

Book Reviews

Antarctic Ocean and resources variability, edited by D. Sahrhage (Springer-Verlag: Berlin), 1988, pp xi + 304, 232 Figs, 880 g, Hard cover, DM 198. [ISBN 3-540-19294-8]

The Antarctic marine living resources are a biologist's paradox. It is often claimed that the Antarctic Ocean has the largest single animal protein source on the earth. The variability in the magnitude of potential and sustainable marine living resources around this seventh continent is still not being properly estimated and it has been a matter of lively debate amongst the Antarctic researchers. At this juncture the present book on the proceedings of a seminar on Antarctic Ocean variability with special reference to krill, held between 2 and 6 June 1987 at Paris (France), is most welcome.

Being a forum for scientific presentations, the discussions centred, around (1) What is known about the variability of the Antarctic Ocean circulation system? (2) What are the probable causes for such variations? (3) To what extent and how does the ocean variability influence primary production, zooplankton and other harvestable living resources? (4) To what extent and how does the ocean variability influence distribution and abundance of krill? (5) What is the magnitude of relationship between krill production and availability of squids, finfishes, seabirds and marine mammals?

Some of the observations and conclusions made from the papers presented at the seminar are listed below:

(i) The results of long time series of measurements over a period of 90 years, have helped in arriving at definite trends about the influence of environmental variability on the distribution and abundance of krill. However, the magnitude of interaction is poorly understood.

(ii) There are large meteorological, oceanographic and biological data sets that could be evaluated by scientists through joint efforts.

(iii) The Southern Ocean circulation, the ice cover and the water mass modification are all intricately linked; the wind driven features must also be considered in terms of their effects on the thermohaline structure and circulation. The biology must also be linked into these environmental features. Since the physical

situation changes at a variety of scales, both spatial and temporal, similar changes in the biology are expected.

(iv) Variations of latitude of the polar front are comparatively independent of longitudes. However, the position of the sub-Antarctic and the sub-tropical fronts exhibit large spatial variations.

(v) The relationship between phytoplankton and krill remains one of the vexing problems in Antarctic marine ecosystem studies. The seasonal variability of the phytoplankton biomass is just as complicated as the spatial variability. Our knowledge of the seasonal variability of Antarctic marine living resources is still limited.

(vi) Why such a small part of the Antarctic Ocean is more productive than its vast expanse gives rise to a score of most fundamental questions in Antarctic ecology and productivity.

(vii) The unavoidable lesson learnt from half a century of Antarctic marine research is that the field seasons are too short and the logistic support is too expensive to provide a proper perspective of the productivity potentials and variability of the Antarctic marine ecosystems.

(ix) Marginal sea ice zones are very important features in the annual cycle of biogenic matter production over the sea ice covered waters of the Southern Ocean.

(x) Eddies are likely to be important features, increasing the retention of krill and giving rise to the normally observed high abundance.

(xi) Studies on hydrographic features in relation to biological productivity of Antarctic waters, have demonstrated a close affinity between biomass and productivity on one hand and major oceanographic front features on the other.

(xii) There is considerable danger in trying to associate biotic and physicochemical variability with statistical significance criteria, alone.

(xiii) Most important recent perturbations to the Southern Ocean ecosystems have been caused by human commercial activity.

While a reader is baffled with the above mentioned ununified observations, the editor arrives at following conclusions:

i) It is evident that there is a large variability in the environmental conditions between seasons; from

year to year even with long-term trends and also with differences from one region to another. ii) It can be noted that the Southern Ocean is not radially symmetrical but many circulations and water mass features vary markedly with longitude and are also dependent on topographical influences viz. ridges, mounts and islands. iii) A special aspect is the appearance of El Nino (Southern oscillations) events which are likely to influence the Southern Ocean. This influence is not yet well understood. iv) Developments in one region have direct consequence for the other sectors.

Thus, the situation about the magnitude of interdependence between environmental conditions and biological productivity, processes in the relatively less explored Southern Ocean still remains far from explicit. The understanding of Antarctic Ocean living resource variability, still poses a challenge to oceanographers and marine scientists.

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Mathematical modelling of ocean circulation, by G.I. Machuk & A.S. Sarkisyan, (Springer-Verlag: Berlin), 1988, pp.xv + 292, 62 Figs, 655 g, Hard cover, DM 198
[ISBN 3-540-18925-4]

Mathematical modelling is the creative and intellectual act of representing complicated phenomena or processes under consideration in mathematical forms and of predicting its future behaviour. Mathematical modelling in oceanography is a new area of research compared to its sister science meteorology. Due to significant developments in related branches of sciences, physical oceanography also has undergone qualitative changes from a purely descriptive study to an applied subject during the last 2 decades. Sophisticated mathematical and hydrodynamical-numerical models are now being developed to understand and predict specific ocean dynamic characteristics. A number of monographs on mathematical modelling of ocean dynamic characteristics, written by eminent scientists from outside the Soviet bloc, have appeared in recent past. However, there are very few publications of the translation of Russian works in English language, despite the fact that a number of such monographs in Russian language are being published in USSR. The present monograph, is one of the latest publications in modelling in the field of ocean dynamics which really reflects the advanced level of scientific research in USSR.

The monograph contains 5 chapters that include fundamental equations of ocean dynamics, efficient numerical methods for solving stationary and non-stationary problems and analysis of results of calculations.

Chapter 1 is devoted to the general formulation of the problem, transformation of basic equations and their simplification, estimation of characteristic values and detailed descriptions of diagnostic and quasi-geostrophic models for the computation of ocean currents. The authors have emphasised that it is absolutely essential to consider the baroclinicity of seawater even in simple ocean circulation models.

Chapter 2 is devoted to various methods of difference approximations, construction of finite difference mesh and the solution of ocean thermohydrodynamic equations. These methods include the well known directed difference method, method of enhancing the approximation order, the Fiadeiro-Veronis method and others. The authors have applied these methods for calculating sea surface topography at ocean basins boundary and solving equations of quasi-geostrophic models and equations of non-linear models.

In Chapter 3, a number of correct formulations of non-stationary problems of ocean circulation and methods of their solution are given. In particular, the authors have considered a non-linear problem for the calculation of ocean thermohydrodynamic characteristics without including turbulence and have successfully proved the uniqueness of the formulated problems in this chapter. In addition, the absolute stability of splitting schemes of the second order by all co-ordinates has also been proved.

Chapter 4 is devoted to stationary problems of ocean dynamics. The modelling of steady state circulation of ocean is the first stage of development of coupled ocean atmosphere models for the prediction of weather and climate on larger time scale. First, it is necessary to simulate the stationary (climatic) state of the ocean using climatic oceanologic fields and then, choosing everytime, climatic oceanic condition as initial data' and using actual data on weather conditions near the sea surface, to generate the perturbations of ocean circulation under the influence of meteorological conditions. The constructed fields of hydrological elements can be used as "initial data" for weather prediction problems. In this chapter, (i) a linearised formulation of oceanic climatic state taking into consideration turbulence, (ii) ocean dynamic model taking into account wind driven currents, (iii) solution of difference equations of ocean dynamic baroclinic component, (iv) simple models of ocean dynamics taking into account non-linear turbulent exchange.