.sehn.org/precaution.html.

> It is the state's policy that *all* public agencies *shall consider* the following principles in administering the laws established for the protection and conservation of coastal waters:
>
> (1) State decisions affecting coastal waters and the ocean environment should be designed and implemented to conserve the health and diversity of ocean life and ecosystems, allow and encourage those activities and uses that are sustainable, and recognize the importance of aesthetic, educational, and recreational uses.
> (2) The ocean ecosystem is inextricably linked to activities on land and all public agencies should consider the impact of activities on land that may adversely affect the health of the coastal and ocean environment.
> (3) It is the state's policy to incorporate ecosystem perspectives into the management of coastal and ocean resources, using sound science, with a priority of protecting, conserving, and restoring coastal and ocean ecosystems, rather than managing on a single species or single resource basis.
> (4) A goal of all state actions shall be to improve monitoring and data gathering, and advance scientific understanding, to continually improve efforts to protect, conserve, restore, and manage coastal waters and ocean ecosystems.
> (5) State and local actions that affect ocean waters or coastal or ocean resources should be conducted in a manner consistent with protection, conservation, and maintenance of healthy coastal and ocean ecosystems and restoration of degraded ocean ecosystems.
> (6) Improving the quality of coastal waters and the health of fish in coastal waters should be a priority for the state.[157]

The legislative declaration that relevant agencies "shall consider" the above "35510(b) factors" requires only an evaluation of the factors; it does not mandate specific action to *implement* them. The mandate to "consider" is further qualified by the fact that most of the factors themselves are permissive ("should") rather than mandatory ("shall"). However, Section 35510(b) nonetheless calls on agencies to at least demonstrate clearly that they are making the above factors an active and important part of their coastal and ocean decisionmaking. This conclusion is consistent with the additional declaration that the purpose of COPA is to "integrate and coordinate the state's laws and institutions responsible for protecting and conserving . . . coastal waters and ocean ecosystems."[158]

Examples of areas in which agencies should incorporate the 35510(b) factors include but are not limited to:

[157] Pub. Res. Code § 35510(b) (emphasis added).
[158] Pub. Res. Code § 35515.

- Development of new regulations, standards, plans and programs;
- California Environmental Quality Act (CEQA) reviews, including Substitute Environmental Documents as well as Environmental Impact Reports (EIRs);
- Decisions on funding and program prioritization; and
- Decisions on specific actions related to implementation, enforcement and litigation activities pursuant to existing authorities, including the Public Trust Doctrine (discussed further below).

Other agencies' mandates to "consider" certain factors in their decisionmaking can provide insight into the scope of COPA's requirement in Section 35510(b). As one example, useful initial input could potentially be obtained from the State Water Resources Control Board and Regional Water Quality Control Boards with regard to their implementation of Water Code Section 13241. This section requires the Regional Water Quality Control Boards to "consider" a suite of factors in establishing water quality objectives and setting waste discharge requirements.[159] Failure of the regional boards to demonstrate that they considered these factors when called for can result in a cause of action against the Board for failure to meet this mandatory duty.[160]

In another example, CEQA states that before taking specific actions, lead agencies "shall consider" the following (among other considerations): the provisions of a negative declaration,[161] EIR,[162] negative declaration or final EIR;[163] comments received on a draft EIR;[164] the views of the public;[165] and the significance of cumulative impacts.[166]

These and other examples of statutory requirements to "consider" various factors affecting environmental decisionmaking shed light on the mandate in COPA for agencies to consider the 35510(b) factors in their own ocean and coastal planning and decisionmaking. However, given courts' deference to agency decisionmaking, and the qualified language of the COPA 35510(b) factors, it may be somewhat difficult to ensure that this consideration has meaningful effect. In other words, as long as agencies make some attempt to comply with the requirement to

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[159] Water Code § 13263(a) ("The regional board, after any necessary hearing, shall prescribe requirements as to the nature of any proposed discharge . . . . The requirements . . . shall take into consideration . . . the provisions of Section 13241").
[160] *See, e.g.*, *City of Burbank v. State Water Resources Control Board*, 35 Cal.4th 613 (April 4, 2005); at: https://casetext.com/case/city-of-burbank-v-state-water-resources-control-bd.
[161] Pub. Res. Code § 21091(f); 14 Calif. Code of Regul. § 15074(b).
[162] 14 Calif. Code of Regul. § 15121(a).
[163] 14 Calif. Code of Regul. §§ 15004(a), 15050(b).
[164] Pub. Res. Code § 21091(d)(1).
[165] 14 Calif. Code of Regul. § 15064(c).
[166] 14 Calif. Code of Regul. § 15064(h)(1).

