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ENERGY SUPPLY AND DELIVERY

I came to crocodylian biology via interests in the respiratory and metabolic physiology of fishes (Queensland lungfish, Antarctic fish, a North American catfish and Port Jackson sharks), so it seemed natural to start wondering about similar topics in crocodiles. Most particularly, I wondered about crocodylian diving capacities. That wonderful English gentleman the late Hugh Cott had written a marvellous paper about crocodiles in Uganda: one of the first wide ranging studies on crocodile biology and ecology, and he had written about the length of time they could stay under water (i.e. a long time!). Long dives prompt questions about their metabolism, their lung capacity, their blood and, of course, their extraordinary heart (Chapter 8). Forty years ago people thought that diving by vertebrates involved anaerobic metabolism, with lactate accumulation resulting in a big 'oxygen debt' to 'pay back' after surfacing. But crocs could obviously dive repeatedly, with only a short breath in between and no time for such a luxury. There were so many questions! We will talk about diving in Chapter 9 after reviewing the heart. This Chapter will be about crocodylian metabolic requirements, respiration and circulation, and their capacity for both aerobic and anaerobic metabolism. It will provide a good background for understanding how crocodylians can remain submerged for so long (Chapter 9).

Different behaviours require different amounts of energy: resting, walking, running, galloping, swimming and diving all require the regulation and management of energy supply. Increased physical activity relies on up-regulation of oxygen usage at the mitochondria to produce more energy-delivering ATP, accompanied by an increase in the supply of oxygen to the tissues by increased blood supply and, in turn, increased ventilation to oxygenate the blood being circulated. As in humans, when metabolic requirements exceed what can be supplied aerobically, glycogen is metabolised locally and activity is supported by anaerobic metabolism.

This Chapter will discuss aerobic and anaerobic metabolism, the lungs, ventilation, and oxygen supply and delivery to the working tissues during rest and during physical activity. Submergence inhibits breathing and, because diving is such a significant behaviour in crocs, we can expect special adaptations for the prolonged dives that they make. The main discussion of diving and its metabolic support will be postponed until Chapter 9, after a discussion of the structure and function of the heart (Chapter 8), but this Chapter provides a useful background.

The metabolic engines: crocodylian biochemistry and metabolism

(This is the shortest biochemistry course you'll ever have!)

From substantial research on alligators in the 1960s through to 1980s by Roland Coulson and Thomas Hernandez at Louisiana State University

The circulatory system plays an important role in the supply of energy to a crocodylian's body.