

David M. Lawrence
Dissertation Prospectus

Last Call for Corals

Life, Death, and Conservation of an Ocean Ecosystem

Who'd be a coral polyp? You can catch a whole suite of really nasty diseases, you can be eaten alive in a very disgusting fashion by a starfish, you can be battered by storms, you can be choked by pollution, and you can be blasted to death by fishermen. And now, we learn, you can be scalded in hot brine and perish that way; or you can hang on, and you can slowly dissolve in soda water. Apart from that, the news isn't all bad. ...

Tim Radford, *The Guardian*

In July 2008—the International Year of the Reef—more than 2,500 scientists, resource managers, and activists from around the world gathered in Fort Lauderdale, Florida, for the 11th International Coral Reef Symposium. The goal of the meeting was to discuss the latest science and status of one of the most important ecosystems on the planet—the coral reefs.

Coral reefs serve many purposes: they provide nursery areas for fish and other marine animals; they provide bountiful feeding opportunities for the inhabitants of the sea; and they protect fragile shorelines from the ravages of storm waves. Specifically for humans, they provide food for hundreds of millions of the world's poorest (and many of the world's wealthiest); they offer

tremendous potential for the discovery of new compounds to treat human illnesses; they provide innumerable and invaluable opportunities for ecotourism to support impoverished tropical economies; and they help counter global warming by removing some of the excess carbon dioxide we emit into the atmosphere.

At the International Coral Reef Symposium, scientists announced a number of dire findings: more than half of coral reefs in U.S. waters (Florida, the Gulf of Mexico, the Caribbean, and the Pacific) are in “poor” or “fair” condition; overfishing (often unnoticed because fishing levels are often drastically underreported), climate change, coastal development, and pollution combine to threaten the stability of reef ecosystems around the world, making them more susceptible to disease outbreaks and other disturbances; and one-third of reef-building corals face extinction. Research published in the journals *Science* and *Nature* in the weeks prior to the symposium highlighted the danger of a by-product of global warming: acidification of ocean water. Ocean acidification—a result of water reacting with carbon dioxide in the atmosphere to form carbonic acid—can devastate coral communities, causing dramatic shifts in species composition (coral and otherwise), and leaving us with degraded as well as possibly destroyed coral ecosystems as the increasingly acid water literally dissolves the carbonate glue that holds the reefs together.

This litany of threats to reef ecosystems may sound like the exhortations of a Chicken Little, nevertheless, the effects of the threats can be predicted by the most fundamental principles of physics, chemistry, and biology. The existence of the threats are supported by rigorous, replicated, and numerous scientific observations from around the world. While some who live far from the coasts may dismiss what happens to coral reef ecosystems as too remote to be of concern, they are mistaken, as they will be affected in their homes by fewer and more costly fish resources for their diet; accelerated global warming as the main long-term global reservoir for

carbon dioxide disappears (and possibly releases that carbon dioxide back into the atmosphere); and even reduced recreational and tourism opportunities that enrich the lives of hundreds of millions of the otherwise landlocked. This crisis is no drill.

In order to combat the accumulating agents of doom massing on the horizon, our global society must make major changes to the way we go about our business: reduce carbon dioxide emissions; reduce releases of urban, industrial, and agricultural pollutants into our coastal waters; eliminate consumption of vanity products like coral jewelry and rare fish species; and better manage reef fisheries in regions of the world where the populations have few options but to rely on the dwindling bounty of the sea. This can be done, but what is needed is an effort to combat what Vice Admiral Conrad Lautenbacher (USN, Ret.), former administrator of the U.S. National Oceanic and Atmospheric Administration, called “ocean illiteracy.”¹

Inspiration

My proposed project, *Last Call for Corals*, is a response to Lautenbacher’s call to combat “ocean illiteracy.” My goal is to produce a multimedia work that will become the *Sand County Almanac* of the sea. It will tell the story of a coral reef, discuss issues affecting reefs in general, and state and justify an Earth ethic—a term inspired by Aldo Leopold, author of *A Sand County Almanac*—that may serve as a guide to wiser stewardship and consumption of natural resources, and especially ocean resources, around the world.

Aldo Leopold’s watershed book, *A Sand County Almanac, and Sketches Here and There*, was published in 1949 after his death. It played a decisive role in awakening the environmental consciousness of the post-World War II generation. Leopold was a pioneering forester and

¹ Conrad Lautenbacher, press briefing at the International Coral Reef Symposium in Fort Lauderdale, Florida, 10 July 2008.

wildlife scientist whose view of the environment evolved from the frontier attitude of exploitation at will to one of an enlightened caretaker who managed the land for its long-term vitality rather than for anyone's short-term profit. In his writing, he avoided polemic—his lessons were all the more powerful for the beauty and subtlety with which he imparted them.

His book was made of three sections. The first section was “A Sand County Almanac,” a series of twelve chapters, based on the months of the year, that illustrated the vibrant life surrounding his farm in Sauk County, Wisconsin. The second part of the book, “Sketches Here and There,” ranged farther afield, describing how places he visited or worked at during his long career either benefitted or suffered from the management policies—or lack thereof—in effect at the time. The third part, “The Upshot,” builds toward his final and most influential chapter, “The Land Ethic,” in which Leopold expanded the notion of ethics, which regulate interactions among humans for the benefit of all, to include our relationships with the land and the other organisms who also reside upon it. “In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such,” Leopold wrote (Leopold 1987, 204).

The Question(s)

My research question, on the surface, seems quite simple: How can we become better neighbors in the community of (sea) life that sustains us? But there is more beneath the surface to be explored. For example, some might dispute the notion that humans are a member of a community that—according to Leopold—includes non-human life as well as the physical environment upon which such life depends. Others might dispute the notion that our actions can have adverse effects on distant ecosystems, or that such adverse effects could, in turn, undermine our quality of life—or our life itself. Still others might dispute the notion that we have any

ethical obligation to mend our fences, if you will, and improve our relationships with our nonhuman neighbors. I hope that—through thorough reporting, vivid writing, and revealing images and sound—the answer(s) will inspire others to be more conscious of their relationship with the natural world of which we are a part and take more action to conserve it.

Wherever I end up doing my field work, I will keep in mind the following relevant questions. The first set of questions addresses how the human community consumes (and regulates its consumption) of natural resources? For example, what are the important events in their harvest² of natural resources? What are the principal events in their agricultural calendar? Do they celebrate or commemorate these events? If so, how? What types of management systems are in place to prevent abuse of the resources? And do those systems work?

The next set of questions addresses what the human community claims to value (e.g., gross national product vs. gross national happiness³) and how does its members live those values? Do they tend to view components of their environment in terms of market value only? Do they tend to view those components from a primarily spiritual or traditional standpoint? Or is the way they place value on components of the environment more nuanced? What do they do to protect the things they say they value? When there is a conflict, say, between market value and spiritual value, how do they resolve it?

The third set of questions addresses the human community's environmental ethic? Do they have an ethic they can describe? If so, how would they describe it? And how do they apply it to their daily lives? How do they resolve conflicts between economic needs and ethical strictures?

² By harvest, I include things like commercial and sport fishing and gathering of marine organisms, such as seaweed.

³ According to the Tourism Council of Bhutan, "...the concept of Gross National Happiness is based on the premise that true development of human society takes place when material and spiritual development occur side by side to complement and reinforce each other" (2013). It is based on four pillars: 1) equitable and equal socio-economic development; 2) preservation and promotion of cultural and spiritual heritage; 3) conservation of the environment; and 4) good governance.

Of course, I will intensely observe the natural history (both in water and on land) of my field sites, documenting the behavior of the species I focus on and how they live in relationship with their animal and plant neighbors. Which species are vitally important to humans? Which species are vitally important to the ecosystem as a whole? What are the key events in their life cycles? And how are they affected by the humans that share the environment with them?

Method

I am agnostic on what label is attached to my method. I prefer immersion or participatory journalism (*sensu* Plimpton 1965).⁴ Many social scientists—especially anthropologists, sociologists, and cultural geographers—might prefer participant observation (Spradley 1980, Jorgensen 1989). It is defined as the

... conscious and systematic sharing ... in the life-activities and, on occasion, in the interests and affects of a group of persons. Its purpose is to obtain data about behavior through direct contact and in terms of specific situations in which the distortion that results from the investigator being an outside agent is reduced to a minimum (Kluckhorn 1940, 331).

Regardless of the label selected, the process involves four basic steps: 1) gaining access to the community being observed; 2) participation in the activity of interest; 3) reporting and recording one's observations in a relevant and appropriate manner, traditionally with pencil and notebook, but now also with audio and video (Garrett 2011); and 4) analyzing one's observations, distilling them, and sharing the insights obtained in a responsible and ethical manner.

⁴ The concept of participatory journalism has been confused by media scholars unfamiliar with their subject's history. Many today refer to non-professional eyewitness reports of newsworthy events as "participatory journalism." I deplore the confusion of terms, as academics should understand the value of precision in language (such precision is often used as an excuse for the use of dense, unintelligible jargon and Byzantine sentence structure). Nellie Bly practiced participatory journalism. George Plimpton practiced participatory journalism. Someone taking photos of a car wreck with their iPhone and sending it to the local newspaper might be doing something loosely called "citizen journalism," but most of the time they are not truly participating in the events they are "reporting."

The goal is to achieve more than a mere recounting of what people say and do. As the anthropologist Bronislaw Malinowski wrote:

... to grasp the native's point of view, his relation to life, to realize *his* vision of *his* world. We have to study man, and we must study what concerns him most intimately, that is, the hold which life has on him. In each culture, the values are slightly different; people aspire after different aims, follow different impulses, yearn after a different form of happiness. In each culture, we find different institutions in which man pursues his life-interest, different customs by which he satisfies his aspirations, different codes of law and morality which reward his virtues or punish his defections. To study the institutions, customs, and codes or to study the behaviour and mentality without the subjective desire of feeling by what these people live, of realizing the substance of their happiness—is, in my opinion, to miss the greatest reward which we can hope to obtain from the study of man” (1922, 25).

While excellent observational skills are important, practitioners of this method achieve that goal by moving beyond the JAFO (“Just Another [insert gerund here] Observer”) phase. Here is what Tom Wolfe had to say about what George Plimpton earned by participating in, rather than merely reporting on, the sports he covered:

By living, training and scrimmaging with the Detroit Lions, Plimpton was able to get the athletes to tell him the sort of things they had never divulged to sportswriters of the ordinary sort. Plimpton played football very poorly, but he was admitted to the fraternity, as it were, because he had entered the arena himself and taken his punishment (Wolfe 1975, 266).

