Chapter 2

Zoogeography of Freshwater Invertebrates of Southeast Asia, with Special Reference to Odonata

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Abstract The present knowledge of the historical biogeography of aquatic invertebrate groups is reviewed. Most orders of aquatic insects have a fossil record starting in the Early Permian, or Middle Carboniferous (Odonata), making even the break-up of Gondwana (Late Jurassic) relevant to understanding present distributional patterns. The complex geological history of Southeast Asia is summarized, and geological area cladograms presented. Biogeographical studies are seriously hampered by the limited information on subaerial history of the various islands and terranes. The historical biogeography of the Platycnemididae (Odonata), with special reference to the subfamily Calicnemiinae, is presented as one of the first examples of such a study of a widespread group. The species of

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southeast Asia derived from African Platycnemididae. Malesian Calicnemiinae derived from ancestors on the mainland of Asia, and may have dispersed along the Izu-Bonin Arc (40–50 Ma), or along the Late Cretaceous “Inner Melanesian Arc” sensus Polhemus. A clade of the genera *Lieftinckia* and *Risiocnemis* (Solomon Islands and the Philippines) represents a more recent westward dispersal of the Calicnemiinae, via the Caroline and Philippine Arcs during the Oligocene.

Various other more limited phylogenetic reconstructions and biogeographical analyses of other freshwater invertebrates, particularly Odonata and Hemiptera, are discussed. Areas of endemism on New Guinea are generally congruent with geological entities recognized, e.g., the microterranes along the northern margin of New Guinea. Special attention is paid to the fauna of Sulawesi. Area cladistic reconstructions based on distribution patterns and phylogenetic reconstructions of, e.g., *Protosticta* Selys (Odonata, Platystictidae) and genera and species of Chlorocyphidae (Odonata), show a pattern of (northern arm (southwest arm – central and southeastern arm)), which is a reflection of the geological history of the island.

Biogeographical patterns recognized in freshwater invertebrates of Malesia do not principally differ from those found in strictly terrestrial taxa. The distribution of land and water seems to be the driving force in speciation during the Cenozoicum. It is unresolved whether rafting of biotas on the various island arcs, or congruent patterns in dispersal, are to be considered the underlying principle. The extreme habitat requirements and poor dispersal power of many species involved seem to make a dispersal scenario unlikely. However, recent studies show that such habitat specialization may develop rapidly.

*Facts such as these can only be explained by a bold acceptance of vast changes in the surface of the earth.* (Wallace, 1860: 177)

### 1. Introduction

Recently, de Bruyn et al. (2004) found extensive genetic divergence between wild populations of the giant freshwater prawn *Macrobrachium rosenbergii* (De Man) in southeast Asia. This species of prawn occurs in the wild from Pakistan to Australia and on some Pacific islands, and it is cultured widely around the world in more than 40 countries (Mather and de Bruyn, 2003). It is of high economic importance for some regions in southeast Asia, with harvesting of wild populations alone exceeding a value of US$800 million in 1998. In the 1990s, harvest of several stocks in culture experienced a decline, presumably due to inbreeding. Consequently, wild populations are important sources of genetic diversity to overcome inbreeding problems, but *M. rosenbergii* is rapidly declining in the wild due to overharvesting and habitat loss. Mating between specimens of different parts of the species range resulted in reduced larval survival, although heterosis (hybrid vigour) was found for other populations from the same region. Obviously,