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P25

Preliminary Study of Circatidal Activity Rhythm in Mangrove Insects: Adaptation to a Regularly Flooded Environment

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Mangrove forests are regularly flooded, with the tide flooding and ebbing in a period of about 12.4 h (tidal rhythm), and for mangrove animals, the tidal rhythm is an important factor determining the timing of activity. Insects on the mangrove forest floor can be active only during low tides, and their activity is interrupted during high tides. Thus, they should determine the “correct” timing of activity by using external environmental cues related to the tidal cycle or by using an endogenous tidal clock. Although the life history of some mangrove insects has been studied, none has demonstrated if ground insects determine the timing of their activity exogenously or endogenously.

Mangrove crickets (*Apteronemobius asahinai*) occur only in mangrove forests. They forage on the forest floor, probably consuming mostly plant materials. Adults have no wings, and thus do not sing. The locomotor activity of 24 crickets was examined at 25°C under constant darkness, and most crickets showed a bimodal daily pattern of activity, i.e., circatidal rhythmicity. The free-running period (τ) of this endogenous rhythm was 25.7 ± 0.4 h (mean \pm SD, $n=15$), which was slightly longer than the environmental bitidal cycle (about 24.8 h). This result suggests that mangrove crickets determine the timing of their activity endogenously.

The coastal tiger beetle (*Callytron yuasai okinawense*) is found in various coastal habitats, including rocky shores, mangrove forests, river mouths, and sandy beaches. Larvae of *C. y. okinawense* in mangrove forests live in shallow burrows on the mounds of mud lobsters (*Thalassina anomala*) and plug their burrow openings before submerging for high tide. Field observations indicated that burrow plugging was a rhythmic behavior, and the mean interval between consecutive burrow pluggings was 12.37 h. Because some individuals plugged their burrows even though the burrow did not become submerged, this behavior may not be a direct response to environmental cues such as inundation of the basement area of the burrow, but may be the result of an endogenous circatidal clock.

Further experiments are needed to determine the exact nature of the free-running rhythm and how animals synchronize to the tidal rhythm, i.e., what environmental cues are used. This preliminary study demonstrated that an endogenous biological clock is associated with the behavioral adaptation to a regularly flooded environment.