Participant observation, *per se*, has a long and at times controversial history within the discipline of anthropology (Cushing 1882, 1883a, 1883b; Malinowski 1922, Mead 1928). The focus in the nineteenth and early twentieth centuries was primarily on cultures that were “exotic,” i.e., non-Western, as the examples cited above indicate: Zuñi from the American Southwest, Melanesians of the Trobriand Islands off New Guinea, and Polynesians of Samoa. But as sociologists and cultural geographers began to recognize the importance of diversity within their own societies, they began to apply the method to subcultures therein, such as swingers (Palson and Palson 1972), underground miners in Montana (Fitzpatrick 1980), wild

mushroom harvesters on the Olympic Peninsula (Love et al. 1998), and recovering alcoholics (O'Halloran 2003). In the late twentieth/early twenty-first centuries, participant observation has been recognized as a valuable tool in studies of environmental management and resource consumption (Richards 1983, Bryant and Wilson 1998, Love et al. 1998, Kellert et al. 2000, Conley and Moote 2003, Nightingale 2003, Goss 2004, Hampshire et al. 2004), environmental health (King 2010, Cormier et al. 2012), globalization and economic/political hegemony (Rankin 2003, Radcliffe et al. 2010), rural geography (Woods 2010), and the creation of cultural landscapes (Mitchell 2001).

Given its long history, it should be no surprise that there is no shortage of articles and books offering an overview of participant observation as a method (Kluckhohn 1940, Vidich 1955, Bruyn 1963, Pohland 1972, Bogdan 1973, Spradley 1980, Jackson 1983, Jorgensen 1989, Bennett 2002, Preissle and Grant 2004, Kawulich 2005, Delamont 2007). Some practitioners have asserted that participant observation—by focusing on what people do rather than say—is superior to ethnographic interviews (Becker and Geer 1957). Others have argued instead that speech is as much an act as what people do, thus participant observation has no inherent superiority to ethnographic interviews (Atkinson and Coffey 2003). While I personally believe in the aphorism that actions speak louder than words, in studies of culture that both have tremendous value. Participatory journalists routinely supplement observation with interviews. Their ability to get information through interviews is often enhanced by their participation—as noted by Tom Wolfe above—and interviews are often the best way to obtain vital context to the activities the journalist participates. From the cultural studies standpoint, I have to agree with Martin Trow that "... the problem under investigation properly dictates the methods of investigation" (1957, 33). It is more common to think of participant observation and

ethnographic interviews as part of a suite of methods that can be used to better answer the question at hand (Trow 1957; Zelditch 1962; Pohland 1972; Bogdan 1973; Spradley 1979, 1980; Jorgensen 1989). In fact, William F. Whyte and others (Delamont 2007) argue that participant observation necessarily includes interviewing, because “any able field worker will supplement what is learned from observing and participating with some interviewing” (Whyte 1979, 56).

As research/reporting methods, participant observation/participatory journalism are not without problems. Among them are how the role of the observer in the community of interest affects the information gathered (Janes 1961), fitting in or integration within the community of interest (Stebbins 1987, Larabee 2002, Ezeh 2003), disengagement after field work is complete (Snow 1980), neutrality of the observer (Cohen 2000), and ethical matters (Jarvie 1969, Smith 1997, Li 2008). Many of these issues are routinely faced by journalists (participatory or otherwise). None pose a lethal threat to obtaining valuable information, but they are matters of which the participant observer/participatory journalist must keep constantly in mind in the course of his or her work.

Participant observation is usually described as a technique used for the study of human communities, but in the latter half of the twentieth century it—or something very like it—was began to be applied to other primates (Sommer 2010, Nekaris et al. 2011), for example, in chimpanzees (Goodall 1964, 1968; McGrew and Tutin 1978; van Lawick-Goodall 1973a, 1973b), mountain gorilla (Fossey 1972, 1974), and orangutan (Galdikas 1982, 1985, 1988; van Schaik et al. 2003). I argue, however, that it should also apply to the *in situ* study of other living communities and even of the abiotic environment.

I reach this conclusion from several lines of argument. Consider this comment about social research and participant observation:

The concept of reflexivity acknowledges that the orientations of researchers will be shaped by their socio-historical locations, including the values and interests that these locations confer upon them. What this represents is a rejection of the idea that social research is, or can be, carried out in some autonomous realm that is insulated from the wider society and from the biography of the researcher, in such a way that its findings can be unaffected by social processes and personal characteristics. ...

There is no doubt that reflexivity, in the sense just outlined, is a significant feature of social research. Indeed, there is a sense in which all social research takes the form of participant observation: it involves participating in the social world, in whatever role, and reflecting on the products of that participation (Hammersley and 19, 15).

We are more than members of a social world. Despite a long history of thought that considered humans as separate from the natural world, we are, in fact, part of it (Hunter 1996, Houck 1998, Uggla 2010).⁵ Edward O. Wilson describes our relationship with other species in his book,

Biophilia:

We are literally kin to other organisms. The common and pygmy chimpanzees constitute the extreme case, the two species closest to human beings out of the contemporary millions. About 99 percent of our genes are identical to the corresponding set in chimpanzees, so that the remaining 1 percent accounts for all the differences between us. ... The genetic evidence suggests that we resemble the chimpanzees in anatomy and a few key features of social behavior by virtue of a common ancestry. We descended from something that was more like a modern ape than a modern human being, at least in brain and behavior, and not very long ago by the yardstick of evolutionary time. Furthermore, the greater distances by which we stand apart from the gorilla, the orangutan, and the remaining species of living apes and monkeys (and beyond them other kinds of animals) are only a matter of degree, measured in small steps as a gradually enlarging magnitude of base-pair differences in DNA (Wilson , 130).

One of the most striking illustrations of that relationship is in what, on a superficial level, is the biggest genetic difference between humans and our ape cousins (chimpanzees, bonobos, gorilla, and orangutan). Humans have only twenty-three pairs of chromosomes. The great apes have twenty-four pairs. What happened to the missing pair? It turns out the two missing chromosomes

⁵ Few scholars who acknowledge humans as members of the natural world would argue that mountaintop removal mining is just as natural a process as beavers' erection of a dam across a stream, however.

are not missing. Human chromosome 2 is, in fact, a fusion at the telomeres (ends) of two ape chromosomes (Lejeune et al. 1973, Yunis and Prakash 1982, Ijdo et al. 1991). By looking at ribosomal RNA (rRNA), a nucleic acid that forms the ribosome, an organelle present in the cells of all living things that translates genetic code into actual proteins, we can likewise see our familial relationship with all other species—animal, plant, and bacterial (Woese et al. 1990).

While Wilson focuses on our relationship with other organisms, Aldo Leopold argues for a more comprehensive vision, “All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. ... The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land” (Leopold 1987, 203-204).

On a practical matter, anyone who observes nature *in situ* interacts with it. From my decades of experience as a student of plant geography, I know I break twigs, trample small plants, spook animals, disperse seeds and spores, and create tiny disturbances in the forests, deserts, grasslands, and expanses of tundra that I have visited in the course of my work. I have helped parasitic insects complete their life cycle by inadvertently offering myself as a blood meal. I have (unintentionally) fed a black bear, and (intentionally) scared the fecal matter out of it by giving it a ride in my truck. (Well, the ride was intentional, the other part, that I found the next morning, was not.) As a diver, I have kicked up sediments, brushed against algae beds, and given pugnacious sunfish something to spar with.

Even when contact is not so direct, a prominent thread in quantum physics suggests that, by merely measuring some aspect of a system, we change it—fix it in one of a potentially infinite number of quantum states. This was once called the “observer effect,” but is now more properly referred to as “wave function collapse.” The phenomenon was first described by Werner

Heisenberg, “Thus, following certain statistical rules, we can draw conclusions, based on one experiment, regarding the results possible for another. The other experiment selects, by itself and from among all the possibilities, one particular one, thus limiting the possibilities for all subsequent experiments” (1927, 184; National Aeronautics and Space Administration 1983, 16). The implications of this led Erwin Schrödinger to propose his infamous thought experiment involving a cat in a box in which the cat is simultaneously dead *and* alive until an observer peeks in (Schrödinger 1935). The implications also lead to the conclusions of a paper by Lawrence M. Krauss and James Dent (2008) that our observations of the universe may affect its age. Whatever one thinks of Schrödinger’s cat or of Krauss and Dent’s claim, it seems reasonable to conclude that observers of natural systems are, in fact, participants in those systems no matter how much they try to maintain some semblance of separation from them.

Interpretation of data from participant observation of non-human communities might be more problematic, given the inability of our species to fully communicate with others. But I do not think it is impossible if we apply Geertz’s interpretive theory of culture:

The concept of culture I espouse ... is essentially a semiotic one. Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in search of meaning. It is explication I am after, construing social expressions on their surface enigmatical (Geertz 1973, 5).

The observer can find meaning by doing what Geertz calls “thick description,” i.e., describing behavior in proper context—the meaning intended by the subject, not that assigned by the observer. This concept can be applied to non-human species. For example, many who visit zoos may find funny the back-and-forth pacing by animals in enclosures that are too small and that lack sufficient stimulation. “Funny” is the meaning assigned by the observer. The animal, however, is more likely communicating stress, or varying levels of neurosis. While it is more

difficult to determine what the animal “means” by a specific behavior, it is not impossible given sufficient effort to understand the animal’s world.

One final note about method. While I have never engaged specifically in participant observation, I have some in-depth experience in participatory journalism. In 2010, I was hired to serve as science writer/editor/photographer for the Sea Education Association’s “Plastics at SEA: North Atlantic Expedition 2010.” It was a major effort on the part of the SEA and a significant change in its operation. Normally, it offered “Semester at SEA” experiences for college credit in which the students engaged in oceanographic research. This was its first research-only oceanographic expedition. I flew out to meet the ship, the *SSV Corwith Cramer*, in Bermuda thinking that I would only be concerned with writing, editing and photography. When I arrived, I was informed that I would also work two watches a day just like everyone else. The chief scientist, Giora Proskurowski, and captain, Chris Maguire, felt such immersion would inform my writing. I was thus thrust into the world of participatory journalism. Despite my exhaustion—which apparently others felt from my writing—I must conclude that Giora and Chris were right.

Here is how I summed up our work, which appeared on the expedition’s Web site, *Plastics at SEA: North American Expedition 2010*:

We've accomplished a lot. We've sailed more than 3,800 nautical miles. In the process we crossed over the Mid-Atlantic Ridge and nearly reached longitude 40°W. We've completed 128 neuston tows, 106 surface stations, 47 carousel casts, and 34 Tucker trawls. We've counted more than 48,000 pieces of plastic and 100 pieces of tar. We've collected 1,388 Halobates and 219 myctophids (lanternfish), and we've counted more than 5,000 copepods, 900 Cladocera, and more than 700 hyperiid amphipods – among other creatures. ...

