Let Them Eat Shrimp: The Tragic Disappearance of the Rainforests of the Sea

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the whole reaction network and then examine its dynamic properties [where math may be needed]" (p. 45), whereas "the reaction–diffusion approach is to try to establish the presence of the motif that confers on the network the symmetry-breaking or pattern-forming property [i.e., that the pattern is formed by chemical dynamics]" (p. 46).

I found chapter 6 on the Turing equations to be somewhat long and wordy; later in the book (p. 159), however, there is a list of possible Turing morphogens of organisms ranging from slime molds to plants to vertebrates. Harrison asks the question, "When one has devised such a mechanism, what kind of experimental evidence does one try to match with it?" (p. 191) and answers by explaining that what we need in order to link theory to experimentation are careful measurements of the rates of change, the amount of time of transitions, sizes, and the number of parts in a pattern. Throughout the book, he offers the simplest models of complex dynamics, with the notion that one should apply Occam's razor to each explanation.

Because of his own training in physical chemistry, Harrison focuses on the pattern that a reaction–diffusion mechanism generates, and he does this through linear analysis—compared with James D. Murray's two-volume *Mathematical Biology* (2002), for example, where a more-complete treatment is given. But computation is essential even here. Harrison believed that to understand development properly, one needs to plunge into the equations that describe the processes. In this regard, he was hampered by an admitted lack of knowledge of partial differential equations, but he saw software as a possible answer, the idea being that it can assist in bringing experiment and theory together by letting individuals explore the interaction among geometry, chemistry, and growth rates without their having had to master the mathematics. To my mind, this is like teaching kids to use a calculator without explaining arithmetic—few of the concepts will sink in.

Turing's (1952) model applies to no particular species; for this reason, it applies to many. It represents a mathematical exploration of the phenomenon that is highly idealized, and it and its extensions (i.e., reaction–diffusion equations) often generate patterns that are similar to what we see in nature. An objection to using these applications is that it is easy to conclude that a matching pattern means a discovered mechanism, but clearly this is not so. The potential confusion is heavily outweighed, however, by the simple and profound insights that such phenomenological models generate.

In today's world, an impression is often given that if we can just take things completely apart, we will understand how they work as a whole. This is not likely to be the case, and, as Harrison intimated, our greatest understanding will come by combining molecular details, phenomenological models, and evolutionary thinking (Dorit 2011). There is no better example of this unified approach than the recent success in using the *Wolbachia* bacteria to suppress the transmission of dengue fever. These papers (Barton and Turelli 2011, Hoffman et al. 2011, Walker et al. 2011) are the seamless blending of the approaches that Harrison calls for in *The Shaping of Life*. The gap was bridged sooner than he could have realized.

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ECOLOGICAL AND SOCIAL CONSEQUENCES OF THE VOID IN MANGROVE CONSERVATION

Let Them Eat Shrimp: The Tragic Disappearance of the Rainforests of the Sea. Kennedy Warne. Island Press, 2011, 166 pp., illus. $25.95 (ISBN 9781597266833 cloth).

Let Them Eat Shrimp: The Tragic Disappearance of the Rainforests of the Sea is designed to draw attention to the devastating effects of industrial aquaculture—shrimp ponds in particular—and of land reclamation on mangroves around the world. These issues are presented as case studies—as informative as they are interesting, as diverse as they are insightful. Author and journalist Kennedy Warne has produced a highly readable but somewhat frightening account of the damage done to this ecosystem, and the patterns of destruction appear to be similar worldwide—with the exception of one or two glimmers of hope.

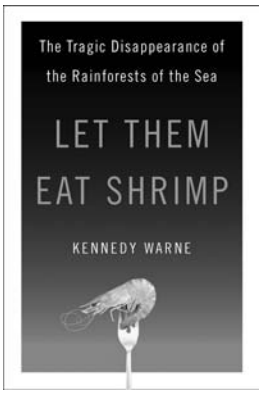
The book begins with an excellent introduction to the unique features of mangrove plants and their environment. The associated fauna is also introduced, as are the communities that live among and depend on mangroves. However, the underlying claim of the book that "without mangroves there would be no shrimp" (p. 29) is misleading. Mangroves are important for a part of the life cycle of some species of shrimp, but shrimp are not wholly dependent on mangrove forests and their waterways.

