Foraging Behavior of *Pachydiplax longipennis* (Odonata: Libellulidae)

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Food intake, prey availability, and prey capture behavior at feeding areas were quantified in the dragonfly *Pachydiplax longipennis* by observing focal individuals on artificial perches, where they exhibited marked short-term site fidelity. Prey capture success was high and relatively constant, but the frequency and duration of feeding flights depended on the time of day and season (at least in part because of associated variation in temperature and other physical factors), study site, sex, density of other dragonflies, and prey density. Individuals rapidly responded temporally and spatially to changes in prey availability, particularly to localized prey concentrations.

KEY WORDS: dragonfly; foraging; Odonata; *Pachydiplax longipennis*; predation.

INTRODUCTION

Although dragonflies are well-known predators of other insects, quantitative investigations of foraging by adult Odonata are rare (e.g., Pritchard, 1964; Higashi, 1973, 1978; Higashi et al., 1979; Shelly, 1982; Parr, 1983; Michiels and Dhont, 1989; Anholt, 1992; Mayhew, 1994; for *Pachydiplax*, Fried and May, 1983; May, 1984) and detailed studies of individual foraging behavior practically nonexistent. Adults eclose with scant energy reserves, and both sexes exhibit at least a threefold mass increase between emergence and sexual maturation (Anholt et al., 1991). Flight muscle formation may also entail large energy inputs during the teneral period (Marden, 1989), especially in males.

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Males of many species are territorial when mature, and territorial defense, because it requires flight, may be energetically expensive (Fried and May, 1983; Koenig, 1990; Marden and Waage, 1990). Females probably devote a large proportion of energy to egg production, which continues throughout adult life. Thus, males defending territories and females producing eggs may be under different but very high energetic requirements that both must satisfy by adult feeding.

*Pachydiplax longipennis* is a common, medium-sized (0.1- to 0.25-g), libellulid dragonfly. Like other adult dragonflies, it is a generalist carnivore (Corbet, 1963), usually feeding on small flying insects. Foraging flights typically originate and terminate at a perch and are short and oriented directly toward individual prey. We chose *Pachydiplax* for this study because of its abundance, size, and perch-based foraging mode, which facilitate observation and quantification of behavior. In addition, foraging and reproductive behaviors are separated in time and space, thus reducing confounding effects of one on the other. Individual males maintain waterside mating territories, where they feed rarely or not at all, for up to several hours between midmorning and late afternoon. Females visit such sites briefly, only to mate and oviposit (Johnson, 1962; Fried and May, 1983; Sherman, 1983; MacKinnon and May, 1995). Fried and May (1983) developed time budgets for territorial males, so reproductive requirements can be related to energy intake and expenditure during foraging.

The primary aim of our research was to assess the biotic and abiotic factors that influence the feeding behavior of *Pachydiplax*. Our specific objectives were to quantify foraging behavior by direct observation and to document how this behavior varies over time and with changes in the physical environment, prey availability, and competitor density. We deliberately chose to examine a wide variety of factors, and some of their interactions, that affect foraging, rather than focusing here on one or two to the exclusion of others. This enabled us to explore the complexity and relative importance of multiple influences on feeding strategy with minimal disturbance of normal behavior.

**MATERIALS AND METHODS**

**Study Sites**

*Pachydiplax longipennis* were studied from 20 April to 31 July 1987 in an open, "‘L’"-shaped, mowed field bordered by woods, approximately 250 m east of Lake Alice (where the species breeds abundantly), at Gainesville, Florida (FL; 29°38'N, 82°21'W). Square perch arrays of nine 1-m-tall green bamboo stakes were erected in each arm of the ‘‘L.’’ Both arrays were sunlit during most of the day, but the east array (FE) received insolation approximately 1.5 h before the north array (FN) and was shaded 1 to 2 h earlier in the evening.