MARINE PUDDLING IN *PAPILIO POLYTES* (LEPIDOPTERA: PAPILIONIDAE)

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Smedly & Eisner (1995, 1996) stressed the difficulties that terrestrial herbivores, including Lepidoptera, suffer in order to fulfill their need for sodium, an essential ion plentiful in the seas, but in short supply in plants.

Adult Lepidoptera drink from puddles, edges of streams, carrion, and excreta from which they obtain sodium and proteins (Beck et al. 1999). Puddling behavior is typically, although not exclusively, carried on by males (Boggs et al. 1991; Sculley & Boggs 1996). It has been demonstrated that sodium acquisition from puddles enables males to provide mates with sodium, presumably via the spermatophore (Pivnik & McNeil 1987; Smedly & Eisner 1996). Sodium intake by males affects their reproductive success, while the transfer of sodium from male to female enhances the reproductive successes of both females and eggs (Pivnik & McNeil 1987) since females subsequently transfer sodium to their eggs (Smedly & Eisner 1996).

Location of resources, which are usually rare and patchily distributed (i.e., puddles with the appropriate salt concentration), is not a simple matter for Lepidoptera, which might use both visual (Papilionidae, Pieridae) and olfactory stimuli (Lycaenidae, Nymphalidae) to locate them (Beck et al. 1999). The sea, an easy to locate source of sodium, is basically unexploited by butterflies.

Fig. 1. Reef shelf at Ipan (Guam) at low tide, showing four specimens of *Papilio polytes* scattered through the shelf on green algae mats.

Fig. 2. Specimen of *Papilio polytes* drinking seawater on Ipan reef shelf (Guam). Note the proboscis introduced into the water.

On August 28, 2004, on a sunny afternoon, we observed about 20 male specimens of *Papilio polytes* Linnaeus, 1758, drinking seawater at low tide, on the Ipan reef shelf on the southeast coast of the island of Guam (Micronesia, USA) (Fig. 1). The butterflies were extending their proboscis directly into the sea while standing on green algae floating mats or on exposed coral structures (Fig. 2), at a distance from the shore ranging from 0.3 to 15 m. This behavior was observed for about 1 h until the butterflies left. No other Lepidoptera were seen on the reef, but numerous specimens of *Euploea eunice* Quoy, 1815, were observed on the beach shrubs.

Sodium may be a rare resource on the oceanic island of Guam, as it is often the case in outwashed tropical soils (Ross & Dykes 1996). However, inland sodium resources are widespread enough to permit butterflies' persistence without drinking marine water. Seawater intake by *P. polytes* in Guam is not likely the only possibility for this butterfly to obtain minerals, but because of the number of specimens seen, it seems a favored option. Higher salt concentration as a result of evaporation during sunny low tide, and resting places on the water, are factors that favored the presence of *P. polytes* in the shallow open waters of the reef shelf. The absence of these factors alone cannot explain why the sea is not more widely used by Lepidoptera as a source for sodium.

We hypothesize that water temperature is a critical factor diverting butterflies from seawater as a sodium source. Water temperature recorded at the sea reef platform at low tide reached 36 to 42°C on the surface, a temperature often reached in mud-puddles used by butterflies in tropical and Mediterranean regions. This hypothesis, together with differences in water availability (Launer et al. 1996), might explain the intraspecific regional differences found in the use of mud puddles, much less visited by the same or closely related species in the cooler climate of central Europe than in the dry steppe biomes of the Mediterranean region (Beck et al. 1999).

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SUMMARY

Adult Lepidoptera rarely uses seawater as a source for sodium. We observed specimens of *Papilio polytes* drinking seawater on the coast of Guam. Based on our observations, we hypothesize that water temperature might play a key role while choosing among puddling sites.

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