"consider," courts will likely find that sufficient.[167] This result may be particularly likely given that the legislative history of COPA demonstrates that the chaptered legislation is weaker than the bill introduced on February 17, 2004, which states that agencies "shall *administer* [coastal] laws" in accordance with the described factors (as opposed to merely "consider" the factors in the adopted version). The introduced version also included a sentence deleted from the adopted version stating that "agencies should refrain from actions that would cause harm to ocean and coastal ecosystems or impair [their] restoration . . . ." The deletion of this sentence further supports an interpretation of deference toward agencies' actions, including their interpretation of "shall consider" (though it does not, of course, obviate that responsibility).

Implementing the Public Trust Doctrine

In addition to mandating agency consideration of the Section 35110(b) factors, COPA additionally declares that the coastal and ocean ecosystems "are natural resources that the state *holds in trust* for the people of the state."[168] Accordingly, an additional strategy that the OPC and advocates can pursue to enhance protection of ocean health is ensuring significantly enhanced application of the Public Trust Doctrine[169] to decisions affecting the coast and ocean.

The Public Trust Doctrine dates back to Roman times and the Code of Justinian, which proclaims that "[b]y the law of nature these things are common to all mankind – the air, running water, the sea and consequently the shores of the sea."[170] California has adopted a particularly broad interpretation of the Public Trust Doctrine.[171] For example, in California the doctrine encompasses the "preservation of those lands in their natural state, so that they may serve as . . . environments which provide food and habitat for birds and marine life."[172] The state Supreme Court further articulated that "[t]he state has an affirmative duty to take the public trust into account" in decisionmaking "and to protect public trust uses whenever feasible,"[173] consistent with its "duty . . . to protect the people's common heritage . . .

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[167] For example, the appellate court in *Cities of Arcadia, et al.*, *v. State Water Resources Control Board* found that because Water Code Section 13241 "does not . . . specify a particular manner of compliance," the "matter is within the regional board's discretion." *Cities of Arcadia, et al.*, *v. State Water Resources Control Board,* 135 Cal.App.4th 1392, 1415-1418 (4th Dist., Div. 1, Jan. 26, 2006, review denied April 19, 2006); at: http://resources.ca.gov/ceqa/cases/2006/City_of_Arcadia_v._State_Water_Resources_Control_Board.pdf.
[168] Pub. Res. Code § 35511(a) (emphasis added).
[169] *See, e.g.*, Mary Christina Wood, *Nature's Trust Environmental Law for a New Ecological Age* (Cambridge Univ. Press, New York, NY 2013).
[170] J. Inst. 2.1.1 (The Institutes of Justinian, Thomas Collett Sanders trans. 158 (1876), citing Institutes of Justinian 2.1.1 (AD 533)); cited in Tim Eichenberg *et al*., "Climate Change and the Public Trust Doctrine: Using an Ancient Doctrine to Adapt to Rising Sea Levels in San Francisco Bay," *Golden Gate Univ. Law Journal* 3(2), 243-281, 247 (2010), at:
http://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1041&context=gguelj.
[171] *See, e.g.*, Eichenberg, *supra*, pp. 249-251.
[172] *Marks v. Whitney*, 6 Cal.3d 251, 259-260, 491 P.2d 374 (1971).
[173] *Nat'l Audubon Society v. Superior Court of Alpine County*, 33 Cal. 3d 419, 446, 658 P.2d 709 (1983); at: https://www.courtlistener.com/opinion/1174072/national-audubon-society-v-superior-court/.

surrendering that right of protection only in rare cases when the abandonment of that right is consistent with the purposes of the trust."[174]

Despite the applicability of the Public Trust Doctrine to California's coast and ocean, relatively little formal agency attention has been paid to implementing the doctrine fully in order to advance ocean and coastal health. The OPC and ocean advocates can promote heightened agency attention to the doctrine and seek a formal, integrated state structure within the OPC for holding agencies accountable for its implementation. For example, the State Water Resources Control Board has established a Public Trust Unit to address water rights and flow issues. While its efforts remain fairly preliminary, it is noteworthy that the State Water Board has committed through the Unit to exercising its mandate to protect natural systems and species "held in trust for the public," through actions to "protect public trust uses whenever feasible" and to "consider these responsibilities when planning" and making other decisions."[175] The OPC and advocates could encourage similar, coordinated commitments and efforts among agencies with coastal and ocean responsibilities.

