

Capillarity and Fibre Types in Locomotory Muscles of Wild Yellow-Legged Gulls (*Larus cachinnans*)

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Accepted by G.K.S. 2/5/98

ABSTRACT

This study analyzes the capillarity and fibre-type distribution of six locomotory muscles of gulls. The morphological basis and the oxygen supply characteristics of the skeletal muscle of a species with a marked pattern of gliding flight are established, thus contributing to a better understanding of the physiology of a kind of flight with low energetic requirements. The four wing muscles studied (scapulotriceps, pectoralis, scapulohumeralis, and extensor metacarpi) exhibited higher percentages of fast oxidative glycolytic fibres (>70%) and lower percentages of slow oxidative fibres (<16%) than the muscles involved in nonflight locomotion (gastrocnemius and iliobtibialis). Capillary densities ranged from 816 to 1,233 capillaries mm^{-2} , having the highest value in the pectoralis. In this muscle, the fast oxidative glycolytic fibres had moderate staining for succinate dehydrogenase and relatively large fibre sizes, as deduced from the low fibre densities (589–665 fibres mm^{-2}). All these findings are seen as an adaptive response for gliding, when the wing is held outstretched by isometric contractions. The leg muscles studied included a considerable population of slow oxidative fibres (>14% in many regions), which suggests that they are adapted to postural activities. Regional variations in the relative distributions of fibre types in muscle gastrocnemius may reflect different functional demands placed on this muscle during terrestrial and aquatic locomotion. The predominance of oxidative fibres and capillary densities under 1,000 capillaries mm^{-2} in leg muscles is probably a consequence of an adaptation for slow swimming and maintenance of the posture on land rather than for other locomotory capabilities, such as endurance or sprint activities.

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Introduction

The varied lifestyles of vertebrates, and the wide range of locomotory modes by which they move, are reflected in considerable structural diversity of muscles. In birds, most studies of locomotion have focused on wing muscles, in which fibre-type composition, capillary supply, and architecture reflect the high metabolic needs associated with flight (see, e.g., Rosser and George 1986; Lundgren and Kiessling 1988; Tobalske 1996). The energetic demands required by flapping and gliding, the two major types of bird flight, are very different (Baudinette and Schmidt-Nielsen 1974; Goldspink et al. 1978; Butler and Woakes 1980; Meyers 1993). In order to cope with the higher oxidative demands of flapping flight, and to improve the oxygen arrival to mitochondria, the pectoralis muscle of birds that exhibit a large component of flapping flight have high capillary densities and small fibre cross-sectional areas (Suarez 1992; Mathieu-Costello et al. 1994).

In addition to flight, birds also use many other forms of locomotion, including walking, running, diving, and different ways of swimming (see Butler 1991). These locomotory behaviours also have an important role in shaping the structural characteristics of avian muscles, especially those of the hindlimbs. In spite of the importance of these forms of locomotion, only a few studies dealing with muscles other than those involved in flight are available (see, e.g., Suzuki et al. 1985; Boesiger 1986; Patak and Baldwin 1993).

To supplement the knowledge of bird muscle structure and its ecophysiological implications, we analyzed the fibre types and capillarization of several wing and leg muscles of a wild species of bird with a pattern of gliding flight, the yellow-legged gull (*Larus cachinnans*).

Material and Methods

Animals and Muscles

A total of six yellow-legged gulls (*Larus cachinnans* Pallas) of both sexes with a mean body weight (\pm SEM) of $1,062 \pm 63$ g were used for this study. Wild animals were obtained from the Medes Islands (Girona, Spain) in April 1993, during a campaign for the control of the population of this species undertaken by wildlife management technicians of the Departament d'Agricultura, Ramaderia i Pesca de la Generalitat de Catalunya.

