

Acknowledgements

The biological portion of the ENUWAR study has been a unique undertaking to synthesize information from a very broad range of disciplines in order to establish the state of the current understanding about the global consequences of large-scale nuclear war. We have relied on the contributions, analyses, discussions, and advice from approximately 200 scientists from over 30 countries around the world, especially through participation at a series of technical workshops. Consequently, the present volume is the product of many people, whose contributions we gratefully acknowledge.

Foremost among these are the three who are listed as primary contributors to the overall volume; this volume could not have been prepared without their contributions. Wendell Cropper, Jr., was the mainstay of the food calculations and the analyses of agricultural productivity, central elements in the Volume II analyses, and he provided considerable insight into ecological and other assessments. Christine Harwell provided invaluable coordination of the overall biological study, a monumental task for a project involving so many scientists from so many countries; she also took on the jobs of preparing Chapter 6 from widely divergent inputs and of editing the entire volume. Herb Grover helped initiate the ENUWAR study and was there at the end to help pull together the ecological analyses. We also particularly acknowledge the coordinating assistance of Ann Freeman as indispensable to the successful completion of the project.

The technical workshops that focused on the biological issues were held in Paris, France (October, 1984) concerning radiation effects; Essex, England (January, 1985) concerning Northern temperate agricultural effects; Hiroshima and Tokyo, Japan (February, 1985) concerning human effects; Toronto, Canada (March, 1985) concerning Northern temperate ecosystem effects; Melbourne, Australia (March, 1985) concerning Southern Hemisphere agricultural and ecosystem effects; Caracas, Venezuela (April, 1985) concerning tropical agricultural and ecosystem effects; and Essex, England (June, 1985) concerning research needs and in review of the draft manuscript. Other workshops were held to plan the ENUWAR project and to identify the specific issues requiring attention; these included workshops held in London, England (April, 1983); Stockholm, Sweden (November, 1983); New Delhi, India (February, 1984); and Leningrad, U.S.S.R. (May, 1984).

We are particularly indebted to the chairpersons of each of the biological technical meetings: Mike Unsworth and Bernard Tinker at the first Essex workshop; Barrie Pittock and Jim Salinger at the Melbourne workshop; Rafael Herrera at the Caracas workshop. Each contributed generously of his time to the success of the workshops by helping to identify the appropriate mix of disciplines and people to participate and by providing the logistical support needed to conduct the workshops under very tight time constraints.

We are quite grateful for the contributions of all of the participants at the various workshops, including preparation of discussion papers, participation in the workshop deliberations, and providing advice and ideas for our approach. A list of participants is included in an appendix to this volume, as there are too many to list here. We wish to make particular note of those who acted as leaders or rapporteurs in the various working groups into which each workshop divided and who prepared synopses of the working groups' consensus: Thomas Rosswall at Stockholm and New Delhi; Yuri Svirezhev and Nick Lukyanov at Leningrad; Charles Shapiro and Warren Sinclair at Paris; Mike Unsworth, Bernard Tinker, Herb Grover, and John Porter at Essex; Larry Bliss, Phil Grime, Jake Levitt, David Walton, Jack Kelly, Russ Wein, Leslie Cwynar, and Charles Shapiro at Toronto; Gilbert White and Takeshi Ohkita at Hiroshima and Tokyo; Jim Salinger and Neil Cherry at Melbourne; Rafael Herrera, Steve Risch, John Vandermeer, Ann Freeman, and Kersti Meema at Caracas.

Certain people among the the workshop participants performed additional roles that were invaluable to this project: Steve Risch contributed to several meetings and provided unique insights into the potential consequences of nuclear war on humans, along with John Vandermeer and Ezra Zubrow. Bob Stewart was responsible for the computer simulations of grain production in Canada and for many ideas concerning effects on agricultural productivity. Grahame Kelly, David Walton, Allyn Seymour, and John Teal provided substantial written inputs on potential effects on marine ecosystems. Phil Grime wrote on the importance of plant strategies in recovery processes. Jim Salinger wrote substantial inputs on potential effects on Australia and New Zealand. Ron Myers conducted an extensive literature review concerning freeze effects on sub-tropical ecosystems and crops. Bob Worrest assumed responsibility for synthesizing the literature on UV-B effects on biological systems. Zenbei Uchijima provided the detailed information on vulnerabilities of rice crops. Jim Detling was responsible for the simulations of temperate grassland effects, along with Jon Hanson. Jack Kelly coordinated the estuarine ecosystem simulations using the Narragansett Bay model, conducted by Jim McKenna. Sam McNaughton used his model of tropical grassland ecosystems for evaluating potential effects. Tom Sinclair performed analyses using his soybean productivity model. Mick Kelly provided an invaluable service in helping us understand the projections from the

climatic scientists. Alan Keast, Magda Havas, and Steve Pacenka prepared substantial inputs on effects on freshwater ecosystems. Josef Svoboda and Harry Taylor provided written inputs on radiation effects. David Pimentel prepared a discussion paper on issues of human energy subsidies to agriculture. John Porter prepared maps of crop distributions around the Northern Hemisphere. Tatsuo Urabe conducted simulations of large warhead detonations over Hiroshima for comparison with the 1945 bombing. Yuri Svirezhev coordinated an extensive effort by the Soviet Academy of Sciences' Laboratory of Mathematical Ecology in evaluating global consequences. Dick Warrick provided much insight from experiences in his project on climate effects on global productivity. Dan Sisler was a valuable resource for food stores and distribution information. Michel Verstraete conducted statistical analyses of the relationships between average temperatures and growing season length.

The final workshop at Essex involved a team of scientists who simultaneously provided technical review on drafts of the manuscript, assistance in finalizing the report, and suggestions on research needs, all of which were of considerable benefit to us. We are especially grateful to Phil Grime, who chaired this group, and to Larry Bliss; these two took on the substantial task of final review of the completed draft. The other participants are also acknowledged for their participation and advice, including: John Bromley, John Edwards, Herb Grover, Alexander Kuzin, Alex Leaf, Nick Lukyanov, Takeshi Ohkita, Steve Risch, Jim Salinger, Bob Stewart, Yuri Svirezhev, Mike Unsworth, and David Walton. We also received comments on drafts of this manuscript from the Volume I authors, including Barrie Pittock, Tom Ackerman, Paul Crutzen, Mike MacCracken, Charles Shapiro, and Rich Turco. Other reviewers of at least parts of the manuscript drafts included: Jack Kelly, Karin Limburg, Tom Malone, Simon Levin, Steve Schneider, Dick Warrick, David Weinstein, Gilbert White, and Ezra Zubrow.

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It should be clear from the extensive listing above and in the appendix that this report represents ideas from many people. We have attempted to reflect accurately the consensus of these scientists, but we assume responsibility for any errors or omissions. The time allocated for the entire process, from project initiation through completion of the workshops, to the final writing and review, has been extremely brief for such a large and complex project. This has inevitably led to the potential for uneven treatment or omission of issues. However, we feel this report presents a comprehensive and balanced contribution to an ongoing process of scientific debate and clarification concerning issues that must remain academic and not a part of the human experience. That so many people volunteered their time and energy in this intensive effort is a testament to the nature of the peril for Earth and the commitment of the scientific community.

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