Of course, another area of effort to improve public trust doctrine implementation would be agency-targeted[176] litigation to enforce its provisions, including but not limited to, in the context of CEQA reviews.[177] This may be most effective in areas especially vulnerable to human-caused impacts, much as Mono Lake was undeniably threatened by water diversions for the City of Los Angeles.[178]

Ensuring the OPC Recommends Needed Changes in State Law

COPA states that the OPC "*shall* . . . [i]dentify and recommend to the Legislature changes in [state] law needed to effectuate the goals of this section."[179] "This section" refers to Section 35615, which reads in relevant part:

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[174] *Id*., p. 441.

[175] *See* http://waterboards.ca.gov/waterrights/water_issues/programs/public_trust_resources/.

[176] Agency responsibilities with regard to implementation of the public trust may vary, prompting consideration of how to best maximize the utility of a lawsuit to apply the public trust doctrine to achieve ocean health. For example, the State Water Board in 1913 "had neither the power nor duty to consider interests protected by the public trust." *Nat'l Audubon Society*, *supra*, p. 444. However, "[a]mendments to the Water Code enacted in 1955 and subsequent years codify in part the duty of the Water Board to consider public trust uses of stream water. *Id*., n. 27.

[177] CEQA provisions impose an obligation to consider the public trust. *Id*., n. 27; *see, e.g*., *San Francisco Baykeeper, Inc. v. California State Lands Commission* (1st Dist., Div. 4, 2015) ___ Cal.App.4th ___, 2015 WL 7271956 (Nov. 18, 2015) (State Lands Commission's CEQA review of San Francisco Bay-Delta sand mining project approval failed to fulfill obligation to consider the Public Trust Doctrine).

[178] *National Audubon*, *supra.*

[179] Pub. Res. Code § 35615(a)(6) (emphasis added). The OPC has a related responsibility to make similar recommendations for needed changes in federal law and policy. Pub. Res. Code § 35615(b).

> The council shall do all of the following:
>
> (a)(1) Coordinate activities of state agencies that are related to the protection and conservation of coastal waters and ocean ecosystems to improve the effectiveness of state efforts to protect ocean resources within existing fiscal limitations, consistent with Sections 35510 and 35515.
> (2) Establish policies to coordinate the collection, evaluation, and sharing of scientific data related to coastal and ocean resources among agencies.
> (3)(A) Establish a science advisory team of distinguished scientists to assist the council in meeting the purposes of this division . . . .
> (4) Contract with the California Ocean Science Trust and other nonprofit organizations, ocean science institutes, academic institutions, or others that have experience in conducting the scientific and educational tasks that are required by the council.
> (5) Transmit the results of research and investigations to state agencies to provide information for policy decisions.
> (6) *Identify and recommend to the Legislature changes in law needed to achieve the goals of this section.*

(Emphasis added.)

The success of the state in general, and the OPC in particular, in meeting the legislative finding that ocean governance should be guided by sustainability, ecosystem health and precaution[180] depends on a clear line of *enforceable* accountability from the state (ideally in the form of an integrative body such as the OPC) to the agencies. The OPC cannot coordinate agency activities, including data collection[181] and research as well as ocean decisionmaking, if the agencies do not respond to OPC overtures.

The line of enforceable accountability for OPC and agency responsibilities under COPA is not currently as clear as it should be. Advocates can and should promote specific legislative recommendations for the OPC's consideration and transmittal to the Legislature in this regard. Advocates should further ensure that the OPC meets its mandate under Section 35625(a)(6) to make such recommendations itself.

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[180] Pub. Res. Code § 35505(c).

[181] A recent report on the utility of integrated monitoring found that "[d]espite the increasing awareness of terrestrial and oceanic linkages, impacts and solutions in each system are generally monitored, evaluated, and managed separately, although salmon [and other species] of course experience these habitats as one integrated whole." In this report, scientists added that the needed integrated monitoring would lead to necessary integration of regulatory activities, including integrated permitting (such as integrated water quality/water rights permits). Brock Bernstein *et al.*, "Turning Data into Information: Making Better Use of California's Ocean Observing Capabilities" (Dec. 2011), at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/SCOOP_report_12-20-11.pdf.

