Temporary freshwater rockpools in the Maltese Islands: formation, ecological processes and implications for management and conservation.

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Summary:

Formation

Temporary freshwater rockpools of the Maltese Islands generally form in karstified solution hollows in coralline limestone substrata. Not all hollows are potential rockpools as they are subject to infilling by allochtonous sediment transported by runoff water and to a lesser extent by wind. The dynamics of sediment in solution hollows is a function of rates of infilling and rates of depletion, which are in turn influenced by the surface area to volume ratio (*A*:*V*) of the depression. A continuum of solution hollows described by *A*:*V* therefore occurs on karst terrain.

Hollows with high *A*:*V* do not generally retain a consolidated layer of sediment since any accumulated material is inadequately shielded and is washed out by heavy runoff or depleted by strong winds. Such hollows do not form pools since high *A*:*V* promotes high rates of evaporation and water retention is consequently very transitory.

Depressions characterised by low *A*:*V* retain large volumes of sediment since accumulated material is adequately shielded from further transport. Such volumes of sediment promote the proliferation of large terrestrial macrophytes including shrubs and small trees. Hollows of this form are not conducive to pool establishment since any accumulated water is rapidly lost by transpiration.

Pool environments therefore form in solution hollows that are characterised by a pool-forming interval of intermediate *A*:*V*, where shielding would be sufficient for accumulation of freshwater while permitting balanced depletion and replenishment of sediment, preventing complete infill of the basin. The sediment in several such pools is consolidated by anchorage systems of plants and any loss of accumulated material would consequently represent a surface phenomenon.

Hollows situated at the lower extreme of the pool forming interval of the *A*:*V* spectrum are frequently without sediment. In such depressions, shielding is insufficient for long-term retention of sediment but is adequate for retention of water for periods comparable with the duration of the reproductive cycles of pool inhabitants. Such pools are generally short-lived, with an aquatic phase that is nevertheless of sufficient duration for initiation and completion of reproductive cycles of specialised colonisers.

Distribution

The distribution of these habitats in the Maltese Islands is correlated with the extent of karstic terrain and such pools are consequently not widespread due to the paucity of suitable geological substrata.

Biota

Such rockpools are supplied by freshwater derived from precipitation and runoff and undergo an autumnal cycle correlated with the biseasonal climatic patterns of the Maltese Islands. Pools are initially flooded in September or October and are generally desiccated by April or May.

During the flooded phase, pool communities are dominated by microcrustaceans, filamentous algae and aquatic macrophytes. Pool communities during the desiccated stage comprise terrestrial macrophytes and foraging invertebrates.

Diversity of the pool biota in terms of species richness is furthermore dependent on the duration of hydroperiod and on the diversity of vegetation colonising the substratum during the aquatic ecophase. In general, longer hydroperiods promote the accumulation of a larger subset of the pool of colonising species, while vegetational diversity increases habitat heterogeneity and hence faunal diversity. No significant correlation between pool surface area and maximum species richness of microcrustaceans was detected during specific studies. Similarly, pool volume and maximum species richness were not significantly correlated either. Results obtained from detailed study of five pools indicate that maximum species richness of crustaceans is more sensitive to hydroperiod duration ($r = 0.75$; $P < 0.001$) and to species richness of vegetation ($r = 0.79$; $P < 0.01$) than to the physical properties of the pools.

Conservation

Freshwater rockpools benefit from direct protective measures and from implicit protection by being included within the boundaries of protected areas. The presence of freshwater rockpools is one of the criteria that can qualify an area as a Site of Scientific Importance. The biota of these pools is locally rare and several species are afforded special conservation status. Such protective measures notwithstanding, several pool landscapes are under direct threat from the construction industry due to the high economic value of the coralline substrate within which they form and due to the continuously increasing demand for residential, recreational and infrastructural spaces.