

# Evolution, Origin of Life, Concepts and Methods

Pierre Pontarotti  
Editor

# Evolution, Origin of Life, Concepts and Methods

 Springer

*Editor*

Pierre Pontarotti 

CNRS and IHU

Aix-Marseille University

Marseille, France

ISBN 978-3-030-30362-4

ISBN 978-3-030-30363-1 (eBook)

<https://doi.org/10.1007/978-3-030-30363-1>

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

For the twelfth year, we publish a book on evolutionary biology concept and application.

We try to really catch the evolution and progress of this field for this goal we are really help by the Evolutionary Biology Meeting in Marseilles. The goal of this annual meeting is to allow scientists of different disciplines, who share a deep interest in evolutionary biology concepts, knowledge and applications, to meet and exchange and enhance interdisciplinary collaborations. The Evolutionary Biology Meeting in Marseilles is now recognised internationally as an important exchange platform and a booster for the use of evolutionary-based approaches in biology and also in other scientific areas.

The chapters have been selected from the meeting presentations and from proposition born by the interaction of meeting participants.

The reader of the evolutionary biology books as well as the meeting participants would maybe like us to witness years after years during the different meetings and book editions a shift on the evolutionary biology concepts. The fact that the chapters of the book are selected from a meeting enables the quick diffusion of the novelties.

We would like to underline that the twelve books are complementary one to another and should be considered as tomes.

The articles are organised in the following categories

Origin of Life (Chaps. 1–3)

Concepts and Methods (Chaps. 4–10)

Genomic Phenotype Evolution (Chaps. 11–15)

June 2019

Pierre Pontarotti  
AEEB and CNRS  
Marseille, France

**Acknowledgements** We would like to thank all the authors and the reviewers of the different chapters.

We thank the sponsors of the meeting: Aix-Marseille Université, CNRS, ECCOREV Federation, Conseil Départemental 13, ITMO, Ville de Marseille.

We wish to thank the AEEB team for the organisation of the meeting.

We also wish to thank the Springer's edition staff and in particular Andrea Schlitzberger for her competence and help.

# Contents

## Part I Origin of Life

- 1 A Non-paradoxical Pathway for the Chemical Evolution Toward the Most Primitive RNA-Based Life-like System . . . . . 3**  
Kunio Kawamura
- 2 Formation of Nucleosides and Nucleotides in Chemical Evolution . . . . . 31**  
Hideo Hashizume, Benny K. G. Theng, Sjerry van der Gaast and Kazuko Fujii
- 3 The First Universal Common Ancestor (FUCA) as the Earliest Ancestor of LUCA's (Last UCA) Lineage . . . . . 43**  
Francisco Prosdocimi, Marco V. José and Sávio Torres de Farias

## Part II Concepts and Methods

- 4 Repeatability and Predictability in Experimental Evolution . . . . . 57**  
Peter A. Lind
- 5 RetroSpect, a New Method of Measuring Gene Regulatory Evolution Rates Using Co-mapping of Genomic Functional Features with Transposable Elements . . . . . 85**  
Daniil Nikitin, Maxim Sorokin, Victor Tkachev, Andrew Garazha, Alexander Markov and Anton Buzdin
- 6 Methods to Detect and Associate Divergence in Cis-Regulatory Elements to Phenotypic Divergence . . . . . 113**  
Juliana G. Roscito and Michael Hiller
- 7 A Look Back Over 20 Years of Evo-Devo Studies on Sponges: A Challenged View of Urmetazoa . . . . . 135**  
Quentin Schenkelaars, Amélie Vernale, Laura Fierro-Constaín, Carole Borchiellini and Emmanuelle Renard

<b>8</b>	<b>A Geometric Morphometrics-Based Mapping Model of Leaf Shape Evolution</b> .....	161
	Yige Cao, Xuli Zhu, Rongling Wu and Lidan Sun	
<b>9</b>	<b>Allostery and Structural Dynamics in Protein Evolution</b> .....	179
	P. Campitelli and S. B. Ozkan	
<b>10</b>	<b>Coevolutionary Approaches to the Science of Language</b> .....	195
	Nicholas Evans	
 <b>Part III Genome and Phenotype Evolution</b>		
<b>11</b>	<b>The Parallel Lives of Human Y Chromosome Lineages Across the Strait of Gibraltar</b> .....	217
	Carla García-Fernández and Francesc Calafell	
<b>12</b>	<b>Vertebrate Genome Size and the Impact of Transposable Elements in Genome Evolution</b> .....	233
	Maria A. Biscotti, Federica Carducci, Ettore Olmo and Adriana Canapa	
<b>13</b>	<b>Genetic Diversity of the Apoptotic Pathway in Insects</b> .....	253
	Mélanie Ribeiro Lopes, Nicolas Parisot, Patrick Callaerts and Federica Calevro	
<b>14</b>	<b>Xenacoelomorpha, a Key Group to Understand Bilaterian Evolution: Morphological and Molecular Perspectives</b> .....	287
	Ulf Jondelius, Olga I. Raikova and Pedro Martinez	
<b>15</b>	<b>Cooperation and Competition in Mammalian Evolution</b> .....	317
	Tomoko Kaneko-Ishino and Fumitoshi Ishino	