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## Bioindication and Collembola

### JF PONGE

Soil springtails are abundant in a variety of environments, from forests to agricultural crops and bogs, from the deep soil to the crown of trees and from seashore to higher mountains (Ponge, 1993; Sadaka and Ponge, 2003; Mouloud et al., 2007). If most species prefer moist environments, due to their tegumentary respiration, some species are adapted to desert and other psammophilic environments, where they live in small interstices between sand grains (Greenslade, 1981; Thibaud, 2008), and many collembolan species support saline stress quite easily (Witteveen et al., 1987; Owojori et al., 2009). However, this apparent ubiquity masks profound differences in the ecological requirements of species. As a consequence, springtail communities exhibit a variable composition. The most cited examples are those relative to soil acidity. It has been shown that, beside a basic species pool, communities of acidic ( $\text{pH} < 5$ ) and less acidic to neutral or alkaline environments differ markedly at the species level (Hågvar and Abrahamsen, 1984; Ponge, 1993; Loranger et al., 2001). Although the direct sensitivity of Collembola to pH has been experimentally demonstrated (Salmon et al., 2002), other studies showed that the attractiveness of some springtails to earthworms and the refuges they find from predation in networks of earthworm galleries may explain why some species are absent from acidic soils deprived of burrowing animals (Salmon, 2001; Salmon et al., 2005). Agricultural soils differ also from forest environments, probably due to a complex and still unexplained factor embracing both climate and soil conditions (Ponge et al., 2003; Auclerc et al., 2009). It has been shown that the first stadium, sometimes called the larval stage, may exhibit specific requirements, not allowing some species to tolerate the contrasted climate of open environments (Betsch and Vannier, 1977). In sub-tropical and Mediterranean areas Collembola may totally disappear during drier months (Bandyopadhyaya et al., 2002), passing the unfavourable season in the form of diapausing eggs or other forms of resistance (Poinso-Balaguer, 1984). For all these reasons, springtail communities have been shown to be good indicators of environmental health (Van Straalen, 1997), although it can occur that the influence of site is higher than that of vegetational types, as this has been shown to occur in Egypt (Alassiuty et al., 1993), pointing to the need for a comprehensive exploration of the regional pool before reaching conclusions based on species composition. The existence of communities locally depauperated in species (compared to the regional pool) may indicate abrupt changes in land use (Ponge et al., 2006) or pollution events (Gillet and Ponge, 2003) with which communities were unable to cope. Similarly, soil springtail communities are sensitive to pesticides and other chemicals in use in agriculture, and their paucity in species may indicate negative impacts on non-target organisms (Wikteliuss et al., 1999; Ponge et al., 2002).

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