

While the book is strong on people and events, it does not neglect institutions. Starting from what is claimed to be Europe's first permanent marine laboratory, the Laboratoire Maritime at Concarneau in Brittany in the middle of the 19th Century, it notes the development of the US Fish Commission in 1871, followed by the Fishery Board for Scotland (set up on the view that "effective management of fisheries should be based on extensive and accurate knowledge") and, in 1884, the Marine Biological Association of the UK (established at Plymouth with an interest first in embryology and second in biological studies of fisheries). But the major institution dealt with at the international level is ICES, which receives a chapter — the largest in the book — to itself, and whose activities are traced in considerable detail over 20 years from its initial starting in 1900.

It is interesting to note what a relatively small number of individuals and establishments played a major role in fisheries research over the hundred years covered in the book. Perhaps that is why it was possible to produce a reasonably coherent story, and perhaps also why the author chose to close his account in 1955 when the field was beginning to expand significantly, and when the Rome Conference on the Conservation of Living Resources of the Sea offered a convenient end point. But it is a pity that he did not continue. The last 20 years are compressed into the final page or two. Smith started the book with the question of why catches fluctuate, and with the conviction of Sars that it could be answered if approached from a scientific point of view. He ends on a depressing note, lamenting that we are unlikely to be able to answer the question because of our inability to develop a programme which is "independent of the management needs of the moment and of the personal agendas of the individual researchers". However, at least in the context of fisheries management, I wonder if we really need such a programme. I wonder, in fact, if we are asking the right question.

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Genetics and evolution of aquatic organisms

Genetics and Evolution of Aquatic Organisms, A.R. Beaumont (Editor), 1994. Chapman & Hall, London, 65, ISBN 0-412-49370-5.

This volume is a series of articles and papers selected from among several presented at a conference of the same title held at the University of Wales, Bangor, during September of 1992. The primary purpose of the book was to update readers interested in genetics and evolution of marine organisms with many of the technical advances made in the past decade. Organizationally, the book is divided into nine chapters, each representing a more-or-less distinct subject area where genetic approaches have been brought to bear on specific questions or issues. Each chapter is opened by a review covering the topical area contained within the chapter. Subsequent papers within each chapter are typically shorter, covering specific research topics.

The initial chapter, entitled 'Speciation and wide-scale genetic differentiation', ostensibly deals with the issue(s) of genetic divergence and new species formation. The opening review (by E.M. Gosling) was a delightfully brief and straightforward overview of speciation concepts. Gosling makes some valid points that need to be appreciated by the biological community at large. Among others are that operational difficulties inhibit application of any or all current species concepts to all organisms, and that multidisciplinary approaches to the study of new species formation (or description) are to be encouraged. The remaining five papers in this chapter each employ allozyme (or isozyme) electrophoresis to demonstrate genetic divergence between or among spatial populations of a variety of marine species, including amphipods, sponges, crustaceans, echinoderms, and bony fishes. While each of the papers were interesting in their own way, the absence of phylogenetic (rather than phenetic) treatment of genetic data was somewhat disappointing, as was the general absence of discussion regarding how observed genetic divergence might relate to new species formation and whether any of the populations studied might represent incipient species. Alternatively, Chapter 1 did provide a genetic data base for future studies in these and related species. The second chapter, entitled 'Gene flow and population structure', is, with one exception, similar to the first chapter in that allozyme data are used to assess genetic divergence between or among populations. In most of the papers, the degree of genetic divergence among populations is less than that described in the first chapter, and in the papers by J. Goudet et al. and P. Borsa et al., readers will find an interesting application of *F* statistics and an elegant hierarchical design, respectively. The exception is the paper by D. Hedgecock, which this reviewer found to be one of the 'gems' in the volume. Hedgecock's thesis is that in many marine organisms a small minority of individuals can replace entire populations in each generation by what he calls a 'sweepstakes-chance matching' of reproductive activity with oceanographic conditions that promote spawning and larval survival. The implications of this hypothesis to variation in recruitment are obvious, and importantly, Hedgecock provides some predictions by which his model might be tested. The third chapter, entitled 'Heterozygosity, heterosis, and adaptation', is an interesting compendium of papers that ask whether (or how) genetic variation (in a general sense or at a specific locus) relates to adaptation and organismal life history. The opening review (by E. Zouros and G.H. Pogson) provides a historical commentary on the (now somewhat contentious) subject of genetic heterozygosity and its relation to organismal fitness, and raises the question of which direction future research on this issue should take. Part of the answer may be found in the second paper (by P.M. Gaffney), where a number of specific hypotheses offered to explain allozyme heterozygosity and fitness correlates are addressed by multilocus analysis of genotypic disequilibria and by laboratory crosses. The remaining three papers in this chapter demonstrate how allozyme variation can be used to examine problems other than population substructuring (as in Chapters 1 and 2).