As for me, I'm obviously still working, so my statistics are incomplete. Through yesterday, I filed 33 daily reports (this is the 34th and final one). For those first 33 days, I wrote and filed 33,155 words – all the Daily Journal entries, all the cutlines for the photos, and six Reflections on Shipboard Life essays.

I shot more than 5,000 photos, all of which take up nearly 13 gigabytes on my external hard drive. Each day I looked at what I shot and what my shipmates had shot and nominated for publication, and selected 10 to be published each day. ...

I don't have statistics for how many times the engineering crew started and stopped the engine or generators. I don't have statistics for how many times we struck or set particular sails. I don't have statistics for how many times we gybed or changed course. Much of that information exists in the various logs the crew keeps, but it hasn't been compiled (Lawrence 2010).

I believe the Plastics at SEA experience will prove invaluable as I prepare for and engage in this project.

In the field, I will document as much as possible with video photography, still photography, and recorded sound. The worst case scenario is that I will use the gear I already have, but I hope to raise funds for upgrades. In Vanuatu, I would also need external hard drives for data backups and a solar charger that generates enough electricity to power a laptop as well as other gear.

In addition, I will take a large supply of reporter's notebooks and pencils for writing down observations in the field—especially when it is not possible to use digital devices to record what I see or hear. Each night, I will fall back upon my field biologist's training and record more substantial notes in binders *sensu* Hall (1962) or on a computer—or both. That offers time to make sense of what one has observed, taking notes of phenomena and patterns that need clarification or worthy of further investigation, and for noting logistical matters (transportation, food, lodging, expenses, hazards, hassles, etc.) that may be of use to future investigators.

Literary Traditions

My work will follow in a long line of exploration/environmental narratives. The tradition, in itself is ancient—in the West extending back to the Greek world—but the written record is spotty, with many works lost through neglect, decay, and war; and the texts that did survive were

often transcribed by hand over the centuries, with errors introduced along the way. A good record of such narratives exists for the past millennium, however.

Ironically, some of the best of the older accounts come from the ranks of those widely regarded as barbarians throughout Western Europe: the Vikings. While the Norse did their share of destroying libraries in the lands they raided, they preserved a rich literary tradition in the form of sagas that probably arose from an earlier oral tradition. Iceland, an island literally beyond the fringe of Western Europe, proved a fertile ground for the recording and preservation of these sagas.

Given that background, I chose “The Saga of Eric the Red” (1906) as the starting point for my analysis of exploration and environmental narratives. The saga, set in the final years of the first millennium CE, details Erik’s establishment of the first permanent European settlement of Greenland. It also refers to his son, Leif Ericson, and Leif’s attempt to colonize Vinland—which we now know to include Newfoundland (Wallace 2009). It is coupled with “The Vinland History of the Flat Island Book” (1906) which deals in greater detail with the history of the Vinland colony. As geographical references, the details in each are rather sketchy:

... They went aboard their ship again and sailed into a certain sound, which lay between the island and a cape, which jutted out from the land on the north, and they stood in westering past the cape. At ebb-tide there were broad reaches of shallow water there, and they ran their ship aground there, and it was a long distance from the ship to the ocean; yet were they so anxious to go ashore that they could not wait until the tide should rise under their ship, but hastened to the land, where a certain river flows out from a lake (Vinland History 1906, 51).

The paucity of description has kept generations of historians and geographers guessing as to Vinland’s location until the discovery of the L’Anse aux Meadows archaeological site on Cape Norman, the northern extension of Newfoundland. Yet the narratives themselves are compelling, with enough seaborne disaster, war, witchcraft (in “The Saga of Eric the Red”), and romance to hold generations’ of readers (and presumably listeners’) attention.

The next three examples span the end of Middle Ages to the beginning of the Renaissance and Age of Discovery. The first, *The Itinerary of Benjamin of Tudela* (Benjamin of Tudela 2007), is a slim volume, detailing the twelfth century travels of a Jewish merchant across Mediterranean Europe from Navarre to Constantinople (now Istanbul), and on into the Arabian Peninsula and North Africa. The second, *The Travels of Marco Polo* (Polo 1926), recount the thirteenth century travels of a Venetian merchant from the Levant across Central Asia into the China. After decades of service there in the court of Kublai Khan, Polo set sail around Southeast and South Asia, then across Persia into Asia Minor before returning to Venice. The last, *The Travels of Ibn Battutah* (Ibn Battutah 2002), summarize the explorations of a Muslim scholar through much of North, East, and West Africa; the Arabian Peninsula; Asia Minor; and Central, South, and East Asia. All are leaps forward in terms of the geographic detail offered:

The wall which surrounds the city of Dihli is unparalleled. The breadth of the wall itself is eleven cubits, and inside it there are rooms where nightwatchmen and keepers of the gates are lodged. The wall also contains stores for provisions, which they call granaries, as well as stores for war equipment and mangonels and stone-throwing machines (Ibn Battutah 2002, 161).

All three likewise have their share of idiosyncracies, such as in Marco Polo's discussion of the legendary Prester John, a supposedly Christian King who won great victories against barbarian hordes somewhere in the interior of Asia; or in the readiness of the transcriber of *The Travels of Ibn Battutah* to supplement Ibn Battutah's memory with details from other accounts of the place visited.

The Age of Discovery began in the fifteenth century. It did not necessarily bring detailed accounts of voyages of exploration. Christopher Columbus was an exception. Perhaps Columbus was thinking ahead to his legacy, but he left quite detailed accounts of his voyages. The journal of his first voyage (Columbus 1906) is a good example. On some days, such as when he was crossing the Sargasso Sea (a part of the Atlantic I know quite well), there was little to report,

such as in this entry from Friday, September 28, 1492, “The course was west, and the distance, owing to calms, only 14 leagues in day and night, 13 leagues being counted. They met with little weed⁶; but caught two *dorados*⁷, and more in the other ships” (103). The paucity of description is not surprising to someone like me who has been there. Where warranted, however, Columbus offers a tremendous amount of detail, such as in his description of the island he called San Salvador after his arrival in what he thought was the Indies:

The island is rather large and very flat, with bright green trees, much water, and a very large lake in the centre, without any mountain, and the whole land so green that it is a pleasure to look on it. The people are very docile, and for the longing to possess our things, and not having anything to give in return, they take what they can get, and presently swim away. Still, they give away all they have got, for whatever may be given to them, down to broken bits of crockery and glass (113).

Here we see excellent observational skills, but also see signs of cultural misunderstanding and intolerance that soon began centuries of strife and eradication of many of the indigenous peoples. Columbus’s propensity to pass judgment on native peoples, plus the eagerness with which he claimed their lands for both the Spanish Empire’s as well as his own profit, was emulated by many of the European explorers who followed him to the so-called “New World.”

This is borne out by the selections from the sixteenth century. Europeans moved into the Americas looking for easy wealth. The Spanish focused on gold and gems. The English, French, Dutch, and others focused more on fish, furs, wood, and other resources. All colonial powers claimed the land and resources, brought the Gospel, and vigorously fought to impose civilization on the natives. The de Soto expedition was especially plagued by conflict and plunged into chaos after de Soto died from illness in what is probably southern Arkansas; the “Gentleman of Elvas” account (*The Narrative of the Expedition of Hernando de Soto* 1907) reads a lot like a bayou

⁶ *Sargassum*, the floating seaweed for which the Sargasso Sea is named.

⁷ Mahi-mahi.

horror story as a result. The Pedro de Castañeda (1907) and Antonio de Espejo (1916) narratives offer much more in the way of ethnography and geography. The most overtly scientific writing, however, is in Thomas Hariot's "A Briefe and True Report of the New Found Land of Virginia," (2007) although he does have his eye on commodities that could be exploited commercially, such as sassafras, "*Sassafras*, called by the inhabitants *Winauk*, a kinde of wood of most pleasant and sweete smel; and of most rare vertues in phisick for the cure of many diseases. It is found by experience to bee farre better and of more uses then the wood which is called *Guaiacum*, or *Lignum vitae*" (12).

The seventeenth century brings more of the same, but also something completely different. The description included with John Smith's *Map of Virginia* (1907) is one of the best accounts of the geography and ethnography of the Chesapeake Bay Region—in its description of the natural world, the Native Americans, and the growing English colony itself. The buccaneer William Dampier offers incredible descriptions of the lands encountered in his *New Voyage round the World* (1968). And Henri Joutel's account of La Salle's final expedition (1714) adds a new wrinkle to the expedition as disaster narrative—mutiny and murder of the expedition leader. The most innovative work, however, is Matsuo Bashō's *Narrow Road to the Deep North* (1966). The work is a mix of memoir and poetry of the travels by Bashō, a student of Zen Buddhism, through Japan. His poetic evocations of landscape are often more powerful than any corresponding—and typically longer—description in prose. When I read, "In the utter darkness / Of a moonless night, / A powerful wind embraces / The ancient cedar trees" (Bashō 1967, 54), I can both feel the wind and smell the cedar. A longer poem reminds me of a nocturnal encounter I once had in the Ozarks of Arkansas:

With a bit of madness in me,
Which is poetry,

I plod along like Chikusai⁸
Among the wails of the wind.

Sleeping on a glass pillow
I hear now and then
The nocturnal bark of a dog
In the passing rain (59).⁹

I do not know whether or not Bashō's writing is as helpful in conveying an intellectual understanding of the landscapes he described, but it may be more effective in conveying the emotional bonds associated with what a geographer calls "sense of place."

In the eighteenth century, we begin to see a transition in the type of author typically penning an exploration narrative. Buccaneers were still around—and, in Dampier's case, were still writing vivid and informative accounts of the places they encountered, such as in this description of crows from the east coast of Brazil in *A Voyage to New Holland* (2009a):

The carrion-crow and chattering-crows are called here mackeraws, and are like those I described in the West Indies. The bill of the chattering-crow is black, and the upper bill is round, bending downwards like a hawk's bill, rising up in a ridge almost semicircular, and very sharp, both at the ridge or convexity, and at the point or extremity: the lower bill is flat and shuts even with it. (43)

But the adventurer-driven exploration narratives characteristic of the previous two centuries was giving way to accounts penned by those increasingly professional in both the act of exploring as well as in the act of writing about it. The man who arguably set the model for the modern explorer—seafaring explorer, at least—was Captain James Cook. In three legendary voyages, he charted much of the Pacific Basin, sailed within sight of Antarctica as well as up into the Gulf of Alaska, and trained an influential cadre of British Royal Navy officers that were

⁸ Chikusai is the hero of a Japanese comedy popular at the time Bashō lived.

