CRUSTACEAN ISSUES 18

Decapod Crustacean Phylogenetics

edited by

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CRC Press
Taylor & Francis Group

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CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

Printed in the United States of America on acid-free paper
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-1-4200-9258-5 (Hardcover)

Library of Congress Cataloging-in-Publication Data

Decapod crustacean phylogenetics / editors, Joel W. Martin, Keith A. Crandall, Darryl L. Felder.
p. cm. -- (Crustacean issues)
Includes bibliographical references and index.
ISBN 978-1-4200-9258-5 (hardcover : alk. paper)
1. Decapoda (Crustacea) 2. Phylogeny. I. Martin, Joel W. II. Crandall, Keith A. III. Felder, Darryl L.. IV. Title. V. Series.

QL444.M33D44 2009
595.3'8138--dc22 2009001091

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Preface

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Decapods are undoubtedly the most recognizable of all crustaceans. The group includes the well-known "true" crabs (Brachyura), hermit crabs and their relatives (Anomura), shrimps (Dendrobranchiata, Caridea, and Stenopodidea), and lobsters (Astacidea, Thalassinidea), among other lesser known groups. They are the most species-rich and diverse group of the Crustacea, which in turn is the fourth largest assemblage or clade of animals (behind insects, mollusks, and chelicerates) on Earth (e.g., Martin & Davis 2001). Currently, the Decapoda contains an estimated 15,000 species, some of which support seafood and marine industries worth billions of dollars each year to the world's economy. Decapods also are the quintessential group of crustaceans in the public eye. Perhaps more than any other group of marine invertebrates, the crabs, lobsters, and shrimps that make up the Decapoda are familiar to nearly everyone.

In part because of the popularity of the decapods, there has been a long-standing interest in their relationships. Over the years, hypotheses of decapod relationships have relied on sources of information as varied as behavior (such as the early split between swimming or "natant" decapods and crawling or "reptant" forms), adult morphology, larval morphology, and, in more recent years, molecular sequence data. Despite these efforts, we remain largely in the dark as to the evolutionary relationships of the major decapod clades and to the relationships of decapods to other groups of crustaceans. Although there is no shortage of publications reflecting the wide variety of ideas and hypotheses concerning decapod phylogeny, there is also no obvious consensus among carcinologists working today. Additionally, prior to January 2008, the world's leading decapodologists had never assembled with the sole purpose of elucidating relationships among the major decapod lineages and between decapods and other crustaceans.

Toward rectifying this deficit, several key decapod workers (Keith Crandall at Brigham Young University (team leader), Joel Martin at the Natural History Museum of Los Angeles County, Darryl Felder at the University of Louisiana Lafayette, and Rodney Feldmann and Carrie Schweitzer at Kent State University) were funded by the National Science Foundation's "Assembling the Tree of Life" program beginning in the fall of 2005 to work toward elucidating the evolutionary relationships of the decapods. That team has been in contact with other decapod researchers all over the world, many of whom have been supplying fresh and preserved material or fossil material for our combined analysis while also collaborating on a variety of component phylogenetic studies focused on decapods. In short, interest in decapod evolution currently is at an all-time high, with most of the world's carcinologists aware of the ongoing Tree of Life project and eager to contribute in some way.

In January 2008, carcinologists from throughout the world convened at a symposium hosted by the Society of Integrative and Comparative Biology and The Crustacean Society in San Antonio, Texas, in order to (1) present methodological updates for research on the diversity and relationships (phylogeny) of the decapods, (2) present overviews on our understanding of the systematics and

relationships within some of the major decapod clades, and (3) work toward assembling and coding molecular and morphological characters toward an overall decapod phylogeny. Invited participants represented a wide variety of backgrounds and included established decapod workers as well as beginning students of decapod phylogeny. Attendees represented fourteen nations (Australia, Belgium, Brazil, China, England, France, Germany, Japan, the Netherlands, New Zealand, Singapore, Spain, Taiwan, and the United States). The chapters that follow are based on contributions to that symposium and on a few additional manuscripts from workers who could not be present at the San Antonio meeting.

The aforementioned meeting on the phylogeny of decapods, as well as this resulting volume, might seem premature at this point, not only because so much remains unknown in general but also because our Tree of Life group is still actively researching the question of decapod evolution from many different angles. Indeed, one of our primary goals is to produce a better-resolved phylogeny of the entire Decapoda than has been published to date. However, the symposium was seen as important for bringing together a majority of the world's preeminent workers, some of whom had not previously met, and for establishing our current state of knowledge with regard to the three major areas outlined above. Thus, the contributions contained herein range rather widely in scope. Some are state-of-the-art reviews of large bodies of literature and/or methodologies for elucidating decapod phylogeny (e.g., Schram on the fossil origin of decapods, Asakura on the evolution of mating and its bearing on phylogeny, Schubart on mitochondrial approaches, Scholtz on decapod "evo-devo" studies, Tudge on decapod spermiocladistics, Palero & Crandall on phylogenetic inference). Others are somewhat preliminary attempts to construct the first known phylogenetic tree for a given group of decapods (e.g., Tavares et al. on the Dendrobranchiata, Tshudy et al. on clawed lobsters, Palacios-Theil et al. on pinnotherid crabs). Several contributions present the most comprehensive analyses to date on major clades of decapods (e.g., Bracken et al. on carideans, Ahyong & Schnabel on anomurans, Robles et al. on thalassinideans, Breinholt et al. on the diversification of the crayfishes, Hultgren et al. on the crab superfamily Majoidea). Still others present data or approaches that, although not widely applied to studies of decapod evolution previously, could be used eventually to help elucidate the phylogeny of the Decapoda (e.g., Porter & Cronin on the evolution of visual elements, Bokyo & Williams on the use of decapod parasites as phylogenetic indicators). All told, we feel that the 29 contributions contained herein constitute both a fascinating overview of where we are currently in our understanding of decapod phylogeny and a tantalizing promise of what's to come.

Many people and several societies participated in supporting the symposium and/or the publication of the resulting volume, and we are indebted to all of them. For financial support of the symposium itself (including the publication of this volume), we thank the U.S. National Science Foundation (NSF grant DEB 072116), the Society of Integrative and Comparative Biology (SICB), the SICB Divisions of Invertebrate Zoology and Evolutionary and Systematic Biology, the American Microscopical Society, the Crustacean Society, and the Society of Systematic Biologists. The decapod crustacean Tree of Life project is also supported by the National Science Foundation via a series of collaborative grants to K. A. Crandall (team leader) and Nikki Hannegan (DEB 0531762), D. L. Felder (DEB 0531603), J. W. Martin (DEB 0531616), and R. Feldmann and C. Schweitzer (DEB 0531670). Our institutions (JWM: Natural History Museum of Los Angeles County; KAC: Brigham Young University; DLF: University of Lousiana, Lafayette) supported us in kind by providing space and facilities for editing the volume and by underwriting some of the research on which it is based. We are extremely grateful to the many conscientious referees who contributed their time to review the chapters on our behalf. Our promise of anonymity prevents us from listing them individually here. We especially thank Dr. Stefan Koenemann, editor of *Crustacean Issues*, for his invitation to publish the proceedings as part of that series and for his help in editing the volume, and John Sulzycki, Senior Editor of CRC Press / Taylor & Francis, for his encouragement and assistance at several stages. We also thank Paul Martin for his invaluable

assistance during stages of copy editing and for readying the overall volume for publication, and undergraduate technician Penelope "ChiChi" Boudreaux for support and assistance at ULL.

Finally, we thank Sue Martin, Cindy Crandall, and Jenny Felder for their support and encouragement during the preparation of this volume.

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