

The Cardiovascular System

FRANK M. SMITH

*Department of Anatomy and Neurobiology
Dalhousie University
Halifax, Nova Scotia
Canada B3H 4H7*

NIGEL H. WEST

*Department of Physiology
University of Saskatchewan
Saskatoon, Saskatchewan
Canada S7N 5E5*

DAVID R. JONES

*Department of Zoology
University of British Columbia
Vancouver, British Columbia
Canada V6T 1Z4*

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I. INTRODUCTION

Birds have evolved a high-performance cardiovascular system to meet the rigorous demands of running, flying, swimming, or diving in a variety of environments, some of them very harsh. Sustained high levels of activity in these environments place severe demands on the transport capabilities of the cardiovascular system to

provide adequate delivery of oxygen to working vascular beds and to provide efficient removal of metabolic products. Furthermore, birds are homeothermic organisms and the cardiovascular system plays a major role in conserving or removing body heat. The descriptions of the component parts of the circulatory system in this chapter illustrate that these transport requirements are met in a variety of ways in birds inhabiting particular environmental niches. This chapter describes the morphology and functional aspects of the avian heart (Section II), hemodynamics of the circulation (Section III), the vascular tree (Section IV), and the physiological properties of the blood (Section V). A common thread running through this discussion is that the component parts of the circulation must cooperate in an integrated fashion in order to ensure that oxygen delivery to the tissues matches demand. The integrative control of the avian circulation by autoregulatory, humoral, and neural mechanisms is described in Section VI.

Modern birds are probably derived from theropod dinosaurs (Chiappe, 1995), while mammals have descended from a group of carnivorous reptiles, the cynodonts. These ancestral lines originated in the Triassic more than 200 million years ago, so in evolutionary terms avian and mammalian stocks have been separated for a substantial period of time. As one might expect, significant differences in cardiovascular structure and function have arisen in the two groups since their separation, yet a number of similarities in their circulatory systems are also evident. Such similarities probably represent both the conservation of characteristics common to organisms ancestral to the two groups and the results