

Springer Earth System Sciences

Philip Micklin
N.V. Aladin
Igor Plotnikov *Editors*

The Aral Sea

The Devastation and Partial
Rehabilitation of a Great Lake

PRAXIS

 Springer

Philip Micklin (Chief Editor) •
N.V. Aladin (Associate Editor) •
Igor Plotnikov (Associate Editor)

The Aral Sea

The Devastation and Partial Rehabilitation
of a Great Lake

 Springer

PRAXIS 

Acknowledgements

Philip Micklin, Chief Editor

My contribution to this book is based on three decades involvement with the Aral Sea issue and numerous trips to the Aral Sea region. Over these years I have received help from many individuals, and funding from organizations, in the United States, Soviet Union, Russia, Western Europe, Japan and Central Asia, particularly in Uzbekistan and Kazakhstan. I want to express my deepest thanks to these individuals and organizations too numerous to name. Special thanks, however, are in order to the Department of Geography, Western Michigan University, Kalamazoo, Michigan; the NATO Science for Peace Program; the U.S. National Academy of Sciences; the Committee for Research and Exploration of the National Geographic Society; the National Council for Soviet and East European Research; the United Nations Environment Program; the Institutes of Geography and Water Problems of the Russian Academy of Sciences in Moscow; Karakalpakstan State University in Nukus, Karakalpakstan (Uzbekistan), and, last but not least, the Zoological Institute of the Russian Academy of Sciences in St. Petersburg. I would also like to express my gratitude to my wife, left to handle family matters during my visits overseas, sometimes for extended periods, in connection with my research on the Aral Sea.

Nikolay Aladin and Igor Plotnikov, Associate Editors

We would like to thank all members of our Brackish Water Laboratory of the Zoological Institute of RAS and all members of the Fisheries Laboratory in Aralsk, Kazakhstan and all members of the International Fund for Saving the Aral Sea, all members of our expeditions to the Aral Sea from Russia, Kazakhstan, Uzbekistan, USA, Germany, UK, France, Spain, Japan, Australia, Sweden, Slovenia and some other countries. A special thanks is in order to our colleagues at St-Petersburg Pedagogic University headed by the famous botanist Lev Aleksandrovich Kusnetsov with whom we did our studies on the Barsakelmes Island in the Aral Sea. We also would like to thank all members of our families who remained without us when we were in our long lasting, numerous expeditions to the Aral Sea during the period from 1979 until 2013. Finally, we would like to remember those

colleagues and friends who passed away and who helped us a lot in our Aral Sea studies: Dr. Evdokiya Markova (Kazakhstan), Dr. Nikolay Vorontzov (Russia), Dr. William Williams (Australia), Dr. William Potts (UK), Dr. Gilbert White (USA), Dr. Tatu Kira (Japan), and especially Dr. David Davidovich Piriulin of our Laboratory.

Contents

1 Introduction	1
Philip Micklin	
Part I Background to the Aral Problem	
2 Introduction to the Aral Sea and Its Region	15
Philip Micklin	
3 Biological Dynamics of the Aral Sea Before Its Modern Decline (1900–1960)	41
Igor S. Plotnikov, Nikolay V. Aladin, Zaualkhan K. Ermakhanov, and Lyubov V. Zhakova	
4 Changes of the Aral Sea Level	77
Sergey Krivinogov	
Part II Modern Recession of Aral	
5 Aral Sea Basin Water Resources and the Changing Aral Water Balance	111
Philip Micklin	
6 The New Aquatic Biology of the Aral Sea	137
Igor S. Plotnikov, Nikolay V. Aladin, Zaualkhan K. Ermakhanov, and Lyubov V. Zhakova	
7 The Present State of the South Aral Sea Area	171
Polat Reimov and Dilorom Fayzieva	
8 Irrigation in the Aral Sea Basin	207
Philip Micklin	
9 Challenges of Transboundary Water Resources Management in Central Asia	233
Bakhtiyor Mukhammadiev	

10	Time Series Analysis of Satellite Remote Sensing Data for Monitoring Vegetation and Landscape Dynamics of the Dried Sea Bottom Adjacent to the Lower Amu Darya Delta	253
	Rainer A. Ressler and René R. Colditz	
11	Aral Sea Hydrology from Satellite Remote Sensing	273
	Jean-François Crétaux and Muriel Bergé-Nguyen	
12	Nature and Economy in the Aral Sea Basin	301
	Kristopher D. White	
13	An Expedition to the Northern Part of the Small Aral Sea (August 29 to September 16, 2011)	337
	Philip Micklin, Nikolay V. Aladin, and Igor S. Plotnikov	
Part III Aral Future		
14	The Biological Future of the Aral Sea	355
	Igor S. Plotnikov and Nikolay V. Aladin	
15	Efforts to Revive the Aral Sea	361
	Philip Micklin	
16	The Siberian Water Transfer Schemes	381
	Philip Micklin	
17	Impact of Climate Change on the Aral Sea and Its Basin	405
	Elena Lioubimtseva	
18	Summary and Conclusions	429
	Philip Micklin	
	Index	445

Chapter 6

The New Aquatic Biology of the Aral Sea

Igor S. Plotnikov, Nikolay V. Aladin, Zaualkhan K. Ermakhanov,
and Lyubov V. Zhakova

Abstract Regression of the Aral Sea began in 1961. At first changes in the fauna were primarily the result of fish and invertebrates introductions. In the 1970s regression accelerated. The main factor influencing fauna is increasing water salinity. In 1970s–1980s invertebrate fauna went through two crises. Freshwater species and brackish water species of freshwater origin became extinct first. Then Ponto-Caspian species disappeared. Marine species and euryhaline species of marine origin survived, as well as species of inland saline waters fauna. By the end of the 1990s the Large Aral became a complex of hyperhaline lakes. Its fauna was passing through the third crisis period. Incapable of active osmoregulation, hydrobionts of marine origin, and the majority of osmoregulators disappeared. A number of species of hyperhaline fauna were naturally introduced into the Large Aral. Salinization of the Aral Sea has resulted in depletion of parasitic fauna. All freshwater and brackish-water ectoparasites and significant part of helminthes began to disappear. Together with the disappearance of hosts, the parasites associated with them in their life cycle had to disappear. Regulation of the Syr Darya and Amu Darya and decreasing of their flow altered living conditions of the Aral Sea fishes, especially their reproduction. In 1971 there were the first signs of negative effects of salinity on adult fishes. By the middle of the 1970s natural reproduction of fishes was completely destroyed. Commercial fish catches decreased. By 1981 the fishery was lost. In 1979–1987 flounder-gloss was introduced and in 1991–2000 it was the only commercial fish. After the flow of the Syr Darya again reached the Small Aral, aboriginal fishes began migrating back to the sea from lacustrine systems and the river. This allowed the achievement of

I.S. Plotnikov (✉) • N.V. Aladin • L.V. Zhakova
Laboratory of Brackish Water Hydrobiology, Zoological Institute of RAS,
St Petersburg, Russia
e-mail: aral3@zin.ru; aral@zin.ru

Z.K. Ermakhanov
Aral Branch of Kazakh Research Institute of Fisheries, Aralsk, Kazakhstan