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### Cover Page Footnote

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## The Puzzling Presence of *Lestes australis* (Odonata: Lestidae) in Wisconsin—Does This Species Migrate?

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### Abstract

*Lestes disjunctus australis* Walker (Odonata: Lestidae), 1952 was described as a subspecies of *Lestes disjunctus* Selys, 1862. In recent decades it has been considered deserving of full species status by most specialists. The core of its eastern North American range is south of Wisconsin, but during April through June of some years, mature individuals, and occasionally reproductive behavior, are observed at shallow ponds and wetlands mostly in the southern half of the state. Since first recorded in Wisconsin in 2002, it has been detected in 13 of Wisconsin's 72 counties. However, there has been no unequivocal documentation of successful reproduction in the state. Various possibilities regarding long-range dispersal or facultative migration of this species and other species of Zygoptera are discussed.

**Keywords:** Zygoptera; *Lestes australis*; *Lestes disjunctus australis*; migration; dispersal

*Lestes australis* Walker (commonly known as southern spreadwing) (Odonata: Lestidae) is an enigmatic, uncommon, early-season species in Wisconsin, where it is at the northern edge of its eastern North American range (Paulson 2011). It is enigmatic, in part, because its identification has long been confused with two morphologically similar species, *L. forcipatus* Rambur (sweet-flag spreadwing) and *L. disjunctus* Selys (northern spreadwing, formerly common spreadwing). Prior to the late 1940s, entomologists were unaware that the *australis* form existed. Montgomery (1941) warned that determinations of *L. disjunctus* and *L. forcipatus* had been so badly confused that published records of the two species should be disregarded. Walker (1952) named the *australis* form as a new subspecies of *L. disjunctus* and he stated that this form "has caused all the confusion between *L. disjunctus* and *forcipatus*." A measure of confusion concerning the identification of *L. australis* persists to this day.

It remains unclear if *L. australis* is a valid species or a subspecies of *L. disjunctus*. Since Walker (1952) named it as a subspecies, most references on Odonata have treated it as such (see Westfall and May 2006). However, Donnelly (2003) urged that *L. australis* should be elevated to species status because of widely overlapping ranges and morphological and life history differences between it and the nominate *L. disjunctus*,

and he noted that the most difficult diagnosis in the complex is in distinguishing the males of *L. forcipatus* and *L. australis*. Paulson (2004) cited the arguments given by Donnelly (2003) and stated that *L. australis* and *L. disjunctus* "must be recognized as a more northerly and a more southerly species distinct from one another." Still, Westfall and May (2006) provisionally retained *L. australis* as a subspecies of *L. disjunctus* because of a lack of genetic distinction between the two forms. Paulson (2011) acknowledged that the genetic differences between *L. australis* and *L. disjunctus* are less than those between most species of *Lestes*, but he again advocated that *L. australis* was deserving of full species rank because of structural differences and a different flight season. Abbott (2011) also considered *L. australis* to be deserving of full species status, as do we in this note.

Current identification tools (Walker 1952, 1953; Catling 2003; Donnelly 2003; Lam 2004; Westfall and May 2006; Abbott 2011; Paulson 2011; DuBois 2019) allow clear separation of males of *L. australis* and *L. disjunctus*, but distinguishing males of *L. australis* and *L. forcipatus* remains somewhat uncertain due to subtle morphologic and color- and pruinosity-pattern differences, and probable overlap in some of the frequently used character states. Therefore, when determining these species, field guide authors have recommended looking

for associated pairs because females of *L. forcipatus* have a long and easily recognized ovipositor that will help rule out *L. australis* (Lam 2004, Paulson 2011, DuBois 2019), but they also warn that males of species of *Lestes* will sometimes form tandem with the wrong species.