⁹ My encounter was not so romantic. There was wind, there was a dog barking in the night, but there was also a skunk running by my sleeping bag at the time I turned a flashlight on it. It went into firing position immediately, and I, almost as quickly, tossed the flashlight and covered my head and nearly passed out from holding my breath. Luckily, my companions did not have to hold their breath on the way back to Louisiana the next day. I know this is not the kind of mood Bashō intended to evoke, but I cannot help bringing my own baggage to what I read.

to contribute to further explorations well into the nineteenth century.¹⁰ In his journals, he notes navigation details, geographic details, and also how he and his crew are affected by what they experience, as can be seen in this entry from August 7, 1774, near the island of Tanna in the New Hebrides (now Vanuatu):

In the night the Volcano threw up vast quantities of fire and Smoak, the flames were seen to ascend above the hill between us and it, the night before it did the same and made a noise like that [of] thunder or the blowing up of mines at every eruption which happened every four five Minutes; a heavy shower of rain which fell at this time seem'd to increase it: the wind blew from that quarter and brought such vast quantities of fine Sand or ashes that every thing was covered with it, and was also exceeding troublesome to the eyes (Cook 2003, 383).

Cook set a standard for professionalism that lasts until today. Nevertheless, shadows of the Dampier-style adventurer remained, even among Cook's crew. John Ledyard, an American from Connecticut, was from the Dampier mold—he abandoned Dartmouth College for a life of wandering, eventually finding his way to England and signing on as a Royal Marine on the crew of the *HMS Resolution*, one of the ships under Cook's command on his last—and ultimately fatal voyage.¹¹ In one passage from his journal of the Cook expedition, he made an astute guess about the processes that formed most Pacific Islands:

It is a fact that every island we visited in the Pacific Ocean is more or less overspread with lava, marked with fissures, excavations and every indication of subterraneous fire: Many of them shew indoubtable proofs that they have partook of some extraordinary struggle in nature sufficient either to place them in their present situation, or to have destroyed them if their original forms had [not] been what they are now (Ledyard 2005, 107).

Thus far, exploration had been driven by the urge to expand empires, to find new opportunities for commerce, and to improve the safety of navigation. More and more, good science was being done on these expeditions, but the science was almost always in the service of some other goal.

¹⁰ Among them was William Bligh, who was a much better navigator than he was a leader.

¹¹ Cook was killed in a dispute with Hawaiian natives on the shore of Kealakekua Bay on the big island, Hawai'i.

The trend continued in the nineteenth century. President Thomas dispatched Meriwether Lewis and William Clark (and some other expeditions) to explore the vast Louisiana Territory recently acquired from France (Lewis and Clark 1953). The promise of cheap—or free—land and a new start set off a great westward migration that adventurers like Francis Parkman (1950) were compelled to join.

But science became more of a justification in itself. Gentleman-scientists, such as Alexander von Humboldt, left lives of privilege and luxury in Europe out of a curiosity about the new worlds being opened up through increasing globalization. Humboldt's work, such as in his *Personal Narrative of a Journey to the Equinoctial Regions of the New Continent* (1995), laid much of the groundwork for the modern science of geography. Two young men, Charles Darwin and Alfred Russel Wallace, seeking fame and fortune—or at least a steady job—shook man's sense of place in the universe with a theory called evolution that both independently stumbled upon in the course of expeditions they undertook (Darwin 2001, Wallace 1989). A Civil War veteran, John Wesley Powell who lost most of an arm in the Battle of Shiloh, set out to explore the geology of one of the most iconic landscapes on Earth, the Grand Canyon (Powell 1987). And the Royal Navy dispatched a ship, the *HMS Challenger*, on three-year expedition to study the world's oceans that yielded valuable scientific contributions for nearly a century after it ended (Tizard et al. 1885).

This was arguably the golden age of the expedition narrative, as we had a growing body of professionally trained scientists that were likewise equally grounded in a literary tradition. Their writings often had an eye for detail and sense of narrative that permits them to be enjoyably read as literature, and they often include details now stripped from “scientific” accounts, relegated to

the lower league of the late-career personal memoir. Some of it is exciting, as in the excerpt from Wallace's *The Malay Archipelago*:

The next afternoon just before dinner, being rather tired with my day's work, I was lying on the couch with a book in my hand, when, gazing upward, I saw a large mass of something overhead which I had not noticed before. Looking more carefully, I could see yellow and black marks, and though it must be a tortoise-shell put up there out of the way between the ridge-pole and the roof. Continuing to gaze, it suddenly resolved itself into a large snake, compactly coiled up in a kind of knot; and I could detect his head and his bright eyes in the center of the folds. The noise of the evening before had been explained. A python had climbed up one of the posts of the house, and had made his way under the thatch within a yard of my head, and taken up a comfortable position on the roof—and I had slept soundly all night directly under him (Wallace 1989, 303).

For anyone who has been surprised by an animal they are scared of—or, as in my case, for anyone who spent hours in a hotel room in Indonesia tracking down and killing a large cockroach that ran across his body in the middle of the night—this anecdote binds the reader to the author and makes everything else in the narrative, including the science, seem much more concrete and relevant to the reader. Unlike in the sterilized portrayals of science frequently seen on television and screen these days, explorers' accounts in this era mentioned the annoyance, boredom, and endless drudgery take a toll on those involved on long expeditions. Consider this comment by Henry N. Moseley, a naturalist on the Challenger Expedition, about the tradition of giving cannon salutes as ships entered a foreign port:

On the ship anchoring at Amboina, it was found necessary that a salute should be fired. The "Challenger" being, as a surveying ship, provided with very few guns, was usually excused this ceremony, but it was thought by the Dutch authorities that the natives would not properly understand the arrival of a foreign man-of-war, without the usual honour being paid to the Dutch flag; so two small Armstrong breech-loaders were let off alternately through the bow ports.

The old Dutch saluting guns on the fort seemed to return the unpleasant noisy compliment with some difficulty, and one of them leapt off the parapet into the ditch, in the excitement of unwonted exercise. It is to be hoped, that before long the intolerable nuisance of saluting will be done away with; it is most astonishing that civilized persons can be so much the slaves of habit, as to make a painful

noise of this kind when necessity does not require it; everyone concerned dislikes the noise, and there is a great waste of material (Moseley 1879, 387-388).

The official narrative of the expedition (Tizard et al. 1885) did not have space for such observations, but Moseley's more personal account, while full of scientific observation, includes many such asides—serving as an honest and useful tonic for those who tend to romanticize the nature of scientific exploration.

The nineteenth century also brings about the environmental narrative—a work that does more than merely recount the characteristics of the natural environment as encountered by the writer, but that uses the natural environment as an inspiration for the exploration of more intimate frontiers. Henry David Thoreau's *A Week on the Concord and Merrimack Rivers* (1998) is much more than an account on a trip up a river valley in New England. *Walden* (1980) is much more than a treatise on life in the woods. Thoreau explores themes such as grief, religion, independence, and then-modern life through the prism of the landscapes he explores. For example, his encounter with a ferryman on a river crossing in New Hampshire inspires a discussion of manners:

There is reason in the distinction of civil and uncivil. The manners are sometimes so rough a rind that we doubt whether they cover any core or sap-wood at all. We sometimes meet uncivil men, children of Amazons, who dwell by mountain paths, and are said to be inhospitable to strangers; whose salutation is as rude as the grasp of their brawny hands, and who deal with men as unceremoniously as they are wont to deal with the elements. They seek out the southern slopes of hills, from which they may look down on the civil plain or ocean, and temper their diet duly with the cereal fruits, consuming less wild meat and acorns, to become like the inhabitants of cities. A true politeness does not result from any hasty and artificial polishing, it is true, but grows naturally in characters of the right grain and quality, through a long fronting of men and events, and rubbing on good and bad fortune (1998, 161).

In the following passage from *Walden*, Thoreau ponders the benefits of rural solitude and arguably helps lay the foundation for the “Back to the land” movement of the 1960s. He definitely inspires the “nature writers” who follow him in the ensuing century:

... My days were not days of the week, bearing the stamp of any heathen deity, nor were they minced into hours and fretted by the ticking of a clock ... This was sheer idleness to my fellow-townsmen, no doubt; but if the birds and flowers had tried me by their standard, I should not have been found wanting. A man must find his occasions in himself, it is true. The natural day is very calm, and will hardly reprove his indolence.

I had this advantage, at least, in my mode of life, over those who were obliged to look abroad for amusement, to society and the theatre, that my life itself was become my amusement and never ceased to be novel. It was a drama of many scenes and without an end. If we were always, indeed, getting our living, and regulating our lives according to the last and best mode we had learned, we should never be troubled with ennui. Follow your genius closely enough, and it will not fail to show you a fresh prospect every hour (1980, 79-80).

The bifurcation between exploration and environmental narratives continues into the twentieth century. The Heroic Age of Exploration comes to an often dramatic—sometimes fatal—end in the icy wastes of the Earth’s poles (Kirwan 1962). Scientific writing becomes more and more formalized. Moseley’s cattiness gives way to the emotionless, impersonal, spare, “Just the facts” language of a Sgt. Joe Friday. To discover the personalities of the explorers, one must turn to the memoirs, such as *Farthest North* (Nansen 1999), *The Heart of the Antarctic* (Shackleton 1999), *The Worst Journey in the World*, (Cherry-Garrard 1997), and *The Home of the Blizzard*, Mawson 1998). *Worst Journey in the World* is one of the most dramatic accounts of exploration ever written. Apsley Cherry-Garrard is unflinching in his assessment of the futility of a side-journey that he made with Edward “Bill” Wilson and Henry “Birdie” Bowers on Robert Falcon Scott’s ill-fated *Terra Nova* expedition. The side journey, to collect eggs of the emperor penguin for embryological and evolutionary research, was horrific in itself:

Birdie always lit the candle in the morning—so called, and this was an historic business. Moisture collected on our matches if you looked at them. Partly I suppose it was bringing them from outside into a comparatively warm tent; partly from putting boxes into pockets in our clothing. Sometimes it was necessary to try four or five boxes before a match struck. The temperature of the boxes and matches was about a hundred degrees of frost, and the smallest touch of the metal on naked flesh caused a frost-bite. If you wore mitts you could scarcely feel anything—especially since the tips of our fingers were already very callous. To

get the first light going in the morning was a beastly cold business, made worse by having to make sure that it was at last time to get up. Bill insisted that we must lie in our bags seven hours every night.

In civilization men are taken at their own valuation because there are so many ways of concealment, and there is so little time, perhaps even so little understanding. Not so down South. These two men went through the Winter Journey and lived: later they went through the Polar Journey and died. They were gold, pure, shining, unalloyed. Words cannot express how good their companionship was (Cherry-Garrard 1997, 251).