For instance, California marine scientists and policymakers agree that ocean ecosystems involve extraordinarily complex, constantly interacting sets of relationships. By contrast, management agencies and laws isolate elements of the ocean systems and minimize the significance of relationships and variability. A shared, holistic vision of ocean health will help integrate agency operations toward "ecological policymaking," to better reflect the complexity of marine systems. At a minimum, the state should invest in strengthening the role and authority of the OPC to bring agencies with ocean responsibilities together to more actively integrate their oversight activities across existing management boundaries. This effort should be joined by agencies with relevant inland responsibilities, as "the health of the terrestrial environment influences the health of the ocean and vice versa."[182]

Greater integration of agency operations will also enhance the understanding and implementation of ocean health goals. Participants at the September 2015 workshop noted the example of management of the Bering Sea pollock fishery, which uses integrated ecosystem research to help adjust fishery management to reflect shifting ecosystem states.[183] Combined with the North Pacific Fishery Management Council's policy of viewing humans as a predator in the system, and controlling human take to allow sufficient prey for other predators, this approach demonstrates one way in which holistic ocean health assessment and tracking can inform more proactive ocean management.

If it is to achieve ocean health, the OPC can and must implement its responsibility to offer specific recommendations regarding state law and budget changes needed to achieve this goal.[184] Advocates could help ensure this result; for example, by encouraging oversight of OPC operations by legislative policy and budget committees in order to support and prompt such recommendations.

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[182] Ocean Health, *supra* p. 115.

[183] *See, e.g.*, http://www.nprb.org/news/detail/benefits-of-integrated-research.

[184] Budget changes could include, among other strategies, cross-cut budgets that link agencies' ocean and coastal operations fiscally. *See, e.g.*, Congressional Research Service, "Crosscut Budgets in Ecosystem Restoration Initiatives: Examples and Issues for Congress" (Jan. 22, 2008), at: http://digital.library.unt.edu/ark:/67531/metadc96799/m1/1/high_res_d/RL34329_2008Jan22.pdf; Bay-Delta Federal Funding Budget Crosscut (1998-2014), at: http://www.whitehouse.gov/sites/default/files/omb/budget/fy2015/assets/bay-delta_year_by_year.pdf *and* at: http://www.gpo.gov/fdsys/granule/BUDGET-2014-PER/BUDGET-2014-PER-1-4; Memorandum from OPC and CDFW to California State Legislature, "Ocean Protection Council-Department of Fish and Game Joint Work Plan" (Nov. 29, 2006), at: http://www.opc.ca.gov/webmaster/ftp/project_pages/DFG_workplan/0611OPCBoard13_Workplan.pdf; California Cross-Cut Budget for AB 32 (2008), at: http://abgt.assembly.ca.gov/sites/abgt.assembly.ca.gov/files/hearings/april%2030th%20%20kb%202008.pdf; National Invasive Species Council Cross-Cut Budget, at: http://www.invasivespecies.gov/global/org_collab_budget/organizational_budget_performance_based_budget.html.

Recognizing in Law the Inherent Rights of Ecosystems and Species

The Constitution of the World Health Organization recognizes "enjoyment of the highest attainable standard of health" as **"**one of the fundamental rights of every human being . . . ." With regard to implementation of this articulated right, hundreds of government bodies, local to international, have adopted laws and policies that recognize and have begun to implement the human right to a healthy environment.[185] In a parallel, more recent effort, government systems around the world are also beginning to recognize the natural world's own right to exist, thrive and evolve.

Inherent human rights are deemed "inalienable" in that they spring from our existence on Earth. Just as our inherent rights arise from our existence, however, so too do the inherent rights of the natural world. We have been ignoring the inherent rights of the natural world to struggle for health and well-being, however, and the oceans (and we as interconnected beings) have been suffering as a result.

As discussed above, our environmental laws have proven inadequate to protect the Earth's natural systems, because they implicitly accept overarching legal systems that treat the natural world as resources and property. Economic and financial systems reward profit-making at the expense of ecosystems, and treat compliance with environmental regulations as a cost to be avoided. We must transform this system to one that instead recognizes and respects the inherent rights of the natural world to exist and evolve. Until our legal and economic systems inherently value the fundamental rights of nature, our environmental challenges will accelerate.

