

MARINE PUDDLING IN PAPILIO POLYTES (LEPIDOPTERA: PAPILIONIDAE)

Authors: Pola, M., and García-París, M.

Source: Florida Entomologist, 88(2) : 211-213

Published By: Florida Entomological Society

URL: [https://doi.org/10.1653/0015-4040\(2005\)088\[0211:MPIPPL\]2.0.CO;2](https://doi.org/10.1653/0015-4040(2005)088[0211:MPIPPL]2.0.CO;2)

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

MARINE PUDDLING IN *PAPILIO POLYTES* (LEPIDOPTERA: PAPILIONIDAE)M. POLA^{1,2} AND M. GARCÍA-PARÍS³¹Marine Laboratory, University of Guam, UOG Station, Mangilao, GU 96913, USA²Permanent address: Departamento de Biología, Facultad de Ciencias del Mar y Ambientales
Universidad de Cádiz, Polígono Río San Pedro s/n Ap. 40. 11510, Puerto Real, Cádiz, Spain³Museo Nacional de Ciencias Naturales, CSIC. José Gutiérrez Abascal, 2. 28006, Madrid, Spain

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 out-washed 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).

We thank the University of Guam Marine Lab friends and colleagues for help and assistance during our visit and especially to Elaine Pinder. MP's stay in Guam was supported by a short-term fellowship of the Ministerio de Educación, Cultura y Deportes of Spain.

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.

REFERENCES CITED

- BECK, J., E. MÜHLENBERG, AND K. FIEDLER. 1999. Mud-puddling behavior in tropical butterflies: In search of proteins or minerals? *Oecologia* 119: 140-148.
- BOGGS, C. L., AND L. A. JACKSON. 1991. Mud puddling by butterflies is not a simple matter. *Ecol. Entomol.* 16: 123-127.
- LAUNER, A. E., D. D. MURPHY, C. L. BOGGS, J. F. BAUGHMAN, S. B. WEISS, AND P. R. ERLICH. 1996. Puddling behavior by bay checkerspot butterflies (*Euphydryas editha bayensis*). *J. Res. Lepid.* 32: 45-52.
- PIVNIK, K., AND J. N. MCNEIL. 1987. Puddling in butterflies: sodium affects reproductive success in *Thymelicus lineola*. *Physiol. Entomol.* 12: 461-472.
- ROSS, S. M., AND A. DYKES. 1996. Soil conditions, erosion and nutrient loss on steep slopes under mixed dipterocarp forest in Brunei Darussalam, pp. 259-270. *In* D. S. Edwards, W. E. Booth, and S. C. Choy [eds.], *Tropical Rainforest Research—Current Issues*. Kluwer, Dordrecht.
- SCULLEY, C. E., AND C. L. BOGGS. 1996. Mating systems and sexual division of foraging effort affect puddling behaviour by butterflies. *Ecol. Entomol.* 21: 193-197.
- SMEDLY, S., AND T. EISNER. 1995. Sodium uptake by puddling in a moth. *Science* 270: 1816-1818.
- SMEDLY, S., AND T. EISNER. 1996. Sodium: A male moth's gift to its offspring. *Proc. Nat. Acad. Sci. USA* 93: 809-813.