INTRODUCTION TO TROPICAL ZOOLOGY

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Contents

1. Introduction
2. Contents of Current Section on Tropical Zoology
Glossary
Bibliography
Biographical Sketches

Summary

The perpetuation of life on planet Earth is presently threatened by innumerable pressures derived from human activities. As we strive to predict and control the damages humans continue to inflict upon the Earth, a key factor that will prove immeasurably valuable is knowledge about the various forms of life, including where and how they live. The word "science" is derived from the Latin verb "*scire*", meaning "*to know*", and "*scientia*", meaning "*knowledge*" (Webster´s New World Dictionary, 1971). Science, as opposed to simple belief, is a system based upon the acquisition of information through observation, study and experimentation. Such a system provides us with facts about our surroundings, and allows the interpretation of phenomena that, ultimately, may be a means to protecting all forms of life. In this Section on *Tropical Zoology* of the Theme '*Tropical Biology and Natural Resources*' we have strived to summarize some major findings concerning different animal groups residing in the tropics. The different chapters range from descriptive information concerning the basic biology and classification of animals to interpretations of conceptual issues that may have played an important role in shaping the evolution and characteristics of tropical animals.

1. Introduction

Zoology (from the Greek *zōion* animal + -LOGY; Webster´s New World Dictionary, 1971) is the science that studies animals, including their evolution, classification, structure, physiology and behavior. There are many ways that animals can be studied, but essentially the student of zoology would discover that all animals share similar basic functions, grow and reproduce through analogous processes, and are shaped by selection pressures derived from their physical and social environments. Despite these striking similarities, it is also obvious that animals differ considerably in form, specific functions, nutrient requirements, and ways of interacting with their surroundings,

whether **biotic** or **abiotic**. The ways in which animals vary in form, function and behavior reflect adaptations to their habitats, and a convergence of forms is often seen in animals subjected to similar selective pressures but which differ greatly in taxonomic affinity. In addition to the basic descriptive ways in which animals can be assessed, they also exhibit all sorts of interactions, and no species can survive without this intricate web of relationships with other organisms. Thus, the study of animals can be undertaken with different perspectives. One could initiate the study of zoology by looking at the most basic hierarchical level of animal organization, the function of cells and tissues of individuals and how these different parts are organized to form different organs. The variation in form and function, even at this basic level, reflects adaptations in response to varying selection pressures. From the cellular level zoology branches into the study of the whole organism, and one way to study the individual is by examining the problems it faces in order to obtain food, grow and function within its environment, interact with other organisms, and reproduce. To understand these facets of an animal's life, detailed knowledge would be required about how an animal obtains, stores and uses its food; the physiological processes that regulate metabolism and growth; how the animal perceives threats in its environment; how it communicates and behaves. Another sphere in the study of animals includes the bioinformation contained in the genetic code of all animals. The underlying framework provided by genetics permeates various interactive disciplines, including physiology, zoology, evolution and ecology.

However, we also need to understand how each genetically unique individual is associated with other similar organisms, and how groups of similar organisms fit within sequentially larger groups. We are thus led to the necessity of classifying animals into assemblages using biologically relevant mechanisms for identification and grouping of these organisms. Naming and classifying animals are activities that have existed as long as humans have been around, and the perception that animals share similar attributes has, from the beginning, been one of the fundamental keys to zoological classification. However, there have been several different types of classifications. One of the first attempts of classifying animals was carried out by the Greek philosopher Aristotle (384 BC – 322 BC), who separated animals according to very broad categories of physical environment: air, water and land dwellers. Another attempt at classification was made by St. Augustine (born in the first century A.D.), wherein he divided animals according to their utility to humans, thus, in three categories: harmful, useful and superfluous. Not much followed these two initial attempts to classify animals according to some key principles until the 17th century, when an English naturalist, John Ray, first coined the term *species*. He defined a species as an assemblage of organisms that derived from similar parents and could pass on parental characteristics to the next generation. A further step toward present-day taxonomy was that provided by Linnaeus. His *Systema Naturae*, the tenth edition of which was published in 1758, provided us with the binomial system of naming organisms in Latin. Each organism was given two names, the first one the genus and the second one the species. Similar species were grouped within each genus. Of course, this simple system became more and more complicated and error-prone as more species were discovered and described. This eventually led to international organizations that formulate the codes and rules associated with the classification and nomenclature of organisms. For example, the International Society for Phylogenetic Nomenclature (ISPN) is currently writing *The Phylocode*, or a formal set of rules governing the naming of taxa. This code is designed to name clades of

organisms that make up the tree of life with explicit reference to phylogeny, or their evolutionary relationships (Donoghue et al. 2004).

