8^{th} International Symposium Cephalopods – Present and Past

August 30 – September 3, 2010

Abstracts Volume

University of Burgundy & CNRS
Dijon - France

http://www.u-bourgogne.fr/cephalopods/

Evolutionary significance of cephalopod egg size during mass extinctions

Vladimir Laptikhovsky[1], Mikhail Rogov[2], Svetlana Nikolaeva[3,4] & Alexander Arkhipkin[1]

[1] Falkland Islands Government Fisheries Department, Stanley, FIQQ 1ZZ, Falkland Islands

[2] Geological Institute of Russian Academy of Sciences, Pyzhevskii Lane 7, Moscow – 109017, Russia

[3] Paleontological Institute, Russian Academy of Sciences, Moscow, 117997, Russia

[4] International Commission on Zoological Nomenclature, The Natural History Museum, London SW7 5BD, United Kingdom

The Ammonoidea and Nautiloidea were the most abundant and diverse cephalopods inhabiting the Middle - Late Palaeozoic and Mesozoic seas. The Nautiloidea survived both the P/T and K/T-extinctions. The Ammonoidea narrowly passed through the P/T boundary and became extinct at the end of the Cretaceous, even though they were the more diverse group, both morphologically and ecologically than Nautiloidea.

The small egg size of ammonoids evolved to reproduce in pelagic layers with high unpredictable mortality because of unstable environment. They evolved high diversity and had relatively short stratigraphic ranges (Stephen, Stanton, 2002). The colonisation of the oceanic epipelagial was accompanied by a further decrease in egg size in Ancyloceratina, as happened in extant cephalopods. The move of Lytoceratina to colder mesopelagic waters provoked a progressive increase in egg size, which also is the case of modern coleoids. The egg size varied with environmental temperatures: Mesozoic boreal ammonoids produced larger eggs than tropical species (Drushchits, Doguzhaeva, 1981). During the Turonian global warming it decreased both in shelf-dwelling Ammonitina and mesopelagic Lytoceratina, with a gradual increase during the subsequent cooling. Ammonoidea became extinct simultaneously with another dominant small-egged cephalopod group – the Coleoid Belemnitida. The most prominent teleost fish that became extinct at the same time were five families of ecological siblings of modern large-bodied predators like tunas and billfishes (Friedman, 2009), which also are small-egged broadcast spawners.

Nautiloids laid large eggs on the sea floor in a relatively predictable and stable environment. Such an attachment to near-bottom habitats prevented an expansion into open oceanic waters. They were low diverse in respect to ammonoids and had longer stratigraphic ranges. Possibly, the absence of a vulnerable paralarval stage saved them from extinction at the K/T boundary. This boundary was also crossed by Sepiida - another large – egged cephalopod group as well as by squids and octopods. Among fish, the extremely large-egged Elasmobranchii and Coelacanthiformes persisted through K/T boundary as well as through many other extinction events.

The appearance of these two types of cephalopod reproductive strategies is in agreement with Vance's (1973) hypothesis that only the extremes of egg size are evolutionary stable strategies. Small – egged, high fecund species are more vulnerable to disasters of a climatic / abiotic character through sudden impact on vulnerable early stages. Low fecund, large-egged species with larger and more resilient offsprings are more vulnerable to disasters of ecological / biotic character influencing later stages of ontogenesis, such as the appearance of new competitors, new predators and fishery.