I have never experienced anything as horrific as Cherry-Garrard describes here, but I have experienced enough that his pain reaches through the decades and grabs me by the throat. His writing, as does that of Nansen, Shackleton, and Mawson, touches me on an emotional as well as intellectual level and fires a longing to experience as well as preserve the deadly landscapes they describe. But twentieth century exploration narratives began to strip themselves of such personal ruminations, appealing to the intellect only and losing their empathic appeal.

The environmental narrative flowered in the twentieth and twenty-first centuries, however. Some focus on solely their evocations of a place, leaving the writer out of the narrative entirely, such as in Margery Stoneman Douglas's account of the Everglades (Douglas 1997), or only including him or her as an incidental character, or in Mike Tidwell's elegy for coastal Louisiana (Tidwell 2003). Some focus on environmental issues, rather than place, such as Rachel Carson's *Silent Spring* (2002) or Carl Safina's *Song for the Blue Ocean* (1997). Others are deeply personal accounts, à la Thoreau, of interactions with a particular environment, such as Jacques Yves-Cousteau and Frédéric Dumas's *The Silent World* (2004), or particular places, such as Edward Abbey's *Desert Solitaire* (1968) or Annie Dillard's *Pilgrim at Tinker Creek* (1988). Even fiction begins to feature strong environmental themes, such as the omnipresent signs of degradation in Peter Matthiesen's *Far Tortuga*:

On the lee side, in stained shallows, wavelets lift melted labels, floating feces, a pale plastic bottle. In the offal is the bobbing head of a green turtle; its shell and

guts scattered on the sand. Another turtle lies upright on the beach, facing inland. Its flippers are bound, and its great weight, unsupported, slowly smothers it. When Raib turns it on its back, it blinks, gasping its ancient sea sound, and sand grains falling from its lids stick in the fluids from its eye (1988, 163).

The environment described by Matthiessen is a far cry from the land Columbus described as “...so green that it is a pleasure to look on it.” Rather, it is a nightmare, an indictment of our disregard in deed for an environment our words praise as paradise.

The Goal

My hope is to produce a work that does more than partially fulfill the requirements for a Ph.D. I hope to reunite evidence obtained by scientific observation with language and imagery that, in keeping with Leopold’s legacy, inspires awareness of the bonds we humans share with the greater community of life around us, and that, in keeping with Carson’s legacy, inspires effective action to better care for that community.

To achieve this, I will have to produce a dissertation that is something of a hybrid: part print, part video, with both components capable of standing alone, but which are much better taken together.

When I first conceived of this project, I thought of it as the *Sand County Almanac* of the sea. I quite frankly am ambitious—this is a work that I hope would join the pantheon of environmental classics such as *A Sand County Almanac* or *Silent Spring*. I hope it will be read, and watched, and that the lessons drawn from it are acted upon before we as Carson warned, silence “the rebirth of new life in this stricken world” (2002, 3).

The MATX handbook says that this proposal should address how this project “...lays the foundation for the anticipated academic or professional career.” I hate to admit that I really don’t care. I began the journey that brings me to this prospectus in 2008 out of a personal “Road to Damascus” moment. I see our civilization inflicting tremendous environmental damage on the

biosphere, damage that can be prevented if we find in ourselves the will to do something about it. I know how to work with words, I'm getting better at working with images, and as I get older I think this project may be my last, best shot at helping inspire positive change. I made a difference before, and I am confident, or arrogant, enough to think I can do it again.

To succeed, I will have to call upon all of the various threads that have run through my life: the scientist, the journalist, the diver, the scientist. It seems to me that my life and its various adventures and misadventures have led me to the point where I am ready to undertake this mission.

But after the academic part of this exercise, I don't know. About all I can be certain of is that the completed dissertation is more of a beginning, rather than an end, of my personal quest to inspire change. What completion of the degree would do is to give me a platform, and with any luck a high though frightening platform, for a blind-faith leap into an uncertain and exciting future.

Work Plan (B)

Plan B assumes that I don't get the Fulbright to Vanuatu this year. Given some of the discussion in the prospectus defense, it made sense to me to swap the order of the work plans and present Work Plan (B) first given that I have already written a very detailed plan for what I would cover if I conduct my research in the Florida Keys. That plan is given in the attached book proposal overview essay (Appendix A).¹² The relevant sections are "Setting," "Structure—Almanac," "Structure—Sketches," and "Structure—Upshot."

¹² Note that the first three pages of that proposal are almost entirely identical to the first three and a half pages of this proposal. I initially planned on the book proposal serving as the bulk of my dissertation proposal, but had to modify it extensively to address issues required by the Media, Art, and Text program.

Unless I find sufficiently remunerative work in the Florida Keys, I will have to conduct my field research on a part-time visits to Looe Key specifically and the Keys in general. While there are some events I would have to be present for on specific dates, such as the Looe Key Underwater Music Festival (in July) or for coral spawning (usually July or August), I should be able to gather sufficient data from handful of seasonal visits over a one- or two-year period. As with Work Plan (A), I would collect data via audio, photos, video, and through any documentary research I find I must do while there. Since in this case, I may be conducting field work on a part-time basis, it may take me longer to finish, but I plan in any event to be done by the spring of 2016—my goal is to have the degree by my 55th birthday, which will arrive later that year.

Work Plan (A)

Plan A assumes that I am eventually awarded a Fulbright to Vanuatu. I have attached the “Statement of Grant Purpose” from my Fulbright application (Appendix B) that outlines in more detail my work plan while there. I would leave in the fall—September or October—for 10 months of field research on both the coral reef environments and the indigenous cultures of the islands, collecting data via audio, photos, video, and through any documentary research I find I must do while there. Admittedly, there are significant differences in culture and geography between Florida and Vanuatu. Nevertheless, there are enough parallels in the seasonal patterns of life between the two that the structure of the final work that I originally envisioned under Work Plan (B) can survive largely intact. After I completed my field work, I would return, probably do some supplemental research in places like Florida—coupled with recollections of my travels to Ascension Island, Bermuda, Venezuela, and Grand Manan Island in Canada—and write and edit with a goal of finishing by the Spring of 2015.

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APPENDIX A

Overview essay for *Last Call for Corals* book proposal

Last Call for Corals

Life, Death, and Conservation of an Ocean Ecosystem

Who'd be a coral polyp? You can catch a whole suite of really nasty diseases, you can be eaten alive in a very disgusting fashion by a starfish, you can be battered by storms, you can be choked by pollution, and you can be blasted to death by fishermen. And now, we learn, you can be scalded in hot brine and perish that way; or you can hang on, and you can slowly dissolve in soda water. Apart from that, the news isn't all bad. ...

Tim Radford, The Guardian

In July 2008—the International Year of the Reef—more than 2,500 scientists, resource managers, and activists from around the world gathered in Fort Lauderdale, Florida, for the 11th International Coral Reef Symposium. The goal of the meeting was to discuss the latest science and status of one of the most important ecosystems on the planet—the coral reefs.

Coral reefs serve many purposes: they provide nursery areas for fish and other marine animals; they provide bountiful feeding opportunities for the inhabitants of the sea; and they protect fragile shorelines from the ravages of storm waves. Specifically for humans, they provide food for hundreds of millions of the world's poorest (and many of the world's wealthiest); they offer tremendous potential for the discovery of new compounds to treat human illnesses; they provide innumerable and invaluable opportunities for ecotourism to support impoverished tropical economies; and they help counter global warming by removing some of the excess carbon

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dioxide we emit into the atmosphere.

At the International Coral Reef Symposium, scientists announced a number of dire findings: more than half of coral reefs in U.S. waters (Florida, the Gulf of Mexico, the Caribbean, and the Pacific) are in “poor” or “fair” condition; overfishing (unnoticed because fishing levels are often drastically underreported), climate change, coastal development, and pollution combine to threaten the stability of reef ecosystems around the world, making them more susceptible to disease outbreaks and other disturbances; and one-third of reef-building corals face extinction. Research published in the journals *Science* and *Nature* in the weeks prior to the symposium highlighted the danger of a by-product of global warming: acidification of ocean water. Ocean acidification—a result of water reacting with carbon dioxide in the atmosphere to form carbonic acid—can devastate coral communities, causing dramatic shifts in species composition (coral and otherwise), and leaving us with degraded as well as possibly destroyed coral ecosystems as the increasingly acid water literally dissolves the carbonate glue that holds the reefs together.

This litany of threats to reef ecosystems may sound like the exhortations of a Chicken Little, nevertheless, the effects of the threats can be predicted by the most fundamental principles of physics, chemistry, and biology. The existence of the threats are supported by rigorous, replicated, and numerous scientific observations from around the world. While some who live far from the coasts may dismiss what happens to coral reef ecosystems as too remote to be of concern, they are mistaken, as they will be affected in their homes by fewer and more costly fish resources for their diet; accelerated global warming as the main long-term global reservoir for carbon dioxide disappears (and possibly releases that carbon dioxide back into the atmosphere); and even reduced recreational and tourism opportunities that enrich the lives of hundreds of millions of the otherwise landlocked. This crisis is no drill.

In order to combat the accumulating agents of doom massing on the horizon, our global society must make major changes to the way we go about our business: reduce carbon dioxide emissions; reduce releases of urban, industrial, and agricultural pollutants into our coastal waters; eliminate consumption of vanity products like coral jewelry and rare fish species; and better manage reef fisheries in regions of the world where the populations have few options but to rely on the dwindling bounty of the sea. This can be done, but what is needed is an effort to combat what Vice Admiral Conrad Lautenbacher (USN, Ret.), former administrator of the U.S. National

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Oceanic and Atmospheric Administration, called “ocean illiteracy.”¹

Inspiration

My proposed book, entitled *Last Call for Corals*, is a response to Lautenbacher’s call to combat “ocean illiteracy.” My goal is to write a book that will become the *Sand County Almanac* of the sea. It will tell the story of a coral reef, discuss issues affecting reefs in general, and state and justify an Earth ethic—a term inspired by Aldo Leopold, author of *A Sand County Almanac*—that may serve as a guide to wiser stewardship and consumption of natural resources, and especially ocean resources, around the world.

Aldo Leopold’s watershed book, *A Sand County Almanac, and Sketches Here and There*, was published in 1949 after his death. It played a decisive role in awakening the environmental consciousness of the post-World War II generation. Leopold was a pioneering forester and wildlife scientist whose view of the environment evolved from the frontier attitude of exploitation at will to one of an enlightened caretaker who managed the land for its long-term vitality rather than for anyone’s short-term profit. In his writing, he avoided polemic—his lessons were all the more powerful for the beauty and subtlety with which he imparted them.

