

# Introduction

The year 2020 will be remembered as the year of the coronavirus disease 2019 (COVID-19) pandemic. No event in recent memory has so affected our work and daily lives. At a time when science and scientists have such a crucial role in combating the spread of the virus and finding a cure for COVID-19, respected members of our community have been marginalized and the scientific method undermined by some political leaders around the world. Despite these unprecedented events, many scientists have redirected their activities toward studying SARS-CoV-2 in search of its origins, mode of transmission, and pathogenesis. Although there's still a lot to learn, in an impressively short time period the etiological agent of COVID-19 was identified and sequenced, its main cellular receptor was revealed, and mechanisms of host defense and disease pathogenesis were elucidated. Most important of all, an effective vaccine appears to be on the horizon—thanks to science.

The *Annual Review of Animal Biosciences* is pleased to have had among the members of its Editorial Committee international experts on animal coronaviruses and other viral pathogens. Animal studies have been crucial in informing our understanding of the current pandemic. Founding Editorial Committee Member Linda Saif has studied the immunobiology and pathogenesis of animal coronaviruses for her entire career; Sue VandeWoude, who joined the Editorial Committee last year, is an expert in feline lentiviruses and epidemiology; and this year, we are proud to welcome to the Editorial Committee George Fu Gao, the Director of the Chinese Center for Disease Control and Prevention and an International Member of the US National Academy of Sciences. A veterinarian by training, George has been a global leader in studying the H5N1 avian flu virus, as well as animal and human coronaviruses, including SARS-CoV and SARS-CoV-2.

In light of the gravity of the current situation, we are pleased to present Volume 9 of the *Annual Review of Animal Biosciences*. This year's collection of outstanding reviews covers a broad swath of animal biology, which has become a hallmark of our journal. From nanobodies to edible insects to food safety and primate conservation, the contributions in this volume will inform and fascinate readers. We trust that during these dark months of the pandemic you will find joy in your own work, as well as in the work of our authors. Stay safe and stay strong. Science and competent political leadership will turn back this pandemic.

Harris Lewin  
Mike Roberts  
Co-Editors



# Contents

Vertebrate Chromosome Evolution <i>Joana Damas, Marco Corbo, and Harris A. Lewin</i> .....	1
Phylogenomics and the Genetic Architecture of the Placental Mammal Radiation <i>William J. Murphy, Nicole M. Foley, Kevin R. Bredemeyer, John Gatesy, and Mark S. Springer</i> .....	29
Genetic Variation and Hybridization in Evolutionary Radiations of Cichlid Fishes <i>Hannes Svartal, Walter Salzburger, and Milan Malinsky</i> .....	55
Genomics and the Evolutionary History of Equids <i>Pablo Librado and Ludovic Orlando</i> .....	81
The Diversity of Primates: From Biomedicine to Conservation Genomics <i>Joseph D. Orkin, Lukas F.K. Kuderna, and Tomas Marques-Bonet</i> .....	103
Genetics and Evolution of Mammalian Coat Pigmentation <i>Eduardo Eizirik and Fernanda J. Trindade</i> .....	125
Physiological Genomics of Adaptation to High-Altitude Hypoxia <i>Jay F. Storz and Zachary A. Cheviron</i> .....	149
Programmed DNA Elimination in Vertebrates <i>Jeramiah J. Smith, Vladimir A. Timoshevskiy, and Cody Saraceno</i> .....	173
Epigenetic Regulation of the Nuclear and Mitochondrial Genomes: Involvement in Metabolism, Development, and Disease <i>Justin C. St. John</i> .....	203
Endogenous Retroviruses Drive Resistance and Promotion of Exogenous Retroviral Homologs <i>Elliott S. Chiu and Sue VandeWoude</i> .....	225
Toxoplasmosis: Recent Advances in Understanding the Link Between Infection and Host Behavior <i>Stefanie K. Johnson and Pieter T.J. Johnson</i> .....	249

Coral Probiotics: Premise, Promise, Prospects <i>Raquel S. Peixoto, Michael Sweet, Helena D.M. Villela, Pedro Cardoso, Torsten Thomas, Christian R. Voolstra, Lone Høj, and David G. Bourne</i> .....	265
Advances in Microbiome Research for Animal Health <i>Raquel S. Peixoto, Derek M. Harkins, and Karen E. Nelson</i> .....	289
Beyond Antimicrobial Use: A Framework for Prioritizing Antimicrobial Resistance Interventions <i>Noelle R. Noyes, Ilya B. Slizovskiy, and Randall S. Singer</i> .....	313
Insects: A Potential Source of Protein and Other Nutrients for Feed and Food <i>Kerensa J. Hawkey, Carlos Lopez-Viso, John M. Brameld, Tim Parr, and Andrew M. Salter</i> .....	333
New Insights in Muscle Biology that Alter Meat Quality <i>Sulaiman K. Matarneh, Saulo L. Silva, and David E. Gerrard</i> .....	355
Strategies to Improve Poultry Food Safety, a Landscape Review <i>Steven C. Ricke</i> .....	379
Applications of Nanobodies <i>Serge Muyldermans</i> .....	401
Bacteriome Structure, Function, and Probiotics in Fish Larviculture: The Good, the Bad, and the Gaps <i>Nuno Borges, Tina Keller-Costa, Gracinda M.M. Sanches-Fernandes, António Louvado, Newton C.M. Gomes, and Rodrigo Costa</i> .....	423
Genetic Engineering of Livestock: The Opportunity Cost of Regulatory Delay <i>Alison L. Van Eenennaam, Felipe De Figueiredo Silva, Josephine F. Trott, and David Zilberman</i> .....	453

## Errata

An online log of corrections to *Annual Review of Animal Biosciences* articles may be found at <http://www.annualreviews.org/errata/animal>