Examples of nature's rights in law exist and are growing. For instance, the 2008 Ecuadorian Constitution endows the environment with inalienable rights to "exist, persist, maintain and regenerate its vital cycles, structure, functions and its processes in evolution," and it empowers individuals to legally defend these rights on behalf of the environment. Numerous court cases and administrative actions have since upheld implementation of this provision.[186] Ecuador's initiative led to the international adoption, led by Bolivia, of the 2010 Universal Declaration of the Rights of Mother Earth, presented to the United Nations in April 2011. Since then, new national statutes in Bolivia, treaty agreements in New Zealand, and dozens of municipal

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[185] *See, e.g.*, David Boyd, *The Environmental Rights Revolution: A Global Study of Constitutions, Human Rights, and the Environmen*t (UBC Press, Vancouver 2011); *see also* United Nations Special Rapporteur on human rights and the environment, at: http://www.ohchr.org/EN/Issues/Environment/SREnvironment/Pages/SRenvironmentIndex.aspx.

[186] *See, e.g.*, Craig Kauffman and Pamela Martin, "Testing Ecuador's Rights of Nature: Why Some Lawsuits Succeed and Others Fail" (Paper Presented at the International Studies Association Annual Convention, Atlanta, GA, March 18, 2016), at: http://www.earthlawcenter.org/literature/.

ordinances across the United States (including in Santa Monica and in Pittsburgh, Pennsylvania) now recognize enforceable rights of nature.[187]

The International Union for Conservation of Nature (IUCN) similarly has recognized the importance of advancing the fundamental rights of nature in law. At its most recent Congress in 2012, the IUCN adopted a Resolution that:

1. RECOMMENDS to the Director General to initiate a process that considers the Rights of Nature as a fundamental and absolute key element for planning, action and assessment at all levels and in all areas of intervention including in all decisions taken with regard to IUCN's plans, programmes and projects as well as in IUCN policy on rights;
2. URGES the Director General to initiate a dialogue for designing and implementing a strategy for dissemination, communication and advocacy concerning the Rights of Nature;
3. URGES IUCN Members to contribute to this effort by bringing forward their national experiences concerning the Rights of Nature as part of the process of developing a Universal Declaration of the Rights of Nature that contributes to a new philosophy of human well-being; and
4. INVITES the Director General and IUCN Members to promote the development of a Universal Declaration of the Rights of Nature, as a first step towards reconciliation between human beings and the Earth as the basis of our lives, as well as the foundations of a new civilizing pact.[188]

Consistent with the growing movement around the world to recognize the fundamental rights of nature in law, California too can build ocean law that reflects the inherent rights of ocean systems to health (as similarly reflected in the WHO Constitution for humans). Such law would necessarily reflect values of care and partnership for, rather than greed and dominance over, ocean ecosystems and species.

ADVANCING OCEAN HEALTH THROUGH OUTREACH AND STEWARDSHIP

As recommended by the Pew and U.S. Commissions on Ocean Policy as well as other global marine experts,[189] we must swiftly move to adoption of ecosystem-based management of the human-marine interface. This cannot be merely a technical or policymaking exercise. Rather, as

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[187] For more information on nature's rights laws and advancements, *see* http://www.earthlawcenter.org/literature/.
[188] IUCN, "Incorporation of the Rights of Nature as the Organizational Focal Point in IUCN's Decisionmaking," Resolution WCC-2012-Res-100 (Sept. 2012, Jeju, Korea), at: http://bit.ly/1QOV39I.
[189] *See, e.g.,* IPSO Report, *supra*, p. 9 (calling for a "rapid adoption of a holistic approach to sustainable management of all activities that impinge marine ecosystems").

marine experts note, this shift to holistic insight and action "has to be part of a *wider re-evaluation of the core values of human society and its relationship to the natural world*."[190]

The ocean health visioning effort must be grounded in values and must represent fully our connection – physical, mental, and social – with the ocean. Values are a critical part of this conversation, yet they do not make themselves readily visible in traditional marine policymaking forums. A different set of discussions and forums should be considered for this initiative.

As noted by Meadows, a vision best becomes "responsible" by "sharing it with other people who bring in their knowledge, their points of view, and their visions. The more a vision is shared, the more responsible it gets, and also the more ethical . . . and the path reveals itself."[191] Accordingly, this re-evaluation of core values cannot itself be simply an agency, NGO, or industry effort. To be successful, it must seek and consider the views of, and build opportunities for stewardship among, Californians more generally. As noted in COPA, "[e]ach generation of Californians has an obligation to be good stewards of the ocean, to pass the legacy on to their children."[192] It is for this reason that COPA finds that "public participation in decisionmaking" is essential to achieving ocean health.[193] Californians must be included in the ocean health vision and values discussion.

