

# VERTEBRATE SPECIATION

EDITED BY W. FRANK BLAIR

# VERTEBRATE SPECIATION

*A University of Texas Symposium*

Edited by W. FRANK BLAIR

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## INTRODUCTION

This volume results from a conference on "Vertebrate Speciation" held at the University of Texas from October 27 to October 31, 1958. This was one of several academic and research conferences convened at the University during the year in observance of the seventy-fifth anniversary of the founding of the University of Texas. That this seventy-fifth anniversary conference date should coincide with the one-hundredth anniversary of the presentation to the scientific world of the Darwin-Wallace thesis of *evolution through natural selection* is highly appropriate. The diversity of research areas and interests (genetics, paleontology, ecology, ethology, palynology, population dynamics, morphology) represented at this conference serves as a dramatic reminder of the progress and diversification in evolutionary research and thinking through one hundred years of Darwinian theory.

A central theme of the conference was the mechanisms of species formation and evolution, with particular reference to the vertebrates. Species are visualized as living systems, and the formal papers presented and the animated discussions that ensued revolved around the dynamic aspects of these systems. The organizers of the conference were exceptionally fortunate in obtaining the participation, as either moderators or speakers, of leaders in fields that are contributory to the understanding of species as dynamic, interacting, and evolving systems.

The moderator for each of the five one-day sessions prepared a brief introduction to the general subject of discussion for that day. Pertinent discussions following the presentation of each paper were tape-recorded, edited by the undersigned with assistance from Clark Hubbs and R. K. Selander, and inserted in the volume after the

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appropriate paper. Technical difficulties unfortunately prevented recording the discussion that followed three of the addresses. The undersigned assumes responsibility for any change of meaning that may have resulted from the editing of these discussions. We hope of course that none occurred.

Organization of this conference was made possible by a grant from the Research Institute of the University of Texas. We are indebted to Dr. W. Gordon Whaley, Dean of the Graduate School, President Harry H. Ransom, then vice-president and provost, and other administrative officials of the University of Texas who gave the conference their enthusiastic support and assisted our efforts in many ways. A grant from the National Science Foundation, through its program in "Systematic Biology," made attendance at the conference possible for thirty-seven graduate students from eleven other institutions.

Clark Hubbs and Robert K. Selander worked with us in organization and conduct of the conference. Our respective graduate students are due many thanks for the assistance they gave both in preparation for the conference and in direction of it.

W. FRANK BLAIR  
*Editor*

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## ISOLATING MECHANISMS

### Comparative Study of

ERNST MAYR, moderator

*Isolating Mechanisms in the Speciation of Fishes* BY C. L. HUBBS, p. 5 · (No discussion recorded)

*Isolating Mechanisms in Anuran Amphibians* BY J. S. MECHAM, p. 24 · Discussion, p. 51

### Origin of

ERNST MAYR, moderator

*A Cellular Basis for Genetic Isolation* BY JOHN A. MOORE, p. 62 · Discussion, p. 66

*Hybridization and Isolating Mechanisms* BY CHARLES G. SIBLEY, p. 69 · Discussion, p. 82



## ISOLATING MECHANISMS

ERNST MAYR

*Harvard University*

DEVOTING THE OPENING SESSION of a conference on speciation to the topic of isolating mechanisms seems appropriate for two reasons. One is that species are defined in modern biological literature as "reproductively isolated populations," and the second, a consequence of this definition, is that speciation is the origin of such isolation.

Today's two sessions thus are logically defined by the nature of species and the nature of the process of species formation. Without wanting to anticipate any of the speakers I would like to provide in a few words the framework for today's discussions.

Isolating mechanisms are all those devices which prevent interbreeding between natural populations, actually or potentially in contact with each other. The earlier literature, even back to Darwin's time, concentrated on a single one of these mechanisms: sterility. The studies of the last fifty years show, however, that numerous additional isolating mechanisms exist and that sterility may be of far less practical importance, at least in the higher animals, than are behavior and habitat barriers. Geographical separation is not an isolating mechanism or else one would have to call every isolated population a separate species. The comparative study of isolating mechanisms is important because the relative valence of the various isolating mechanisms differs from species to species, from genus to genus, and from family to family.

## Comparative Isolating Mechanisms

In this morning's session, we shall hear what the major isolating mechanisms are among the fishes and anurans, how they can be studied, and where and under what circumstances they may break down and thus result in natural hybridization. The important question of the origin of these isolating mechanisms will be discussed in this afternoon's session. That even Darwin and Wallace argued over whether isolating mechanisms were an incidental by-product of the genetic divergence of isolated populations or the result of natural selection is a fact perhaps not generally known. It now appears that a universal answer, equally valid for all isolating mechanisms, may not be possible. The explanation for sterility barriers may be different from the explanation for behavior barriers. That the sterility barrier could be improved by natural selection would seem highly improbable, as Darwin himself has pointed out. Far more experimental work is needed to determine whether the strength of isolating mechanisms is greater among sympatric populations of two related species than it is outside the zone of overlap. That there are considerable differences among the populations of a species is indicated by many observations, perhaps the most convincing being the fact that the reproductive isolation among perfectly good sympatric species may break down at limited locations. The study of hybridization, then, is quite evidently an important area of the study of isolating mechanisms.



# Isolating Mechanisms in the Speciation of Fishes<sup>1</sup>

CARL L. HUBBS

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THAT THE PROBLEM of segregation versus integration is one of long standing will be obvious from the fact that I treat it as it is exemplified among the lowest of the vertebrates. Speciation in its early stages obviously results from the ascendancy of segregation, as integration is reduced and eventually eliminated. (I hasten to add that I derive no moral from this concept, and draw no comparison with any current social problem.)

We may visualize speciation as a long-continued and often fluctuating conflict between forces that tend to unify the gene pool and those that tend to diversify populations genetically. The prime unifying force is interbreeding. The opposing factors, which lead to genetic isolation and speciation, are, I believe, numerous and complex; they are both intrinsic, in genetic mechanisms, and extrinsic, in ecological relations.

I belong to the school that stresses what may be called the environ-

<sup>1</sup> Contributions from the Scripps Institution of Oceanography, University of California, New Series.