His book was made of three sections. The first section was “A Sand County Almanac,” a series of twelve chapters, based on the months of the year, that illustrated the vibrant life surrounding his farm in Sauk County, Wisconsin. The second part of the book, “Sketches Here and There,” ranged farther afield, describing how places he visited or worked at during his long career either benefitted or suffered from the management policies—or lack thereof—in effect at the time. The third part, “The Upshot,” builds toward his final and most influential chapter, “The Land Ethic,” in which Leopold expanded the notion of ethics, which regulate interactions among humans for the benefit of all, to include our relationships with the land and the other organisms who also reside upon it. “In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land community to plain member and citizen of it. It implies respect for his fellow-members, and

¹ Conrad Lautenbacher, press briefing at the International Coral Reef Symposium in Fort Lauderdale, Florida, 10 July 2008.

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also respect for the community as such,” Leopold wrote.²

Setting

Rather than focusing on a farm in Wisconsin, *Last Call for Corals* will focus on Looe Key Reef, formerly a small, sandy strip of land—reportedly with its own tree—discovered on Sunday, February 4, 1743 (1744 according to the Gregorian calendar), when the *HMS Loo*, the British frigate for which the reef is named, and a prize vessel, the *Billander Betty*, ran aground the reef shortly after 1 a.m. In the darkness *Loo* Captain Ashby Utting and his men began salvaging what they could from the stricken ships, and looked for ways to engineer rescue and avoid capture by the Spanish, or even worse, the Calusa, native inhabitants of South Florida and the Keys with reputation for killing captured Englishmen.

Utting thought he had struck a shoal near Double-Headed Shot Key, on the Salt Key Bank (Cay Sal Bank) in the southeastern part of the dogleg where the Straits of Florida turn from an eastward path (between Florida and Cuba) toward a northward path (between Florida and the Bahamas). When sun arose, Utting surveyed his domain and realized he was mistaken: a current had pushed the ships off course, and he was within a few leagues of the Florida Keys, on the northern edge of the Straits. While Utting and his nearly 275 men were on land, the fact offered little comfort. The key measured about 900 yards long and 300 yards wide, and was so low a decent wave could wash them all into oblivion. Luckily for Utting and his men, rescue came Monday in the form of a sloop deserted by its Spanish crew as an armed party of Utting’s men in small boats chased it down.

The former *Billander Betty* was all but destroyed as the waves dashed it upon the corals that Sunday morning. The *Loo*, while holed below the waterline, was largely intact. Utting set fire to the ship, and as the sun set that Monday it exploded, scattering debris across the island and surrounding waters. For decades afterward, the island was marked as Looe Key—“Looe” being a spelling error on Admiralty orders for the construction of a replacement for Utting’s lost ship. The error became enshrined in nautical charts through the centuries, the origins of the name

² Aldo Leopold, *A Sand County Almanac, and Sketches Here and There*, Special Commemorative Edition (New York: Oxford University Press, 1987), 204.

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forgotten until the wreck was rediscovered and salvaged in the middle of the twentieth century.

Looe Key has all but disappeared as sea-level rise and erosion took their toll on the sandy strip from which Utting and his men sought deliverance. The last reported sighting of the island was by Louis Agassiz in 1851. But the reef remains, one of the highlights of today's Florida Keys National Marine Sanctuary. The reef—perched on the edge of the Florida Shelf where it rises abruptly from the depths of the Straits of Florida—lies about 25 miles southwest of Marathon, Florida, and about 30 miles east of Key West. Hawk Channel, which separates Looe Key from the spine of the Florida Keys proper, ranges between 20 and 40 feet in depth. Looe Key rises to within a foot of the surface; Coral rubble at the eastern end of the reef occasionally projects above the surface during low tides.

The reef is best described as a bank reef—a reef consisting of a shallow area dominated by sand and seagrasses, bounded by spur-and-groove coral formations (elongated coral ridges and sand- and debris-filled valleys) facing deeper waters.

Looe Key Reef itself is triangular in shape, with the base of the triangle toward Cuba, and the apex of the triangle pointing northward toward nearby Big Pine Key. The main rampart of the reef—which runs the edge of the continental shelf—is the nearly 5,000-foot-long forereef that forms the triangle's base. Spectacular spur-and-groove formations, the primary draw for scuba divers, are found here. The spurs, averaging about 500 feet long, tower more than 20 feet above the bottoms of the grooves, which themselves are typically 20 to 30 feet wide. The main axes of the spurs and grooves run more-or-less perpendicular to the edge of the shelf. The spurs descend to about 30 to 35 feet depth on the seaward side. On the landward site, the spurs may rest in 5 to 10 feet of water, and their upper portions—the reef crest—may be exposed at low tide.

At the base of the forereef, a gently sloping sand flat extends toward the depths of the Florida Strait. Toward the southwestern portion of the forereef, however, a deep reef takes the place of the sand flat. The deep reef extends westward for several hundred feet. To the south, the deep reef follows an ever-steepening slope until it reaches a drop-off at a depth of 110 to 120 feet.

At the heart of Looe Key Reef lies a shallow lagoon, or reef flat, with a maximum depth of about 10 feet. Bounded by two arms of coral rubble on the landward side and the forereef on the seaward site, the bottom of the lagoon features a mixture of coral sand and coral fragments. Seagrasses and an occasional patch of live coral are also present. The rubble that surrounds the

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lagoon forms something of a rampart that, landward of Looe Key, rests upon sand and seagrass flats. The rubble is formed primarily from corals broken off the reef during storms. The triangular shape of Looe Key is generated by deposition of the rubble by waves refracting—bending—around the forereef. Sand flats and seagrass beds, each with the occasional patch of live coral, dominate the area in the shallow waters beyond the arms of coral rubble.

Structure—Almanac

As the structure of *A Sand County Almanac* proved quite successful—Leopold’s work is one of the most influential books of the twentieth century—I propose to use it as a model for *Last Call for Corals*. As with *A Sand County Almanac*, the proposed book will begin with a series of monthly essays that focus on Looe Key Reef. Each monthly essay will document changes in the lives of the reef inhabitants—spawning, development of larvae and juveniles as they drift with ocean currents, return of the prodigals to settle in more permanent surroundings on the reef, and their transformation into adults. The narrative will not be limited in focus to the primary residents—the corals—but will weave through representative stories of all major groups associated with reefs: microscopic and macroscopic algae, seemingly innumerable invertebrates, and the fish and other vertebrates that add to the plethora of colors and shapes that makes diving or snorkeling on reefs such an awe-inspiring sensual experience.

Instead of beginning in January—the month most of the Western world considers as the start of the year—*Last Call for Corals* will begin the almanac portion in August with a chapter appropriately called, “In the Beginning.” It is the beginning of the life cycle for the most important organisms on the reef: the corals that built it. Most of the primary corals spawn in a coordinated nighttime release of eggs and sperm a few days after the August (or sometimes late July) full moon. The corals aren’t the only animals spawning in the late summer; Many other invertebrates and vertebrates—including the massive goliath grouper—are similarly occupied at the time.

September is the heart of the Atlantic hurricane season, and the corresponding chapter, “Agents of Destruction,” will chronicle the potentially devastating effects of hurricanes on coral reefs and their residents. The power of water, as demonstrated by the storm surges that strike land, does as much if not more damage to corals and other sessile animals and plants in the

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relatively shallow areas where reefs are found. Notorious storms such as the Labor Day Hurricane of 1935 proved especially devastating to the Florida Keys. The storm that most recently wreaked havoc in the Lower Keys, where Looe Key is found, was Wilma in 1998. The effects of storms are not entirely negative, however. Storms also increase diversity on coral reefs, clearing patches for new combinations of corals, sponges, algae, and other organisms to settle.

The spawn of many coral organisms spend their early lives drifting with ocean currents as zooplankton, grazing on the microscopic plants called phytoplankton, and growing and developing until they reach a stage where they are ready to abandon their wandering ways and settle on the reef and begin their mature lives as sessile reef residents. The stories of some of those wayward offspring—and their return to the reef—will be chronicled in the chapter for October, “Prodigal Children.”

The ocean bottom—whether sand, rock, or living or dead coral—is not the only substrate for reef life to settle on. Other fish can serve as perfectly nice sites for colonization by internal and external parasites. When the host fish feels it is time to get clean, it goes to a cleaning station for inspection and service by specialist fish—such as cleaner wrasse or gobies, or cleaner shrimp. While at a cleaning station, enemies abandon their usual hostilities (or typical feeding behavior), calmly awaiting their turn as the cleaners give them a thorough going-over. The inspections—the subject of the November chapter, “The Cleaners”—are both external and internal, usually inside the mouth and gills, as the cleaners seek out, pick off, and eat the unwanted guests on the host fishes’ bodies.

Most human visitors to coral reefs come in the day, when they can see vast, sunlit vistas of colorful sea life—as well as easily see their dive gear, their dive buddies, and potential hazards. Relatively few humans see the reef at night, when a different cast of characters, who spend the day hiding from predators, come out in the relative safety of darkness. Some predators are more likely to show up after dark, too, such as the bull shark and moray eels. As December brings the longest nights of the year in the Northern Hemisphere, it is the ideal month for a chapter discussing the “Night Life” of the reef.

Though time is a continuum, humans insist on breaking it down into artificial subdivisions and marking the passage of it with devices such as calendars, clocks, and watches. The smallest

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subdivision of time (that most of us use, anyway) is the second, sixty of which make up a minute. Sixty minutes makes up an hour, twenty-four hours makes up a day, 365 days make up a year—the beginning of which is, for most of us, a holiday in which we reflect on the past and look to the future. Throngs go to places like Times Square in New York City, to public and private celebrations all over the world, and count down the last seconds of the old year before cheering the arrival of the new. On the reef, though, there are no such celebrations. Time on the reef remains an unbroken continuum marked by the never-ending activities of individual organisms struggling for survival. Many do not live long enough to be able to have a sense of history—if it was possible for them to be cognizant of such. But one species, the “Redwood of the Reef,” or giant barrel sponge—with a life span of centuries—has the longevity to be the reef’s historian. Its story will be focus of January’s chapter.

The wreck that led to the discovery of Looe Key occurred in February, therefore it is the appropriate month for the chapter “Shipwrecked!” This chapter will address the damage caused to coral reefs by wrecks, anchors, and spills and other discharges; It will also address what can be done to repair that damage. The discussion will be informed by a more recent wreck, that of the University of Miami’s research vessel *Columbus Iselin*, which ran aground on Looe Key Reef in 1994, and its aftermath—including the long-term effort to restore the portion of the reef damaged in the grounding. The chapter will also investigate how life on the reef reclaims its sovereignty over the areas damaged and the debris left behind by humanity’s mistakes and misdeeds.