The evaluation of shrimp yield and mangrove data by Lee (2004), who used principal-components analysis, showed that shrimp yield is most strongly correlated with tidal amplitude, which suggests that shrimp catch is influenced by the amount of intertidal area available and not merely by the area of mangroves. Moreover, no significant relationship was noted between shrimp catch and relative mangrove area. Dietary evidence

supports this view: Stable-isotope studies have shown that the proportion of mangrove matter used as food for shrimp declines farther offshore, where phytoplankton and microalgae form the bulk of a shrimp's diet.

Although most of the case studies in *Let Them Eat Shrimp* are well researched and colorfully described, additional detail could have been helpful for one or two. For example, in the case study of the mangroves of the Rufiji Delta, Warne neglects to mention that in 1904, the colonial state of German East Africa (modern-day Tanzania) supplanted the local community's use of these mangroves with its own. Having pronounced the mangrove forests to be "ownerless, uninhabited, and off-limits to peasant use" (Sunseri 2003), the aim of the colonial government was to tax the communities of the Rufiji and to regulate the production of sisal hemp, coffee, and cotton as cash crops. The pivotal Maji Maji rebellion of 1905–1907 was the result of this policy, the first large-scale movement of resistance to colonial rule in East Africa. From this historical illustration, a lesson could perhaps have been gained: How acceptable should it be now for governments to restrict or ignore the rights of access of local communities to mangrove resources?

Similarly, the Sundarban mangroves are given deserved credit in the book for minimizing damage and loss of life during cyclones, but the valuable benefits of the planted mangrove greenbelts on the remaining parts of the Bangladesh coast are also worthy of mention. The extensive protection offered by the sustainable management of both natural and planted mangroves cannot be disputed. In addition, the minimal damage suffered by the coastal areas of Bangladesh from the Indian Ocean tsunami on 26 December 2004 can be attributed simply to the good condition of both the natural mangroves and the planted mangrove greenbelt of that country (Saenger 2011). The damage in other neighboring countries, where greenbelts do not exist or where natural mangroves had been severely degraded, was immense, sadly resulting in a great loss of property and lives. It is my view that the planting of mangrove greenbelts should be more actively and globally promoted—particularly in a world concerned with the possibility of rising sea levels. Planted mangrove habitats would also offer the added bonus of biodiversity conservation. The book touches on this



point but argues that system functionality is not restored for about 30 years (p. 109)—a time frame I have found to be much shorter (i.e., 4–6 years).

Despite my role as a mangrove ecologist and one who is generally wary of unfettered industrial aquaculture, I was disappointed by the book's treatment of industrial aquaculture and land development as being quintessentially evil, whereas subsistence extractive use—whether it be timber, fish, crustaceans, honey, thatch, or molluscs—is painted in Arcadian hues. The fact remains that without good management (both of the resource itself and of the political process governing it), both types of land use, when they are taken to extremes, can be destructive (Din et al. 2008). In the Middle East, for example, traditional camel herders have caused extensive mangrove destruction through severe overgrazing, and the loss of certain mangrove tree species (e.g., *Heritiera littoralis*, *Bruguiera gymnorhiza*, and *Ceriops tagal*) to traditional dhow construction has reduced the spread of these mangroves by hundreds of kilometers. Although these traditional practices appear at first glance to be sustainable, they are no more so than the commercial shrimp ponds for the giant tiger prawn *Penaeus monodon*.

It seems to me that many of the destructive activities in mangroves are the result of poor governance, based on incompetence, incomplete or improper valuation, or corruption. It is the politicians, therefore, who must be convinced that mangroves are valuable and in need of protection. Sending a message to politicians that mangroves are "green machines," tirelessly providing valuable environmental services, rather than "green cathedrals" (the approach stressed in the book), in which only some of us can worship, would be a useful step toward sustainable land-use practices.

Let Them Eat Shrimp succeeds admirably, however, at bringing the decline of mangroves and the resultant plight of dependent communities into public focus. It is not only the fate of the mangroves at stake but also the social consequences of their loss. The book raises many questions that we will ponder long after reading it.

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