Beyond the mere description and organization of living creatures into discrete groups lies the more fundamental question of how they came into existence, how they developed their characteristics and why they have their present day geographical distributions. Evolution is the central theme that underlies all aspects of zoology. The present day concept of evolution is that all organisms are derived from previous ancestral forms by descent with modification. Several fields of study provide ample evidence that complex life forms in existence today derived from simpler organisms in the past. Evidence in support of evolution has been generated by studies in comparative anatomy, developmental biology, paleontology, geographic distribution, biochemistry, and genetics. Charles Darwin provided the first, and what can probably be considered the most comprehensive, study of evolution developed by any single person. In 1859 he published an overwhelming collection of convincing data to support the theory of evolution through natural selection in *The Origin of Species by Means of Natural Selection.* Darwin´s broad thesis of evolution through natural selection has generally been upheld throughout the last century, even while the details concerning the mechanisms of evolution are still being examined. Many topics continue to be the focus of studies concerning evolution. So, for example, aspects of evolution that remain puzzling include the role of mutations and of nonadaptive genes in the gene reservoir of each species, units of selection, and the process of reproductive isolation during the speciation process, to name a few.

The topic of this Section on *Tropical Zoology* is a focus upon animals that reside in the tropics, including key aspects of their life history. Why, specifically, should tropical zoology be a theme of interest? Due to the enormity and complexity of such a topic, it would be impossible to cover it in a single Section on *Tropical Zoology*, despite the restriction provided by the term "tropical". This Section on *Tropical Zoology*, however, covers some of the key groups of tropical organisms and theoretical concepts, and results from the necessity of providing as much information as possible about animals in the tropical zone. The study of plant and animal life in the tropics has emerged as one of the most important tasks for present-day biologists.

The tropics encompass the area lying between the Tropic of Cancer (23°26' N latitude) and the Tropic of Capricorn (23°26' S latitude). Despite the popular stereotype of the tropics as a region of continuous rainforests, it in fact includes many different **habitats**, from tropical rainforests, to grasslands and deserts, alpine regions, and even permanent glaciers. This heterogeneity of landscapes, in addition to climatic factors, are elements that promoted the evolution of vast numbers of species in all taxonomic groups, so that the highest numbers of animals on the planet are concentrated in the tropics. However, this region is undergoing rapid change, leading to an accentuated decline in animal populations. For example, it is now known that less than 5% of the Earth's land surface, most of which lies in the tropics and subtropics, contains about 75% of the world's threatened avifauna (BirdLife International, 2000). Although conservation efforts and public awareness have increased tremendously in recent years, these are only as effective as the information base used to develop conservation measures. Thus, we reemphasize the importance of the acquisition of knowledge about this region, which is

now so essential to preserve the Earth's biodiversity.

Tropical animals are not only fascinating due to their overwhelming diversity, but also because they often exhibit complex and poorly known patterns of behavior, unique types of social and mating systems, and physiological mechanisms that are markedly different from those of their temperate counterparts. Such complexities and unique characteristics have been neglected due to the fewer studies developed in the tropics, as compared with temperate regions. The bottom line is that we are only now initiating the arduous task of researching the tropical fauna so that information may be available not only for conservation purposes, but also to correct the distorted picture of biological diversity derived from studies of the less diverse fauna of temperate regions.

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about the behavioral ecology of tropical birds, and which makes many comparative evaluations about avifauna of the tropics relative to temperate birds].

Biographical Sketches

Regina H. Macedo is a Professor at Universidade de Brasilia, where she coordinates the Animal Behavior Laboratory. Her present research interests range from the study of the guira cuckoo´s cooperative breeding system to sexual selection and social systems of birds in Brazil.

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