The first Wisconsin record for *L. australis* was a male collected on 26 June 2002, at a beaver pond in northern Douglas County (one of Wisconsin's northern-most counties; Fig. 1). It was determined as *L. australis* by RBD, but because it was so far north of its known range, it was sent to T. W. Donnelly, an expert with the group, for verification. Donnelly confirmed the specimen as *L. australis*. Subsequent visits to the site did not detect more specimens, so it was presumed to be a vagrant. Five years later, another male was collected in Monroe County on 28 April 2007. When adult odonates in Wisconsin are seen as early in the flight season as April, they are usually migrants, such as *Anax junius* (Drury) and *Sympetrum corruptum* (Hagen). May (2013) noted that the mean date of first appearance of migrants was at least six weeks earlier than the mean date of first emergence of resident species in Maryland and New York. We therefore considered the possibility that *L. australis* might be a migrant. We are not the first to voice the possibility of migration in this species. Donnelly (1992) noted that in some years, numbers of *L. australis* were taken at several sites around Binghamton, New York, which he called episodic irruptions. These observations led Soltesz et al. (1995) to pose the question, "Do Zygoptera migrate?"

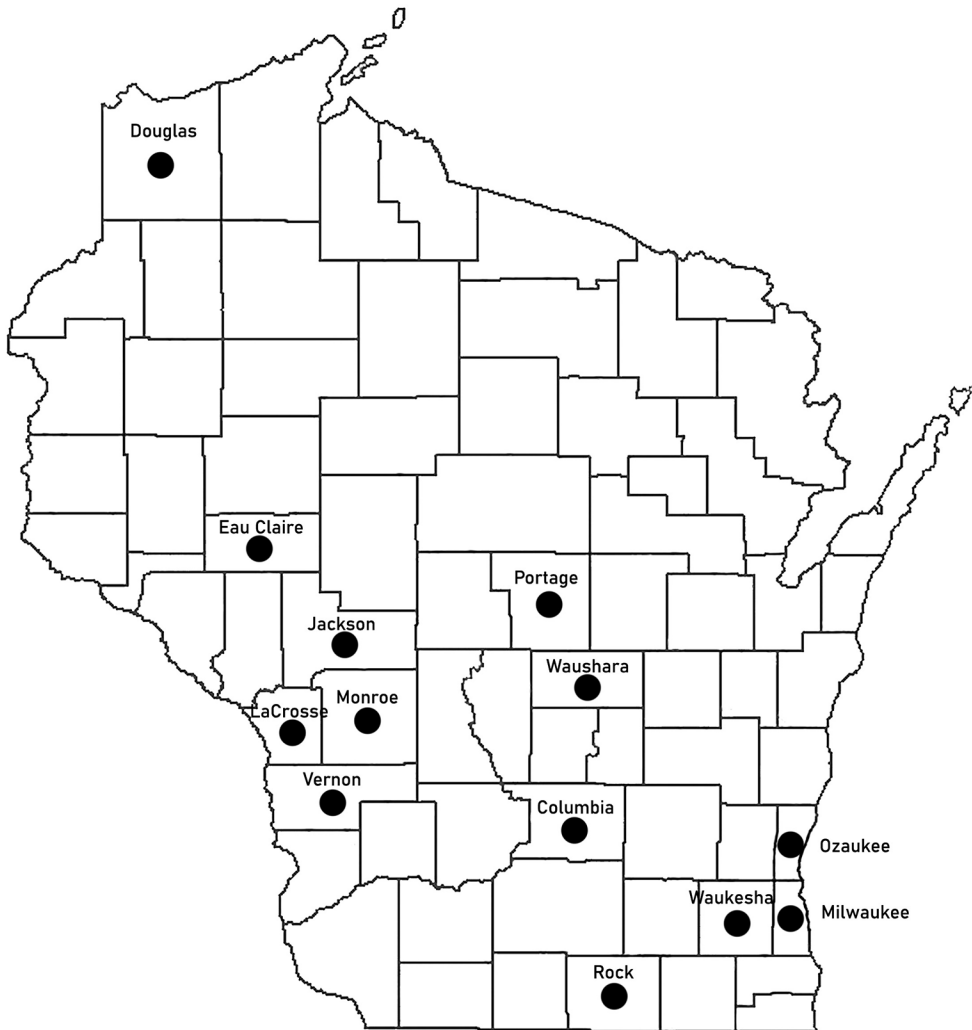
Another five years passed without additional observations of *L. australis*, but the lack of observations could have been due to low levels of early season sampling effort rather than the absence of the species in the state. In 2012, unassociated males of *L. australis* and some pairs in copula and ovipositing were observed on four occasions from mid-May to mid-June in a small, frequently visited retention pond in the Town of Holmen, La Crosse County (D. Jackson, pers. comm.). Since then, at least a few early-season individuals of *L. australis* have been observed most years at this retention pond, including many males and reproductive behavior in 2015 and 2018. *Lestes australis* was not seen at the pond in 2013 or 2019, and in May 2020 only a single male was found. However, two teneral *Lestes*, a male and a female, were collected along a short shoreline of the pond on 24 July 2020. Both were tentatively determined as *L. australis*, but because of their teneral condition, including some key body parts being twisted or shriveled, and the lack of full color or

any pruinosity, their identity could not be confirmed with certainty.

