SEA CHANGE: A MESSAGE OF THE OCEANS

By Sylvia A. Earle
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Reviewed by John Alton Duff

Sylvia Earle's *Sea Change: A Message of the Oceans* serves as a clarion call to take a closer look at the life blood of planet earth, the oceans. The thoughtful mixture of wonder and concern outlines Earle's years of study and thousands of hours working, playing, and living beneath the ocean's surface. Earle intersperses tales of discovery and enlightenment with easy to read discussions of biology, engineering, law, and policy, to weave a tale advocating better stewardship of our ocean resources. A biologist by formal training and explorer by natural curiosity, Earle reminds us of what we learned in elementary school, that water covers most of the planet.

Dr. Earle begins by giving the reader a sense of geological time over which the earth has taken shape and the oceans have formed. She points out that post-Columbus man has occupied this planet for a mere 4 s in the geological year representing the earth's 4.6 billion-year history. She notes modern oceanography, from its origin in the 1870s with the expedition of the HMS *Challenger*, covers <1 s on that time scale.

Having humbled human knowledge of the seas on a temporal scale, Earle assuages our species ego by touting the great advancements that have enabled humans to descend, albeit briefly, to the deepest part of the oceans. She revels in the fact that she grew up in an era that saw Cousteau and Gagnan develop SCUBA equipment. Divers, unfettered from bulky diving helmets and air hose shackles, could now significantly increase access to, "where most of the living action on Earth is concentrated: underwater." She relishes the milestone achieved when U.S. Navy Lieutenant Don Walsh and Swiss engineer Jacques Picard descended in the bathysphere *Trieste* to a depth of 35,800 feet in the Marianas Trench. The visit to the deepest point in the ocean in 1960 out-paced the ascent of Mt. Everest in many ways.

The author recounts her own fascination and relationship with the sea from her days as a child on the coasts of New Jersey and Florida to her study of marine flora in the Gulf of Mexico as a graduate student. In self-deprecating style, Earle outlines the series of circumstances that led from her participation in an otherwise all male oceanographic expedition in 1964 to an underwater living experiment in 1970 "manned" by an all-women research team.

As her curiosity grew and technological development allowed, Earle began venturing into those depths and activities that had not yet hosted human activities. She participated in early observations of humpback whales off the coast of Hawaii. In 1979 she made a record dive to 1,250 feet in an untethered specially designed diving suit. Each adventure strengthened her conviction that the ocean as a living system merited additional research to increase human understanding.

Earle's sense of wonder and desire to further scientific observation led her to cofound Deep Ocean Engineering, Inc. The private company designs and manufactures deep sea remotely operated vehicles (ROVs) and manned submersibles. Balancing the limits of the human body and the desire for feasible access to the ocean depths, Earle notes that although economics and human frailty may favor ROV's, "there is no completely satisfactory substitute for being there." Engineer Earle notes that while her own business venture is successful in making inroads to deep sea exploration, the United States lags behind other nations in developing a national policy toward deep ocean exploration. She illustrates her point in recounting her opportunity to descend >2½ miles, not in one of her own creations or one sponsored by the United States, but in a Japanese-built submersible.

In the second part of her book, Dr. Earle outlines the results of unbridled technology on the ocean and its resources. Fisheries, once thought inexhaustible, have been decimated by commercial ventures, "ever reaping, never sowing." Earle notes that the world's ocean resources suffer a tragedy of the commons of global proportions.

She laments the effects of the well-meant, but perhaps ill-implemented Magnuson Fishery and Conservation Management Act. Although the goals of the Act are laudable, she notes, the policies to effect those goals are flawed. Earle contends that the establishment of Regional Fishery Councils, controlled to a large degree by commercial fishing interests, is akin to letting the "barracuda guard the fish coop." She further observes that although the Act allowed the United States to control fishing access in its 200-mile Exclusive Economic Zone, it merely drove out foreign fishing and replaced it with an overcapitalized domestic fishing industry.

Earle notes that scientists and policy makers have addressed the problem of

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overfishing with naive or weak analytical methods. Scientist Earle very succinctly questions the credibility of maximum sustainable yield (MSY) estimates of fish stocks, given the multiple and uncertain factors necessary to determine such an estimate. Such "scientific" methods may in fact do more harm than good, contends Earle, "the concept of MSY snares good minds, creates unrealistic expectations and encourages the setting of unattainable goals."

Earle paints a picture of myopic policies that have resulted in problems of bycatch of nontargeted fish, marine mammals, turtles, and birds. The original goals of the MFCMA, asserts Earle, have been undermined by practices that have led to, "a squandering of natural assets deliberately encouraged by national policies." She does note that some of these problems are slowly being addressed. Congress, federal agencies, and fishery councils are developing new methods that may achieve better success in conserving our ocean resource capital. And policy makers are shifting their population analyses away from MSY concepts.

Earle also paints a picture of the "coral bleaching" of tropical reefs. Slight variations in ocean temperatures have dramatic effects. Wide expanses of reefs once alive and vibrant in color are now dying and leaving behind expansive white coral corpses. The decline of fish stocks and the death of coral communities are detrimental not only in their short-term loss, but also in the long term. "Each species is a part of a planetary insurance policy for maintaining gradual, not cataclysmic, adjustments to changing environmental circumstances," explains Earle.

Earle examines the extensive effects of human activity on marine life. Toxins disposed of in the water infiltrate the marine food chain. Fish, polar bears, whales and penguins who have never directly encountered species *homo sapiens* suffer increased levels of toxins in their organs and tissues. Although ocean disposal may appear attractive to our species, it is by no means benign. Highly persistent plastics and other wastes dumped at sea have led to an alarming, but common, postmortem determination of many forms of sea life: "death by debris." The casualties included an estimated 50,000 North Pacific Fur seals annually during the 1980s. These more obvious concerns have led to international laws banning or restricting ocean dumping.

Earle rounds out her discussion of manmade threats to the ocean environment with eyewitness accounts of the *Exxon Valdez* spill and the act of environmental terrorism perpetrated by Saddam Hussein in the Persian Gulf. The former disaster affected some of the world's most pristine coastline, a stretch the size of California's shore. The latter spill was an intentional dumping of the equivalent of 50 *Valdez* spills.

In the final part of her book, Earle notes the cumulative impact that 20th century civilization has had on the shore and the sea. In addition to the cataclysmic events outlined earlier, Earle indicates that increasing populations, advances in technology, and the affinity for people to live closer to the shore leads inevitably to a proliferation of sea walls, marinas, channels, and shoreline development. The marine life in these areas suffer a "death of a thousand cuts." Although the ocean may have the assimilative capacity to absorb many human uses, there are significant areas of the ocean that have lost a vitality and mixture of life that they will likely never regain.

Human impact on the oceans, cautions Earle, warrants a sea change in attitude: we must maintain the environmental capital that our ocean resources represent. The first step in attaining a better attitude toward the ocean system is a better understanding of it explains Earle, "perhaps with knowing will come caring, and with caring an impetus toward the needed sea change of attitude."

Earle points to the establishment of marine sanctuaries or reserves as one step toward better understanding. She presents an overview of national and international efforts in a concise appendix. She contends, however, that marine reserves, specifically those under the U.S. National Marine Sanctuaries Program, ought to be funded and protected in a manner analogous to the National Park Service system.

Sea Change delivers a tale of discovery and adventure while advocating an effort to increase our understanding of the planet's ocean system. It serves as valuable reference for the casual reader as well as for professionals involved in ocean and coastal issues. It merits space among Carson and Cousteau on the bookshelf. ❑