

Patterns in the Oceans: Ocean Processes and Marine Population Dynamics

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The title of this book sounds just like one of those thematic collections of reprints *Scientific American* publishes, with long forewords and introductions vainly attempting to

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force some order into an incoherent whole. Not so here: the title means something, i.e. the book really deals with 'patterns', and how these shape the population dynamics of marine organisms. In fact, patterns are so important to this book that the author presents his own, evolutionary explanation for the fact that we humans enjoy identifying deeper and deeper patterns, e.g. in music or literature.

Patterns, in this book, occur at two levels, one dealing with the way we know things about the ocean, and which may be called 'epistemological', the other dealing with the way things 'are', and which may therefore be called 'ontological'. At the epistemological level, patterns are crucial because, as Bakun emphasizes, we cannot perform experiments involving large-scale fluctuations of ocean regimes or fish stock sizes (except for our changing the global climate, an unplanned experiment), and hence we must rely on the comparative method to tease out insights from data, e.g. on patterns of similarities. Here the danger is that we commit the fallacies involved, for instance, in most correlational studies of fish recruitment, which happily convert pattern of association into cause-and-effect relationships. To avoid this, one's understanding of the ocean must truly reflect its underlying patterns, e.g. of circulation, and this leads to the only tedious – if necessary – part of this otherwise entertaining book, in which Bakun takes us 'beyond [our] experience' as terrestrial dwellers with limited ranges (airplanes notwithstanding), and presents the 'different rules' which determine how water currents flow, and/or which determine how marine organisms move, breathe and feed. A deep knowledge of these rules, frequently counterintuitive, and too often unknown to marine and fisheries biologists, is what has made Andy Bakun the world's leading fisheries oceanographer. And before one can enjoy this profound book, one must understand these rules, just as a knowledge of music can enhance one's appreciation of great musical work.

Epistemological and ontological patterns meet repeatedly in this book – or less pompously: there are in this book several sections in which explanations based on the comparative method succeed in explaining an extraordinarily wide range of phenomena. The most prominent of these is the presentation of Bakun's 'triad hypothesis', the claim that large, productive stocks of fishes require the occurrence of areas in which processes of (plankton) enrichment, concentration and (fish larvae) retention can occur. Simple as it may sound, this hypothesis has led to an outburst of new insights on the use, by fish, of fronts and other oceanic features. Many of these, by Bakun and his long-term collaborator Richard Parrish, are presented, as are related developments by Claude Ray and Philippe Cury (ORSTOM, France), whose discovery of dome-shaped recruitment 'windows' in clupeoids of upwelling systems is highlighted.

Much of the book is devoted to the identification of triad patterns in different parts of the world's oceans, and of the mechanisms – some well known, some rescued by Bakun from obscure physics journals – of physical mechanisms underlying triads: stratified Taylor columns, Lasker events, Langmuir circulation, Kelvin waves and other eponyms. We should let these concepts enrich our vocabulary, concentrate our research on them, and retain those that prove their mettle.

The most ambitious part of the book deals with global patterns, the often simultaneous, decadal shift of regimes which appear to have affected many stocks of small pelagic fishes throughout the world, and the global shift, induced by our climate-changing ways, that these regimes presage. Here, I believe, we reach the limits of Bakun's and of our pattern-recognition ability. The patterns are too faint, and the time

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series too short to generate more than an ominous feeling that the fine-tuned triads upon which many of our important exploited stocks depend will come unravelled as global changes shift the geographic location of fronts and other oceanographic structures.

I am not a dispassionate Bakun-watcher: we have been friends since 1980 and we have argued about many of the key ideas in this book. On the other hand, I teach a Philosophy of Science course, and can tell a good story when I see one: a few simple, largely unarguable points are used to explain an extraordinarily wide range of phenomena, but enough work is left for younger scientists to follow up, while older, less successful colleagues argue it is all wrong, that things are much more complicated than that. Just like *Origins* – and I don't mind being Bakun's Huxley.

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