Evolutionary Faunas and Macroevolutionary Change

Quantitative Paleontology

WVU

2015
Development of marine invertebrate diversity, the five mass extinction events and possible interactions with volcanism, global climate and sea level fluctuations.
Sepkoski’s Evolutionary Faunas of Marine Animals
SEPKOSKI'S THREE EVOLUTIONARY FAUNA

CAMBRIAN FAUNA
PALEOZOIC FAUNA
MODERN FAUNA

C O S D C P T J K T
PALEOZOIC MESOZOIC CENOZOIC

CAMBRIAN FAUNA
PALEOZOIC FAUNA
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C O S D C P T J K T
PALEOZOIC MESOZOIC CENOZOIC
Jack Sepkoski, 1948-1999
Figure 20.4

The history of family diversity of the three great “faunas” of marine animals, showing a Cambrian phase, a Paleozoic phase and a “modern” phase. The three phases add together to produce the overall pattern of diversification in Fig. 20.2a. Geological period abbreviations are standard, running from Vendian (V) to Tertiary (T). (Based on Sepkoski 1984.)
The diversification of four groups of multicellular organisms during the Phanerozoic: (a) marine animals, (b) vascular land plants, (c) non-marine tetrapods, and (d) insects. All graphs show similar shapes, with a long initial period of low diversity, and then rapid increase since the Cretaceous. Geological period abbreviations are standard, running from Vendian (V) to Tertiary (T). (Based on various sources.)
Figure 20.3
Theoretical models for the diversification of life plotted as if for the last 600 myr (a) in the absence of major perturbation and (b) with two mass extinctions superimposed.
Figure 20.5

Sepkoski’s three-phase coupled logistic model for diversification of animal life in the sea. (a) The family-level diversification curve for marine animals, showing the three evolutionary “faunas” from Fig. 20.4, each shaded differently. Numbers I to V are the five big mass extinctions, in sequence from left to right, Late Ordovician, Late Devonian, end-Permian, Late Triassic and Quaternary-Cretaceous. (b) The handover from the Cambrian to the Paleozoic “fauna” involved a shift in equilibrium diversity \( \bar{k}_e \); equilibrium diversity is achieved when origination \( (k_o) \) and extinction \( (k_e) \) rates match. (c, d) The coupled logistic model gives a simple representation of the broad outlines of the progress of the three evolutionary “faunas” 1, 2 and 3 (c), and perturbations, shown by vertical arrows, may be added to correspond to the mass extinctions (d). (Based on information in Sepkoski 1979, 1984.)
Collector Curves for Modern Organisms. Some groups are better known than others.
Collector Curves for Fossil Organisms. Some groups are better known than others because of collection bias.

http://potiphar.jongarvey.co.uk/2014/10/29/on-the-fossil-record/
Evolutionary faunas based on standardized sample sizes drawn from the Paleobiology Data Base. (John Alroy, 2001)
Taxonomic Rank affects the Pattern of Diversity
Proportion of motile to non-motile marine animals over the Phanerozoic. A fish is given as an example of a motile animal, and a brachiopod as a non-motile example. Graphic reproduced from Bambach et. al., 2002.
Change in Diversity also reflects increased Predation over Geologic Time
All the major and many of the minor living branches of life are shown on this diagram, but only a few of the millions of species that have existed since Earth’s birth are represented.

www.evogeneao.com/tree.html
The Tree of Life

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