Interview with Orrin Pilkey and Linda Jarvis-Pilkey

Q: You've written numerous books on coastal hazards and how we should respond to them. Why did you want to write this book about the abuse of mathematic models?

Orrin H. Pilkey and Linda Pilkey-Jarvis: For more than twenty-five years we have monitored beach nourishment projects around the United States. In order to secure federal funding and justify the enormous costs of these projects, anyone undertaking one must make a prediction of how long the sand will last on the replenished beach. The predictions are based on mathematical models that are said to be sophisticated and state of the art, and yet are consistently, dramatically wrong—always in an optimistic direction. In the rare instances when communities questioned the models after the predictions of a long healthy replenished beach clearly failed, the answer typically was that an unusual and unexpected storm caused the error. Well, the occurrence of storms at any beach is neither unusual nor unexpected. Eventually we became interested in how models were used in other fields. When you start looking into it, you find that a lot of global and local decisions are made based on modeling the environment. There are some fascinating (and discouraging) stories of model misuse and misplaced trust in models in the book.

Q: What is the problem?

OHP and LP-J: The problem arises when we rely on quantitative models to find an accurate "when," "where," and "how much." We find that these types of applied models are frequently detached from reality—built on oversimplified and unrealistic assumptions about natural processes. Worse yet, we found that the modelers in many fields (global climate change being an exception) don't look back at the predictions to see if they were right. Instead they march forward, creating ever more sophisticated models. If your basic assumptions are wrong, it doesn't matter what the math does. By the way, the reader should not worry that this book is full of mathematical equations—it's not! This book is full of interesting stories and illustrates how the mathematically challenged can confront modeled predictions.

Q: You frequently use the term "fig leafs" throughout Useless Arithmetic. How does it apply to models?

OHP and LP-J: One example from our book is the "fig leaf" coverage provided by quantitative modeling in the Grand Banks fishery. The Canadian Grand Banks fishery has been described as the greatest in the world. It provided cod to the Western world for 500 years. In our lifetime, we watched the wild and senseless overfishing lead to the demise of an industry that employed as many as 40,000 people. The models, which many realized were questionable, provided a fig leaf behind which politicians could hide to avoid making the unthinkable decision to halt fishing.

Q: You also write about politics polluting mathematical models. How so?

OHP and LP-J: We tell the story of the selection of Yucca Mountain (Nevada) as the permanent repository for our nation's nuclear waste. Overconfidence in models caused the U.S. government and courts to set a ludicrously impossible standard of safety for the site. Now the federal government requires one million years of certainty that radioactive waste will not endanger the local communities. It should be obvious to all of us that there is no way to predict what will happen in the next million years—a time span longer than that of humans. During the next million years there will be several ice ages and vast changes in climate, and possibly earthquakes and volcanoes. The Yucca Mountain prediction is based on a precarious pyramid built by stacking hundreds of inaccurate models on top of each other.

Q. So what is the solution?

OHP and LP-J: The problem is not the math itself, but the blind acceptance and even idolatry we have applied to the quantitative models. These predictive models leave citizens befuddled and unable to defend or criticize model-based decisions. We argue that we should accept the fact that we live in a qualitative world when it comes to natural processes. We must rely on qualitative models that predict only direction, trends, or magnitudes of natural phenomena, and accept the possibility of being imprecise or wrong to some degree. We should demand that when models are used, the assumptions and model simplifications are clearly stated. A better method in many cases will be adaptive management, where a flexible approach is used, where we admit there are uncertainties down the road and we watch and adapt as nature rolls on.