Lobster is a delicacy far beyond New England. While New Englanders are justifiably proud of their big-clawed crustaceans, Floridians are equally proud of their home-grown version, the spiny lobster. This small-clawed distant cousin of the American lobster is one of several crustaceans, large and small, that hail from Looe Key Reef. It and its cousins, including crabs and shrimp, add considerable character to the reef environment. Florida’s regular lobster season traditionally ends in March, thus this is an appropriate month for a chapter, “Life of a Delicacy,” describing their biology and role in the ecology of the reef.

Coral reefs, like most of the ecosystems on Earth, depend on light from the sun to provide the energy that makes life possible. In many ways, reef ecosystems are like forests, with organisms competing for light by overtopping their neighbors, capturing sunlight (and its energy) for

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themselves and denying it to others. The corals are the primary trees of the reef. While animals, they live in a mutualistic relationship (a symbiotic relationship that benefits both parties) with zooxanthellae, microscopic algae that take up residence inside the corals' cells. The zooxanthellae are capable of photosynthesis—they capture the light from the sun and store the energy in the form of chemical compounds that they and their host corals can use. Corals compete among themselves for light, but an even more high-stakes competition is with macroscopic algae, which can grow faster and displace the corals, destroying the reef's ability to support the vast diversity of life typically found there. Oftentimes it is up to grazers, such as sea urchins, keep algal growth in check. The interactions among organisms, both positive ones such as the mutualism between the corals and their zooxanthellae, and the negative ones, such as the competition between the corals and the macroscopic algae, will be the focus of the April chapter, "Good Neighbors/Pesky Neighbors."

So far, the almanac portion of *Last Call for Corals* has focused on herbivory (animals eating plants), parasitism (small animals living off the flesh or fluids of larger organisms), and mutualism. The May chapter, "Predators and Defenses," will focus on predation—animals eating other animals. As on land, many prey organisms use large numbers, camouflage, or mobility to escape those who would eat them. But in the sea, many prey organisms are as mobile as your average pet rock. Since sessile animals cannot evade or escape their predators, they rely on chemical defenses and armor to render themselves less palatable to predators. Some organisms, such as *Tritonia*, a nudibranch, even take advantage of the chemical defenses of their prey—the common sea fan—to use as a defense against their predators, the bluehead wrasse.

The final two chapters of the almanac focus on visitors to the reef. The June chapter, "Drifters and Swimmers," will discuss the plankton—organisms large and small whose movements are primarily controlled by currents and wind—and pelagics, free-swimming species whose home is in the depths beyond the reef. Plankton range from microscopic phytoplankton to large drifters like the moon jelly and the Portuguese man-of-war. Microscopic plankton serve as the primary food source for many reef organisms—especially the corals and related organisms. Potential pelagic visitors include whale sharks, manta rays, ocean sunfish, sea turtles, and whales, among others. They come from the depths to feed, breed, or just pass by the reef on the way to somewhere else.

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The almanac will end in July, the month of the notorious Underwater Music Festival at Looe Key. The final chapter of the almanac, “Nep-Tunes Realm,” will highlight the festival, a tradition that has lasted a quarter century. The festival, as advertised, does take place under the sea, featuring scuba divers and performers listening to music broadcast via underwater speakers. The revelry is a joyful celebration of the reef and what it offers humanity in terms of sensual and spiritual experiences, but the story is not entirely a positive one, for recreational divers often damage reefs as well.

Structure—Sketches

As in *A Sand County Almanac*, the sketches portion of *Last Call for Corals* will stray from the focus on the one reef. It must, as this is the portion that will discuss something of the geological, biological, and social history of coral reefs as well as the many issues—already named—facing reefs today. This section is crucial, as it provides much of the backstory for why reefs in particular and oceans in general need to be included within humanity’s ethical framework. Leopold’s land ethic, for many, seemed to stop at the shores. It was most effective as a guide for conduct where someone, either a government or private landowner, has some degree of sovereignty over the territory being managed. As the oceans fall largely outside the boundaries of sovereign entities, they have repeatedly suffered the tragedy of the commons, with destruction of marine environments and collapse of fisheries occurring more rapidly year-by-year.

The list of suggested sketches is tentative, as unforeseen events may dictate what must or should be included in the final cut of the book. Nevertheless, there are some ideas that should be included. The section will begin with a discussion of the geology, history, and environmental requirements for the development of coral reefs. Among other things, reef-building corals tolerate a rather narrow range of conditions of depth, salinity, and temperature—warm-water corals, for example do best at temperatures between 73°F and 77°F. Warmer conditions triggered by climate change make corals more susceptible to coral bleaching (loss of the zooxanthellae from the corals themselves) and coral diseases. Living and fossil reefs also contain evidence of past climates; as a result, they also offer clues to what else may be expected from future climate change. Climate change, therefore, will be subject of the second sketch. As ocean acidification is a by-product of rising carbon dioxide levels in the atmosphere, it will be addressed in the third

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sketch. The carbon dioxide that in the atmosphere triggers the greenhouse effect dissolves into ocean waters and forms carbonic acid, which—if acidic enough—can dissolve the carbonate skeletons of marine organisms.

Case studies—probably of the collapses of the Kaneohe Bay Reef ecosystem in Hawai'i and the Discovery Bay Reef ecosystem in Jamaica—will be the focus of the fourth sketch. At Kaneohe Bay, pollution and eutrophication favored a phase shift between a coral-dominated system and an algae-dominated one. In Discovery Bay, a system already stressed by hurricane damage was hit by a massive die off of the long-spined sea urchin, one of the major grazers of seaweeds on the reef. Again, algae cover increased at the expense of coral cover.

The goliath grouper—the largest, critically endangered, member of the sea bass family—was once a favorite of Florida anglers, but overfishing of this slow-growing species pushed it to the brink of extinction. An analysis of how removal of the goliath grouper and other key species affect reef ecosystems will be the subject of the fifth sketch. Coral health will be the subject of a sixth sketch. It will include a discussion of coral bleaching, white pox disease, and black band coral disease; all three may be triggered or exacerbated by human abuse of the environment through climate change, pollution, and land use changes. Other coral and reef systems—such as cold-water corals, deep-water corals, and oyster reefs—will be profiled in the final sketch.

Structure—UpShot

The final section will build on work by Leopold, Safina, and others, making a concise, understandable case for more than a land ethic, as Leopold devised; and more than a sea ethic that Safina has written about. In this section I will state an Earth ethic that, I hope, can inspire people far from the seas, and bind people of many cultures—from fishing communities depending on the reefs for subsistence, to the sport fisherman whose efforts drain fish populations of the most prolific breeders, to the nouveau riche of China who dine on exotic fish delicacies and the fashionistas in New York who wear coral jewelry in celebration of their wealth and status, and to the farmer in Kansas who eyes the southern sky in search of Gulf of Mexico-fed rains—in an enlightened relationship with the Earth that ultimately sustains us all. What we do in our own homes affects the sea, land, air, and the other life that shares these resources with us. Eventually, what we do to the land, sea, air, and our non-human neighbors

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comes back to haunt us—to some extent in ways that we can envision, but also in ways we have yet failed to imagine.

Market considerations

My hopes for *Last Call for Corals* is to offer a work that may inform readers of the natural history of coral reefs, and inspire current and succeeding generations to undertake greater efforts to conserve marine resources. There is a need for such a book. In July 2008, I attended the International Coral Reef Symposium in Fort Lauderdale. While there, I saw plenty of works targeting the professional community of scientists, managers, and activists. I saw little for the general public that serves my dual goals of information and inspiration. While there are many books about coral reefs that target a non-professional audience, most of them serve the educational needs of a young adult or child audience, or they are field and identification guides and reference books for scuba divers, snorkelers, and fish and shell collectors. They are excellent books in themselves: the *World Atlas of Coral Reefs* (University of California Press), the reef identification guides by Paul Human and Ned DeLoach, and Peterson's *A Field Guide to Coral Reefs* are all good examples. Other general-interest books on coral reefs include David Dobbs' *Reef Madness*, which examines the scientific controversy between competing theories of how coral reefs form. There are also excellent books on the oceans and ocean issues, such as *The Oceans* by Ellen Prager and Sylvia Earle; *Sea Change*, again by Earle; *Song for the Blue Ocean*, by Carl Safina; and *The Unnatural History of the Sea*, by Callum Roberts. In each case, coral reefs and issues affecting coral reefs make up a relatively small part of the book.

The one somewhat close competitor to my proposed work is J.E.N. Veron's *A Reef in Time*, which focuses on Australia's Great Barrier Reef and, in one reviewer's words, is more of an anticipation of the death of coral reefs rather than an examination of their life. My book's focus on the Florida Keys is more likely to inspire interest among American readers than a competing book focused on Australia. The focus of the proposed work—on the life of the reef rather than its death—and its carefully developed case for an Earth ethic, rather than a land ethic or a sea ethic, will be more likely to leave readers feeling empowered rather than paralyzed.

There is a significant market for *Last Call for Corals*. Of course, those concerned about environmental issues—particularly ocean issues—will be interested. But scientists, like the

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legions of scientists (including myself) who were inspired by Aldo Leopold's work, will find it worthwhile. Recreational divers, snorkelers, fishers, anyone with a salt-water aquarium in their homes, and legions of children and former children who grew up watching the movie *Finding Nemo* all make up likely purchasers of the proposed work. If I achieve my vision of writing the *Sand County Almanac* of the sea, *Last Call for Corals* has the potential to become a classic that sells and remains the focus of critical debate for decades to come.

Why do I want to write this book?

I have long been interested in the oceans, but for most of my life, had little contact with them. That changed in my mid-30s, when I began working as a research assistant at Lamont-Doherty Earth Observatory, where much of the geologic and oceanographic research that led to the development of the theory of plate tectonics was conducted. I also attended Columbia University's Graduate School of Journalism, and in the spring of 1997 took Sam Freedman's book seminar. My project, about the effort to map the ocean floor and how it inspired the development of plate tectonics, became (if memory serves) the ninth book contract to come out of Freedman's seminar and (no worries about memory here) my first book, *Upheaval from the Abyss: Ocean Floor Mapping and the Earth Science Revolution* (Rutgers University Press 2002). Since then, I have become more involved in studying and writing about the oceans. I have developed and taught an oceanography course for a Virginia community college and become certified as a scuba diver. I am now a professional diver—a PADI-certified divemaster who never gets enough time in the oceans. In nearly everything I now do, my passion is to make others more aware of and appreciative of the mysteries of the deep.

Why should I write this book?