The structure of the discussion must actively ensure appropriately wide representation and "empower the community as a whole,"[194] including "those lacking power."[195] For example, focus groups can help pull out community values and visions for ocean health more effectively than public workshops, which may stifle the give-and-take discussion needed to reach below the intellectual surface arguments. Focus groups can create an interactive, non-judgmental environment in which participants with shared experiences (such as a shared coastal community home) are empowered to offer their opinions, values and visions, become aware of the visions of others, and come to an understanding of their relationship with the coast and ocean as a common experience. The group leader in such a context would listens to and facilitate the conversation, but would not answer questions or otherwise act as the expert.[196] Through multiple focus groups, the values and vison for ocean health can emerge as guidance for government action.

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[190] *Id.* (emphasis added).
[191] Meadows, *supra*.
[192] Pub. Res. Code § 35505(a).
[193] Pub. Res. Code § 35505(c).
[194] Ecosystem Health, *supra*, p. 23.
[195] *Id.*, p. 94.
[196] For more information on the utility and recommended structure and process for effective focus groups, *see* Synneve Dahlin Ivanoff and John Hultberg, "Understanding the multiple realities of everyday life: Basic assumptions in focus-group methodology," *Scandinavian Journal of Occupational Therapy* 13: 125-132 (2006).

The questions developed for the focus group or other outreach methodology should be broad enough to allow participants to express and vision successfully. For example, scientists who have examined processes for visioning ecosystem health emphasize the need for participants to:

- Focus on what you want, not what you will settle for (for example, happiness versus its reflection as GDP; self-esteem versus expensive, purchased symbols of it; security versus unsustainable economic growth);
- Judge a proposed vision by the "clarity of its values," not the "clarity of its implementation path" (*i.e.*, hold onto the vision but be flexible about the path to achieving it);
- Acknowledge the physical constraints, but do not be "crushed" by them;
- Share the vision so participants in turn become responsible for it;
- Stay open to the vision continually evolving.[197]

In other words, scientists tracking the declining health of the world's ecosystems are urging us to shift our gaze to what is possible, rather than new ways of shifting around the status quo. Moving this ocean health discussion forward "will require continued efforts to integrate physical, biological, and social sciences, and greater political and public involvement and support."[198] Incorporating lessons from the social sciences on community stewardship and broad visioning will significantly enhance the effort to identify California's ocean health values and goals, and ensure their implementation.

CONCLUSIONS

As reinforced throughout this report, the primary impediment to achieving ocean health is not implementation challenges, but a "lack of a coherent, relatively detailed, shared" vision of what a healthy ocean looks like, and what our associated relationship with it should be. This vision must reflect the ocean's own, intrinsic right to health, and must be grounded in values of connection, stewardship and respect for the ocean's well-being. The visioning process accordingly should include not only marine scientists and policymakers, but also the public, which is ultimately responsible for implementation.

This does not mean that the visioning process must occur before new actions are taken to prevent and mitigate ocean harms. Quite the opposite – the information we have now urges immediate, enhanced action to protect ocean well-being while an ocean health vision and associated strategies are developed. Though much research is still needed to define "normal form and function" of marine ecosystems, we can move forward now to prevent ongoing degradation. For example, action can be initiated immediately to establish and enforce

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197 Ecosystem Health, *supra*, p. 256.
198 Ocean Health, *supra*, p. 122.

additional precautionary measures, and to significantly expand application of the Public Trust Doctrine to the marine decisionmaking process.

Moreover, it is important to keep in mind that the visioning process itself is not the ultimate goal. The ultimate goal is, of course, a healthy ocean, which necessarily includes healthy relationships between humans and marine systems. It is these relationships that we must constantly oversee and nurture to stay on track towards a thriving Earth society.

Visioning thus will evolve over time as needed to achieve this goal. As reflected by Donella Meadows, "[v]isioning is the first step, and a continuous step, because visions continue to get revised and shared and built and elaborated and made more rich and more true." An ongoing process of visioning and adaptive management, which allows us to swiftly adjust management goals and strategies as we gather better information, will help us develop and sustain an enduring, healthy relationship with our ocean home.