

BANSE, K. and S.A. PIONTKOVSKY (eds.). – 2006. **The mesoscale structure of the epipelagic ecosystem of the open Northern Arabian Sea.** Universities Press, Hyderabad, India. 237 pp. ISBN 81 7371 496 7.

This book presents an extensive body of information obtained mainly from the thirtieth cruise of the R/V Professor Bodyanitsky to the Arabian Sea, carried out in 1990. It is part of a series published by the Universities Press, India, with the support of the Indian Academy of Sciences in Bangalore, whose aim is to narrow the English-Russian language gap concerning scientific literature on low-latitude oceans.

Apart from the foreword and references, the book contains 15 chapters. The first and the second are co-authored by the editors and present, respectively, an "Overview of results" and useful explanations on "Gear and terminology". The remaining chapters are contributed by 17 scientists (including one of the editors) from the National Academy of Sciences of the Ukraine. The content of these chapters is arranged in the order of hydrography, oxygen and nutrients (nitrate, nitrite and phosphate), heterotrophic bacteria, phytoplankton, micro-, meso- and macrozooplankton, and mesopelagic fishes and cephalopods. The last chapter deals with the coupling between vertical current velocities and their coupling with some chemical and biological characteristics. As explained by the editors, although most of the chapters were already in final form by 1998, a series of factors delayed completion of the volume until 2006.

The thirtieth cruise of the R/V Professor Bodyanitsky (February-March 1990), which took place during the northeast (winter) monsoon, undertook a mesoscale study of physico-chemical and biological variables. The stations were positioned along two large grids and a small grid in the north-western Arabian Sea. The typical distance between stations of the large grid was 0.5 degrees (about 55 km). In addition, many chapters of the book consider material from earlier cruises in the area, in particular from the eight cruise of the R/V Professor Vodyanitsky (March-May 1980). Many of these

expeditions had a multidisciplinary scope and studied aspects ranging from hydrography to several levels of the trophic food web.

Chapters 3 (Artamonov), 4 (Covrigina and Izmeteva) and 5 (Bobko and Rodionova) deal with the hydrography and chemical characteristics of the area. The overall picture that emerges is that of high variability at synoptic, seasonal and interannual scales. The grid surveys revealed the presence of numerous eddies, with different senses of rotation, interacting in complex ways. The resulting upwards and downwards movements of the waters were reflected in the nutrient fields. An interesting feature was the presence of an oxygen minimum layer.

Several chapters present qualitative relationships between the taxonomic or size structure of different components of the plankton community and mesoscale hydrographic features such as eddies and fronts. For example, Shumakova (Chapter 6) notes that bacterial abundance tended to increase in the convergences and decrease in the zones of upwelling. During the northeast monsoon of 1990, large phytoplankton contributed most of the primary production in cyclonic gyres, whereas small-celled phytoplankton dominated in anticyclonic gyres (Kuzmenko, Chapter 8). The maxima and minima of microzooplankton tended to be found, respectively, near the centre of cyclonic and anticyclonic eddies (Sazhina, Chapter 9). Meso- and macrozooplankton showed local peaks associated with the edges of eddies and the frontal zones between eddies (Piontkovski and Melnik, Chapter 10). The taxonomic structure of macrozooplankton was completely different in upwelling and downwelling zones (Ignatyev, Chapter 12), while Chesalin and Zuyev (Chapter 14) mention that squid was mainly concentrated in upwelling zones in cyclonic eddies and adjacent frontal zones.

Several chapters address functional aspects. Chmir (Chapter 7), reports on bacterial production and provides helpful comparisons between some early techniques used by Soviet scientists and the more modern ³H-thymidine method. Kuzmenko (Chapter 8) reports high levels of phytoplankton biomass and primary production that support the consideration of the region as a productive one.

Sazhina (Chapter 11) deals with mesozooplankton production. In addition to distribution and biogeography, Tsarin and Boltachev (Chapter 13) consider size and life-cycle aspects of mesopelagic fishes.

In Chapter 10, Piontkovski and Melnik use 1990 data to reassess the biomass distribution of microzooplankton, copepods, macrozooplankton, crustaceans and fishes. In agreement with earlier information for the area, they found an inverted trophic web pyramid, with biomass increasing from microzooplankton through copepods and macrozooplankton to mesopelagic fishes. The biomass increase stopped with squid predators of mesopelagic fishes, which reached much lower biomasses than these fishes. Similar inverted biomass pyramids have been reported for other areas, but predator trophic levels above macrozooplankton have only rarely been considered.

The last chapter (Kushnir and Piontkovsky, Chapter 15) develops an algorithm for estimating vertical velocities and uses CTD data to estimate vertical fluxes of chemical variables such as oxygen and phosphate. The approach is very interesting, although the forest of equations is difficult to follow for non-experts. The authors found that the vertical flux of phosphate was significantly correlated with heterotrophic bacterioplankton production and with mesozooplankton biomass and conclude that, in order to find meaningful correlations, biological properties must be related to dynamic parameters of physico-chemical fields rather than to basic structural characteristics of water masses, such as temperature or salinity.

The book also has some weak points. A more detailed treatment of the relationships among vertical distributions of physico-chemical and biological variables (including features such as the oxygen and nitrite maxima) in the upper part of the water col-

umn would have very welcome. Of course, the standard sampling intervals of 20-25 m depth used between 0 and 100 m did not help to address this question. With regard to formal aspects of the book, a problem is the low quality of some of the figures, and sometimes the complete lack of them. For example, a general schema of the circulation in the region would have helped unfamiliar readers to visualise the different current flows described in the introduction to Chapter 3. There is no index and the individual papers lack summaries, although the overview (Chapter 1) helps to covers these gaps. There are few typing mistakes, but some of them, such as the loss of apostrophes in Equation 22 of Chapter 15, are particularly annoying.

The content of the book reflects in part the timing of the reported research, but also a particular oceanographic tradition, with interesting qualities. Some of the chapters provide detailed taxonomic accounts (for example, of phytoplankton, mesozooplankton, myctophids and cephalopods) that are difficult to find in the current western oceanographic literature and may prove very valuable in a “global change” context. The work compiled in this book reveals a strong emphasis on multidisciplinary and on the consideration of dynamic aspects of physical–biological interactions, a question of high current interest.

In summary, in spite of the time that has passed since the reported cruises, this book may prove very valuable not only for scientists interested in the Arabian Sea, but also for those interested on general aspects of mesoscale coupling between physico-chemical and biological dynamics.

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