

Toshio Sekimura · H. Frederik Nijhout
Editors

Diversity and Evolution of Butterfly Wing Patterns

An Integrative Approach



 Springer Open

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Invited speakers, poster presenters, and other participants in the IABP-2016 meeting. H. Frederik Nijhout (*front row center*) and Toshio Sekimura (*front row, second from right*). Just outside the meeting room of the Active Plaza of Chubu University, August 3, 2016.

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Foreword

An international meeting titled “Integrative Approach to Understanding the Diversity of Butterfly Wing Patterns (IABP-2016)” was held at Chubu University, Japan, in commemoration of the exhibition of “Fujioka Collection of Japanese Butterflies.” It was our great pleasure to host the meeting with the participation of many researchers including the world-leading researchers from abroad. The Fujioka Collection was recently donated to Chubu University by Dr. Tomoo Fujioka himself, who is a world authority on laser engineering and also a famous butterfly collector in Japan. In order to store the collection properly, Chubu University established the Research Institute for Butterflies at Chubu University’s Nagoya Campus, Tsurumai, Nagoya, Japan.

The Fujioka Collection contains 220,000 specimens of various butterflies all collected by Dr. Fujioka for about 70 years. It includes many extinct butterfly species and valuable species showing spectacular geographical variations. Other natural history museums in Germany or England also asked for the donation of Dr. Fujioka’s collection. It was our honor to receive the collection and keep it at Chubu University. We hope that it will fascinate many people and also provide useful and valuable research materials for butterfly researchers in the world.

Finally, I would like to thank Professor Toshio Sekimura of Chubu University and Professor H. Frederik Nijhout of Duke University, USA, for their efforts to organize the interesting meeting: “Integrative Approach to Understanding the Diversity of Butterfly Wing Patterns (IABP-2016).” I also express my sincere thanks to all members of the IABP-2016 executive committee of Chubu University for their strong and continuous support. I hope that the proceedings will mark an epoch-making milestone in the integrative approach to the analysis of the diversity and evolution of butterfly wing patterns.

Chairman, Board of Trustees
Chancellor, Chubu University
Kasugai, Japan
January 2017

Atsuo Iiyoshi

Preface

The diversity in the color patterns of butterfly wings is one of the most spectacular and mysterious puzzles of and unsolved problems in nature. Most of the 15,000 or so species of butterflies can be identified by their wing color pattern alone, giving evidence of a great evolutionary radiation of patterns that rivals, and arguably exceeds, that of any other group of organisms. Until fairly recently, there were few effective methods for analyzing the mechanisms by which this enormous diversity of patterns is produced, how these patterns are controlled genetically, and the mechanisms by which they have evolved and continue to evolve. Since the late 1980s, new and powerful experimental and computational techniques have been brought to bear on these problems, and the past decade and a half, in particular, has seen a veritable revolution in our understanding of the development, genetics, and evolution of butterfly wing patterns.

Much of this progress has come about through the application of modern molecular genetic techniques to the understanding of mimicry and through the discovery of many of the genes involved in both the early and later processes of pattern specification and development. In addition, studies of how environmental and climatic factors affect the expression of color patterns have led to increasingly deeper understanding of the pervasiveness and underlying mechanisms of phenotypic plasticity.

The study of butterfly color patterns has grown from a primarily comparative and morphological approach to one that embraces, and is guided by, the most modern and cutting-edge experimental, analytical, and mathematical techniques by a large and diverse group of investigators spread across the globe. In recognition of the great progress in research on the biology of butterfly wing color patterns, an international meeting titled “Integrative Approach to Understanding the Diversity of Butterfly Wing Patterns (IABP-2016)” was held at Chubu University, Japan, for 3 days from the 1st to the 3rd of August 2016. The meeting was organized by Chubu University in commemoration of the Fujioka Collection of Japanese Butterflies, which includes approximately 220,000 specimens representing almost all butterfly species in Japan. The collection was recently donated and is stored at Chubu

University's Nagoya Campus. The collection is planned to be made available as a resource for professional and amateur researchers after some initial work on the collection is completed.

The speakers invited to the IABP-2016 meeting covered fields such as “Evo-Devo,” “Eco-Devo,” “Developmental Genetics,” “Ecology,” “Food Plant,” and “Theoretical Modeling.” This diversity of approaches is essential to develop a deep and realistic understanding of the diversity and evolution of butterfly wing color patterns. Invited speakers included young researchers with new findings as well as world leaders in both experimental and theoretical approaches to wing color patterns. This volume is based on papers from the invited speakers, and some papers qualified in the poster presentations of the meeting. The meeting provided a great opportunity for active researchers to communicate with each other, discuss recent progress, and facilitate development of an integrative understanding of the diversity and evolution of butterfly wing color patterns. We hope that this volume will help to communicate the excitement felt by the participants of the meeting to a wider audience and serve to open a new era of integrative approaches to the analysis of butterfly wing color patterns.

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First of all, we would like to thank Dr. Atsuo Iiyoshi (Chairman, Board of Trustees, Chancellor, Chubu University) for his warm, helpful, and generous financial support. We also thank Dr. Okitsugu Yamashita (President of Chubu University) and Dr. Akinori Ohta (Vice President of Chubu University) for their continuous strong support. We express our sincere thanks to all the members of the executive committee of the IABP-2016 meeting: Dr. Hiromichi Fukui (Director, Chubu Institute for Advanced Studies, Chubu University), Prof. Kaname Tsutsumiuchi (Department of Biological Chemistry, Chubu University), Assoc. Prof. Yuichi Oba (Department of Environmental Biology, Chubu University), Assoc. Prof. Koichi Hasegawa (Department of Environmental Biology, Chubu University), and Dr. Satoru Sugita (Lecturer, International Digital Earth Applied Science Research Center, Chubu University).

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