The next two chapters entitled 'DNA technology and genetics of aquatic organisms' (Chapter 4) and 'DNA technology and phylogeny of fish' (Chapter 5) involve the application of DNA technology to studies of marine organisms. The initial paper in Chapter 4 (by D.O.F. Skibinski) provides an excellent review for scientists who are inexperienced with DNA technology. The difficulties in working with DNA are a bit overstated, and Skibinski did not minimize the 'aura' that typically surrounds molecular biology. Nonetheless, Skibinski's paper is well-written and thought provoking, and readers should pay

attention to the section on micro- and minisatellite loci. Both (especially microsatellite loci) are becoming increasingly important in population genetics and animal breeding. The third paper in Chapter 4 (by G.H. Pogson) describes the use of random cDNA probes for RFLP (restriction fragment length polymorphism) analysis, and makes a strong case for the use of this approach in population-level studies. The initial paper in Chapter 5 (by A. Meyer) is a somewhat long, but excellently-referenced review of DNA methods and their use in phylogenetics. The section on methods of analysis was somewhat underdone, but the literature on this subject is rapidly becoming vast and nothing really substitutes for the experience of carrying out a phylogenetic analysis of one's own data. The sections on the mitochondrial (mt)DNA genome and on evolutionary rates make the important point that the choice of DNA sequence is paramount relative to phylogenetic resolution among taxa in which one might be interested. The remaining four papers in this chapter are quite varied. One (by R.W. Chapman et al.) provides a comparison of mtDNA divergence among four species of clupeid fishes; whereas one (by P.A. Prodohl et al.) is a 'techniques' paper that discusses a cloning procedure for isolating minisatellite probes from brown trout. The second paper showed how one could use a single restriction enzyme to obtain data on allelic variation at five, nuclear-encoded loci. The third paper (by Hartley and Davidson) demonstrates how highly-repeated, satellite DNA could be used in phylogenetic considerations. The last paper (by Scribner and Avise) documents phylogeographic structuring in cytonuclear (mtDNA) and nuclear genes and demonstrates that species-specific differences in life-history characters affect the genetics of natural hybrid zones.

Chapter 6, entitled 'Genetics of aquatic clonal organisms' presents an interesting series of studies designed to ask various questions about ecology and/or evolution of clonal animals. The opening paper (by G.R. Carvalho) is one of the longest in the volume, presenting a rather detailed review of the hierarchical components of population structure in clonal animals, the methods one might use to discriminate among clones, and the value of clonal organisms in ecological and evolutionary studies. Carvalho's review is very well referenced, and does make the cogent point that clonal propagation provides an unparalleled opportunity to measure reproductive value/performance of specific genotypes. Three of the remaining five papers in the chapter employ various species of the cladoceran genus *Daphnia* to ask questions about the genetic component(s) of specific behavioral or sex allocation traits, or whether there is seasonal regularity of clonal coexistence in temporally-fluctuating environments. All three papers demonstrate the advantage of using clonal systems to address these issues. The penultimate paper examines whether traditional population-genetic parameters (estimated from allozyme data) fit expectations based on reproductive mode (they do!), and the last paper asks questions about the evolution of haploid and diploid phases in life cycles. In general, Chapter 6 presents a more than adequate job of displaying the types of research that can be carried out on clonal animals.

Chapters 7 and 8, entitled 'Chromosomal genetics' and 'Genetics and pollution', respectively, were somewhat disappointing to this reviewer, but for different reasons. Chapter 7 primarily includes papers describing standard karyotypes from a variety of marine organisms, and in their own way, each of the authors ultimately acknowledged the difficulties associated with not knowing homologies of individual chromosomes. The opening review (by C. Thiriot-Quievreux), for example, discusses chromosome numbers in a number of aquatic invertebrates and one group of fishes, and ultimately concludes that chromosome

