

**Physiological and Ecological Adaptations to Feeding in Vertebrates.** J. Matthaias Starck and Tobias Wang (eds). Science Publishers Inc., Post Office Box 699, Enfield, New Hampshire 03748, USA. 2005. 425 pp. Price: US\$ 114. ISBN 1-57808-246-3

Animals need energy for various activities they perform to ensure their survival, growth and reproduction. Needless to say that even resting metabolism requires energy. The energy source is obviously the food that the animals ingest, digest, assimilate and also absorb nutrients. Great differences in the availability of food in terms of diversity and abundance are encountered in nature depending upon the habitat and geographical location. Consequently, vertebrates have to adapt themselves to their local conditions which necessitate evolution of phenotypic plasticity in the gastrointestinal (GI) tract, morphology and physiology, leading to the evolution of diverse feeding habits and strategies that differ enormously among taxa. In addition, the form and functions of GI organs have been shaped to reject a plethora of antigens, bacteria, viruses and toxins through this open barrier.

In recent years, researchers of GI tract have focused attention to studies on physiological and evolutionary adaptations to the environment. Indeed, the GI tract forms a useful model in the study of physiological ecology and functional ecological morphology in elucidating the physiological and ecological adaptations to fluctuating environmental conditions (e.g. seasonal variation in food availability, ectothermy, etc.).

The book provides excellent perspective focus on the GI tract from an integrative ecological and evolutionary point of view, which is based on a physiological/biochemical/morphological information elucidating the basic mechanisms that are well understood and quantified. The book has 15 chapters that are written by various experts from a variety of specialized fields ranging from comparative morphology through ecological and molecular physiology and immunology. Various theoretical models have also been proposed wherever appropriate with reference to feeding behaviour (ingestion, digestion, absorption, etc.). The first chapter deals with a comparative morphology that outlines evolution of the feeding apparatus in vertebrates. Chapter 2 deals with the factors controlling or affecting the digestive efficiency, viz. mean retention time of food in the digestive tract, food particle size and ef-

fectiveness of mastication, level of food intake, digestive tract capacity, hydrolytic enzyme activities and finally absorptive capacities. The next chapter goes further in reviewing carbohydrate hydrolysis and absorption. This chapter brilliantly examines the application of chemical reactor theory to digestion and digestive capacities in vertebrates with reference to sucrose hydrolysis and hexose absorption in nectar- and fruit-eating birds as examples. Chapter 4 summarizes studies on the regulation of digestive capacity, limits due to volumetric capacity of the gut and rate at which food material is broken down mechanically or biochemically with reference to avian ecology. The studies show that while there may be digestive constraints, capacity for absorption per se is not limited. The subsequent chapter highlights the importance and also the mechanisms of paracellular uptake by way of diffusion and solvent drag of nutrients across the intestine in homeotherms. Thus, the first five chapters are logically sequenced. These chapters elegantly summarize basic and advanced aspects of digestion and feeding ecology in vertebrates.

Chapter 6 which deals with mass-balance models for animal isotopic ecology, is a welcome deviation from the classic GI tract physiology. Measurement of natural stable isotopes is a technique well known to plant physiologists, atmospheric scientists and geochemists. Only in recent years, attempts have been made to integrate biological, ecological and geochemical processes, especially in extinct animals. In fact, palaeontologists and archaeologists rely on stable isotopes as tools in the reconstruction of the diets and habits of extinct animals and ancient humans. The chapter examines available data on the use of stable isotopes in reconstructing animal diets, patterns of resource allocation to reproduction and also to track animal migration. The authors also assess the flux of materials from the sea into terrestrial food webs and so on.

Chapter 7 is concerned with structural flexibility of the digestive system of tetrapods and examines the patterns and processes involved at the cellular and tissue levels. It sheds light on how animals adjust their GI system to fluctuating conditions of food availability, triggers for anticipation of diet switches in relation to predictable circannual seasonality as well as unpredictable fluctuations in the food supply. The chapter focuses on how GI tract histophysiology changes (including mechanisms controlling it) in response to

fluctuations in food abundance in reptiles, birds and mammals.

Chapter 8 summarizes aspects of adaptive interplay between feeding ecology and features of digestive tract with reference to birds. The next chapter deals with GI responses to fasting based mainly on data obtained from hibernating mammals. Chapter 10 deals with interplay between diet, microbes and immune defences of the GI tract.

Chapter 11 examines the influence of digestion on the respiratory and cardiovascular physiology of ectotherms and herpets (amphibians and reptiles). Apparently, physiological challenges associated with digestion in these groups of vertebrates provide novel models for investigating the 'design' principles and physiological mechanisms that underlie the cardiopulmonary responses to elevated oxygen consumption and the mechanisms of acid-base regulation. The authors show how studies on postprandial exercise may enhance our knowledge of the physiological and structural constraints that limit the ability of herpets to sustain high metabolic rates. The next chapter examines the factors governing postprandial responses in fishes, amphibians and reptiles, and provides a link to the preceding chapter.

Chapter 13 describes neuronal and hormonal control of gut motility and secretion in fed and fasting nonmammalian vertebrates. Chapter 14 deals with the influence of dietary fatty acids on the physiology of environmental adaptation in fishes (changes in metabolic rate, tolerance to hypoxia, cardiac performance, exercise performance and osmoregulatory ability). The last chapter reviews aspects of protein and amino acid digestion and utilization by marine fish larvae.

Each chapter provides a perspective paragraph at the end to stimulate future research in the area. Indeed the book is a good state-of-the-art document. All chapters read lucidly. I enjoyed reading this interesting book though as a non-specialist. The book addresses professionals in the area of vertebrate biology, veterinary science, animal nutrition, medial gastroenterology as well as graduate students. It is highly recommended to all libraries, researchers and teachers interested in understanding the evolution of feeding in vertebrates.

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