In addition to my first book, *Upheaval from the Abyss*, I am the author of a second, *Huntington's Disease* (Chelsea House 2009), and am under contract for a third, *Time Detectives: Climate Change and Scientists' Quest to Know Earth's Future from Its Past* (Rutgers University Press 2012). My two published books reveal an ability to clearly, engagingly, and understandably write scientific narrative. The evidence is in the reviews for *Upheaval from the Abyss*—it received critical acclaim. One reviewer wrote “*Upheaval from the Abyss*, therefore, is

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as suitable for the den as for the classroom. To tell the story of Wegener's theory [of continental drift] is one thing; to make anyone other than an oceanographer care is another. It's Lawrence's enthusiasm for his subject that makes the difference. It shines through nearly every chapter, making us better appreciate the science that is at stake.”³ Another wrote “Lawrence's first book is a sleeper; if he continues on track he could join the ranks of elite science writers like Stephen J. Gould in geology and evolution and Jared Diamond in anthropology.”⁴

In addition to the two books, I recently contributed to two anthologies, *The Science of Dune* and *The Science of Michael Crichton* (both BenBella Books, 2008). In both, I again demonstrate the storytelling and scientific skills needed to write the proposed book. In the *Dune* book, I wrote about the ecology of the planet Arrakis based on Frank Herbert's original writings—and I compared Herbert's fictional ecological and climatological transformation of Arrakis to the historical ecological and climatological transformation of Ascension Island in the South Atlantic Ocean. (Ascension Island, ironically, has no coral reefs.) In the Michael Crichton book, I offered a scathing critique of Michael Crichton's climatically skeptical screed, *State of Fear*. Here is what one reviewer said of my contribution to the Michael Crichton book, “The most outstanding contribution, however, is meteorologist David Lawrence’s skewering of *State of Fear* (2004), Crichton’s loosely fictionalized attempt to debunk global warming. Here, Lawrence forcefully argues that whatever writing chops Crichton possesses, sometimes he gets the science far more wrong than right.”⁵

My books and book contributions are in many ways products of my many years of straddling the lines between science and journalism. I am a respected researcher and a respected (and award-winning) reporter. I hold two relevant master's degrees, one in geography from George

³ Mark Burgess, review of *Upheaval from the Abyss: Ocean Floor Mapping and the Earth Science Revolution*, by David M. Lawrence, *Parson’s Review*. <http://webpages.charter.net/maburgess/science#Upheaval> (Accessed 18 October 2002).

⁴ F.T. Manheim, review of *Upheaval from the Abyss: Ocean Floor Mapping and the Earth Science Revolution*, by David M. Lawrence, *Choice*, September 2002.

⁵ Carl Hays, review of *The Science of Michael Crichton: An Unauthorized Exploration into the Real Science behind the Fictional Worlds of Michael Crichton*, ed. by Kevin R. Grazier, *Booklist*, 15 February 2008.

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Mason University, the other in journalism from Columbia University. My scientific career includes teaching biology, geography, meteorology, and oceanography at the college level—with me ultimately reaching the rank of adjunct assistant professor at one school. In addition, I have worked as a research assistant at several universities and related institutions—such as Lamont-Doherty Earth Observatory—and consulting firms; and have worked in environmental risk assessment for federal and state government agencies.

My equally long journalistic career includes stints in various editorial and correspondent capacities at the *Richmond (Va.) Times-Dispatch*; the *Daily Press* and *Digital City Hampton Roads/dailypress.com* in Newport News, Va.; *The Progress-Index* in Petersburg, Va.; the *Daily Record* in Parsippany, N.J.; the *Daily Progress* in Charlottesville, Va.; and *The Times* in Shreveport, La. In addition to the books I have written or contributed to, my writing about science and scientists has appeared in publications such as the magazines *Geotimes*, *The Lancet*, *The Lancet Infectious Diseases*, *Mercator's World*, *Vegetarian Times*, and *SolveClimate.com* and on the radio shows *Our Ocean World* and *MicrobeWorld*. Other significant publications include several articles in the *Encyclopedia of the Developing World*, *Magill's Medical Guide*, and the forthcoming *Diseases and Disorders*, *World History Encyclopedia*, the *History of Cartography* project, and the *International Encyclopedia of Human Geography*.

In all of my science writing work, as well as in my scientific research publications, I have displayed the skill to make technical topics accessible—even interesting—to scientists and non-scientists alike. This skill is vital to the success of the proposed work in informing the public about such an important and timely topic.

APPENDIX B

Fulbright Statement of Grant Purpose

STATEMENT OF GRANT PURPOSE

David M. Lawrence, Vanuatu, Journalism

[ENVIRONMENTAL] TALES OF THE SOUTH PACIFIC

I propose to go to the South Pacific to learn how indigenous peoples live in relationship with the sea. This project is part of the research for my dissertation project: to write a book modeled on Aldo Leopold's seminal environmental work, *A Sand County Almanac and Sketches Here and There*, but in contrast to his focus on life (including human life) on land, I will focus on the sea. I will investigate how members of an indigenous community consume—and more important, regulate their consumption of—natural resources, learning their values (e.g., gross national product vs. gross national happiness) and ethics (in the sense of Leopold's suggestion that humans be good citizens of a community that includes water, soil, plants, and animals).

My plan is to travel to Vanuatu and engage in a project of immersion journalism: to immerse myself in a coastal community that lives in a largely sustainable manner, to share in the tasks of their daily lives—especially the portion of their lives devoted to reaping, sharing, and protecting the bounty of the sea and land that sustains them—and document our experiences with interviews, photography, and audio and video recordings. In addition, I will seek the insight of local and regional experts in government, academia, and non-governmental organizations regarding the sustainability or unsustainability of traditional practices; the effect of outside (as in outside the local community) commercial and development activities on the sustainability of traditional practices; and the effect of global and regional changes on the sustainability of traditional practices. If necessary, I will collect baseline ecological data on coastal and marine ecosystems, such as coral reefs, in order to document differences in the ecological health of ecosystems differentially affected by human activities.

I chose the South Pacific for a host of reasons. First, my primary interest is in studying coral reef ecosystems as a microcosm of marine ecosystems overall. Reef systems are feasible to study, more tangible to a non-specialist audience familiar with seeing reef life in aquaria, while snorkeling or scuba diving on vacation getaways, or from the portrayal of reef life in books, television, and movies (such as *Finding Nemo*). Coral reefs are among the most ecologically and economically important marine ecosystems, supporting more species per unit area than any other marine ecosystem and—despite covering only 1 percent of the Earth's surface—provide hundreds of billions of dollars of ecosystem services such as food production, storm protection, and recreation.¹ The South Pacific has the largest expanse of coral reef ecosystems in the world as well as the largest and most diverse array of human communities, especially indigenous communities, that live on those ecosystems. Those indigenous communities offer an important alternative view of life with the sea and provide the lens I need to examine the effectiveness of Western approaches to environmental appreciation, protection, and valuation.

Vanuatu is an ideal nation in which to conduct such an examination because, despite the nation's efforts to embrace modern development, there are still substantial areas where ni-Vanuatu (native people of Vanuatu) have resisted the tides of change. *Kastom*, their traditional system of taboos and folkways, survives and adapts—and in some cases prevails—outside the nation's main economic and tourist centers. *Kastom* exerts a strong influence on environmental management in many small communities, enabling the ni-Vanuatu to live in a largely sustainable manner.² Traditionally, islanders have depended heavily on subsistence agriculture and the harvest from nearshore coral reefs.

STATEMENT OF GRANT PURPOSE

David M. Lawrence, Vanuatu, Journalism

[ENVIRONMENTAL] TALES OF THE SOUTH PACIFIC

The island of Gaua has a number of villages where people live according to *kastom*—thus offering the conditions I seek to study—while allowing me somewhat reliable access to places where I can restock supplies and, if need be, communicate with the outside world. It is also a microcosm of Vanuatu itself, offering a range of environments from sandy beaches and coral reefs to an active volcano and volcanic lake enshrouded in tropical rain and cloud forest.

After spending two or three weeks meeting with my affiliates at SPC-GIZ Climate Change Vanuatu and Dr. Marc Léopold of the Fisheries Department of Vanuatu and French Research Institute for Development, meeting with other local experts, and completing an intensive course in *bislama*, the local pidgin language, I expect to spend three or four months exclusively on Gaua. I will initially stay in local guest houses until I make arrangements to join the community of a local village where I will learn about their culture by living and working with them as they fish, grow crops, prepare meals, and celebrate the key events of their personal and community lives. Afterward, I plan to make short visits to other islands to get a broader perspective of the range of relationships islanders have with the sea. I will then return to Gaua for the final month or two of the project to tie up loose ends and, I hope, cement long-term relationships with the people that I know will have had a tremendous impact on my work and, more important, my life.

My career up to this point has prepared me well for this task. With decades of experience both as a scientist and a journalist, I have honed the skills needed to accurately observe what the members of the community do, to learn what they think about what they do, and to ask critical questions as the need arises. I can scientifically document the characteristics of their environment through sound ecological sampling methods and journalistically document cultural and natural phenomena through “shoe-leather” reporting as well as by recording photographic and video images and sound.

The results of this project will be incorporated as a series of essays that form a substantial portion of my dissertation project as well as other work, such as essays or mini-documentaries on a Web site designed to accompany my dissertation work. After my dissertation is complete, I plan to use my reporting from Vanuatu as part of a book on marine conservation and environmental ethics. In addition, I hope my video work will lead to a documentary film or series that focuses on our relationship with the sea and illustrates how we, in Leopold’s words, can be better “neighbors” with the residents of the watery spaces of Earth.

I will archive copies of any notes, photographs, and audio and video recordings, as well as copies of finished books and other writings, and audio and video presentations with an appropriate institution in Vanuatu so that local and visiting scholars can use my work to further their own research. This documentation is key, for Western societies, and those societies hoping to join the West’s more affluent club, have much to learn from indigenous peoples about how to live within their environmental means. It will also serve as an epitaph of sorts for communities whose homes and livelihoods may be lost through climate changes of our—not their—making.

¹ Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, et al. “The Value of the World's Ecosystem Services and Natural Capital.” *Nature* 387, no. 6630 (15 May 1997): 253-60.

² Hickey, Francis R. “Traditional Marine Resource Management in Vanuatu: World Views in Transformation; Sacred & Profane.” *Fisheries Centre Research Reports* 11, no. 1 (2003): 117-37.

Coral reefs are large underwater structures composed of the skeletons of coral, which are marine invertebrate animals. Corals are found all over the world's oceans. Each individual coral is referred to as a polyp. Coral polyps live on the calcium carbonate exoskeletons of their ancestors, adding their own exoskeleton to the existing coral structure. As the centuries pass, the coral reef gradually grows, one tiny exoskeleton at a time, until they become massive features of the marine environment.