number 'appears' to have increased in some groups, but to have decreased in others. The third paper in the chapter (by L. de Guevara et al.) goes a bit further in identifying nucleolar organizer region (NOR) bearing chromosomes within species of oysters. Comparisons of NOR chromosome among species, however, was difficult on the basis of chromosome size and shape alone. The weakness of this chapter is technological: in the absence of metaphase banding procedures that produce serial or lateral striations along chromosome arms (e.g. G-bands and R-bands), one simply cannot test homologies of individual chromosomes other than by size or position of primary constrictions (centromeres). When most metaphase chromosomes in a complement are similarly sized, as is the case in many, if not most, lower organisms, this problem constrains almost any attempt to infer polarity of chromosome number change among species or to identify specific chromosomes (or chromosome arms) involved in interchromosomal or intrachromosomal exchanges. Consequently, more discussion in this chapter on the *limitations* of standard karyology, along with a review of serial banding methodologies and examples of where G- or R-banding has been applied successfully in lower vertebrates, would have strengthened this chapter immensely. The disappointing aspect of Chapter 8 was that so little research appears to have been focused on the use of genetic markers to assess pollution. With one exception, the papers in this chapter were directed towards a study of the effects of thermal and/or chemical pollution on allozyme frequencies, allozyme heterozygosity, or enzyme activity. The exception was an elegant paper by J. Barsiene that examined chromosome set changes in several different freshwater mollusc species exposed to highly polluted habitats. Not included in the chapter was any reference to work on thermal-shock genes or to work on rare messenger RNA expression following exposure to a variety of suspected pollutants. Very likely, these will be the next generation of genetic markers used in assessing pollution.

Chapter 9, entitled 'Application and relevance of genetics in aquaculture', was one of the most enjoyable chapters to read, and was noteworthy for the quality of the work reported. The opening review (by A.R. Beaumont) was straightforward and written in a way that would be comprehensible to non-specialists. The remaining four papers in the chapter were short and to-the-point, and each provided a distinct application of genetics to questions relevant to aquaculture. This reviewer particularly enjoyed the brief paper by M. Castelli that showed how one can use gynogenesis to document sex chromosome mechanism and the homo- and heterogametic sex. The only thing missing from this chapter was a discussion regarding the potential use of microsatellite loci as a means to identify quantitative trait loci (QTLs) for incorporation into breeding programs.

All in all, this is a very good book that belongs on the bookshelf of anyone interested in what's current in the area of genetics and marine organisms. There are a few chapters (e.g. Chapter 7) that would have been improved by a more 'modern' treatment, and readers should be advised that new genetic markers and tools are appearing almost monthly. The latter means, in part, that this book will likely become out-dated sooner than the volume (published in 1978) that precipitated this work. Nonetheless, this book is timely and should provide a valuable resource to university and agency researchers. It will be particularly valuable to individuals who might want to present an introductory graduate course in genetics of marine organisms. Finally, the price (65) is reasonable for most full-time professionals, and students should certainly request that a copy be purchased either by their department or by their university.

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Principles of aquaculture

Principles of Aquaculture, Robert R. Stickney, Wiley and Sons, 1994, 502 pp., £58, ISBN 0-471-57856-8.

Until around 3 years ago the choice of general works on aquaculture was limited; Marcel Huet's *Textbook of Fish Culture* and Bardach et al. *Aquaculture, the Farming and Husbandry of Marine Organisms* are the two books which come to mind. However, the apparent gap in the market has now been filled with several books, each of which tends to reflect the main interests of its editor or major contributor. Notable examples are *Aquaculture, Principles and Practices* (Pillay, 1993), *Introduction to Aquaculture* (Landau, 1992) and *Aquaculture* (Barnabé, 1990). Any student of fish, shellfish or seaweed farming would benefit from access to all of the books.

The latest addition to the literature comes very firmly from a North American base; so firmly that, for example England is named as being a major salmon farming country with no mention given to Scotland in the same list. This is a minor, distinctly nationalistic criticism; while many of the examples used in the text relate to North America, they have general application. However, anyone concerned with the growing field of the feeding of marine larvae might perhaps find the sections on culture of zooplankton and *Artemia* surprisingly short.

The book is divided into nine chapters each based around a theme and using examples from across the range of aquaculture types. I welcome the prominence given to economics with the inclusion of a section on the subject as Chapter 2. The next three chapters (comprising almost 200 pages) are focused around water and its management, bringing in other aspects of the environment, including culture systems, light and temperature. An interesting distinction is made between non conservative and conservative aspects of water quality; the former which are those influenced by biological activity. However, the inclusion of suspended solids in the latter category might surprise some farmers for whom suspended solid problems usually relate to uneaten food or to faeces in the water.

Further chapters (each with an extensive bibliography) cover feeding nutrition and growth, reproduction, breeding and genetics, disease, predation and cannibalism, harvesting, hauling and processing. I was a little surprised that there was no chapter dealing specifically with what might be termed 'husbandry'; however, topics which might be included are covered under other chapters and easy to find through the comprehensive index.

This book obviously should take its rightful place alongside the others mentioned at the start of this review as an essential part of the student reading list. However, I am beginning to come round to the view expressed to me by Dr. Roger Pullen of ICLARM that perhaps