

Water landing as a foraging strategy to water collection in a social wasp:

Polistes dominulus

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Abstract: This study describes the first case of water landing for water collection in the European paper wasp *Polistes dominulus*. Wasp workers land directly on the water surface and spend 10-15 s collecting water. By doing so, the workers may avoid predation by ground predators. However, not all workers land directly on the water surface, and we suggest that this specialized behavior is performed only by experienced foragers

Key-words: Behavioral plasticity, Polistinae, paper wasps, predation risk.

O pouso na água como estratégia de forrageamento para coleta de água em uma vespa social: *Polistes dominulus*

Resumo: Este estudo descreve o comportamento de coleta de água da vespa social europeia *Polistes dominulus*. As vespas campeiras pousavam diretamente na superfície da água e gastam 10-15 s coletando água. Ao fazer isso, as vespas podem evitar a predação por predadores no solo. No entanto, nem todos os indivíduos pousam diretamente na superfície da água, e sugerimos que esse comportamento especializado seja realizado apenas por forrageiras experientes.

Palavras-chave: Plasticidade comportamental, Polistinae, risco de predação, vespa papel.

Foraging for food resources, materials for nest construction, and water represents an important task to the maintenance of colonies in social wasps (Richter, 2000; Clemente et al., 2012; Barbosa et al., 2014). During foraging trips, wasps perform flights that can reach over 500 m from the colony (Bechinski et al., 2009; De Souza et al., 2010). A side from energetic costs, foraging trips may also increase predation risk to the wasp workers. In fact, as already reported for stingless bees (Nogueira-Neto, 1997), foraging wasp workers are exposed to many predators, including birds, geckos, frogs, and many arthropods such as mantises, assassin bugs, ants, and spiders (e.g. Jeanne, 1970). Thus, the experience acquired by wasp workers during foraging trips may decrease energetic costs and predation risks, as well as may increase resource acquisition (Richter, 2000).

Water is used by social wasps for two main functions within the colony: (1) to be mixed with masticated plant fiber in processing material for nest construction, and (2) to be evaporated with wing fanning to cool the nest (Wilson, 1971; Akre, 1982). Although water is clearly important for the colony, there are few studies focused on how wasp workers forage for this particular type of resource. In this study, we describe the behavior of the European paper wasp *Polistes dominulus* (Christ, 1791) while foraging for water. As far as we know, this is the

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first report of water landing by wasp workers while foraging for water. We discuss the possible benefits of water landing as a foraging strategy in social wasps.

We carried out field observations at a rural property in Vila Ruiva, Alentejo region, southern Portugal (40°34'12.67"S, 7°30'59.77"W) in 2007, during the beginning of summer, a period with warm temperature and dry weather conditions. We recorded the foraging activity of wasp workers in a water box of approximately 2 m², during the hottest hours of the day (13-15 h). Our observations comprised a total of 8 hours distributed along 2 days, during which we recorded 80 foraging visits to the water box.

We observed workers of *P. dominulus* landing directly on the water surface (n = 60). The workers kept their legs fully spread, probably to distribute body weight on the surface and float due to the water's superficial tension (Fig. 1). Workers remained about 10 to 15 s (n = 60) landed on the surface collecting water with the mouth parts. We also observed workers collecting water on the edge of the water box (n = 20), thus avoiding direct contact with the water. However, this behavior was less frequent than the water landing. Moreover, workers that landed on the ground spent about 20 to 40 s to collect water.

Water can be a limiting resource for wasps (Horwood, 1993), and in periods or areas where fresh water is scarce, wasp workers are frequent visitors to sinks and dripping water spigots (Richter, 2000). In the social wasps, water foraging typically involves landing close to the water source, moving to the best access point, collecting water, and flying back to the colony (Richter, 2000). The water landing behavior reported here may decrease predation by terrestrial animals, including geckos, frogs, ants, assassin bugs, and wandering spiders. However, not all workers land on the water surface, and we suggest that this specialized behavior is performed only by experienced foragers. This hypothesis can be tested with marked individuals of known age within a colony.

Although social wasps are incredibly diverse and well-studied in the neotropics, there is no report of water landing among species of this region. Workers of Neotropical wasps usually collect water from flowers, leaves, and phytotelma, but are also able to land on the ground and collect water from ponds avoiding direct contact with the water (Richter, 2000). The presence of a rich fauna of water predators may explain why water landing does not occur in neotropical wasps. Some fish species, such as *Osteoglossum bicirrhosum* Vandelli, 1829, feed mainly on



Figure 1. Example and angles of water landing behavior for water foraging in the wasp *Polistes dominulus*. A – Posterior view; B – Front view; C – Upper view

insects (Coleoptera and Hymenoptera) captured on the water surface (Chaves et al., 2005). Thus, predation by fish may be an important selective pressure acting against water landing in the neotropics.

Why other social wasps from Temperate regions do not land directly on the water surface is still an open question. The foraging behavior described here for a population of *P. dominulus* may be a rare case of behavioral plasticity or a local adaptation to ecological conditions, such as intense predation by ground predators. In this sense, future studies should test if predation risk is higher for workers that land preferentially on the ground when compared with workers that land preferentially on the water surface. Moreover, field observations with other populations of *P. dominulus* and closely related species may help to understand how widespread is water landing among Temperate social wasps.

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