At another frequently visited site, a man-made wildlife pond in the Buena Vista State Natural Area in Portage County, we observed *L. australis* adults on two occasions in 2016 and 2017. We made four visits to the pond in May 2017 to collect *Lestes* nymphs, hoping to document survival of *L. australis* through the winter. However, all 17 nymphs reared from the pond were *L. eurinus* Say (amber-winged spreadwing), and 74 F-0 and F-1 nymphs that were preserved and identified were also all *L. eurinus*.

Over the last decade, individual males or in a few cases multiple specimens have been observed or collected at a handful of additional sites so that *L. australis* has now been observed in 13 of Wisconsin's 72 counties, mostly in the southern half of the state (Fig. 1; <https://wiatri.net/inventory/odonata/SpeciesAccounts/SpeciesDetail.cfm?TaxaID=168>). However, the only hint of successful reproduction remains the uncertain determinations of two tenerals at the Holmen retention pond in 2020.

In central and southern Wisconsin, the habitats where *L. australis* has been found include permanent, but usually shallow ponds and marshes with abundant emergent vegetation and probably an absence of fish (at least lacking centrarchids). Elsewhere in the range of *L. australis* it is also found in lakes and slow streams, but we have not found it in those habitats in Wisconsin. Here it has a short, early flight period that peaks in late May and early June. Any *Lestes* seen in Wisconsin in April or the first half of May are most likely to be *L. australis*. In the core of its range in the U.S. south of Wisconsin, *L. australis* is known to have a long flight season that extends well into autumn (Paulson 2011), but in Wisconsin it has not been confirmed later than the end of June. *Lestes eurinus* is also an early season, resident Wisconsin species commonly found in the same habitats as *L. australis*, but it is larger and distinctively marked, and while there is overlap in the flight periods of the two species, the onset of the flight season of *L. australis* is earlier by more than a week. Specimens of *L. australis* arrive suddenly and fully mature, as would be expected with migration or extreme vagrancy. However, we cannot dismiss the possibility of some successful reproduction in Wisconsin, or even the existence of some resident populations. Successful reproduction is expected to be hard to confirm because of the previously noted difficulty of identifying the species, especially when teneral, or as nymphs or exuviae.



**Figure 1.** Counties in Wisconsin where observations of *Lestes australis* have been recorded.

Based on the limited data, we suggest that *L. australis* has a substantial tendency to disperse, and that it does so into Wisconsin from unknown areas to the south. Long-range dispersal is known to be frequent and wide-spread in the Odonata (Russell et al. 1998, Corbet 1999, Dijkstra 2007, May 2013), and large strong-flying insects like odonates would be expected to have a wider range of dispersal than most insect groups (Gillespie and Roderick 2002). Zygoptera are not generally known to have strong dispersal tendencies, but dispersal has only rarely been rigorously studied for species of *Lestes*. Conrad et al. (1999) reported that 8.1% of *Lestes sponsa* (Hansemann) made short-range dispersals away from their natal

pond in a series of nearby ponds (distances between ponds 30-860 m), a finding that was similar to the dispersal percentages of six other species of Odonata at the ponds (range 3.4–11.9%). Utzeri et al. (1984) described as “scarce” the short-range dispersal (up to 100 m) of *Lestes barbarus* (Fabricius) in a network of small ponds, such that colonization of non-populated ponds was not promptly obtained. Longer-range dispersals of *Lestes* have not been documented.

We note, however, that Zygoptera have the flight capabilities to be highly vagile, and one tiny coenagrionid, *Ischnura hastata* (Say) (citrine forktail), is known to have colonized the Azores archipelago,

which is located about 1,500 km from the nearest mainland, and it has been captured at an altitude of 300 m in nets deployed from aircraft (Cordero Rivera et al. 2005). We suggest that the movements of Zygoptera might often go undetected because they are small and hard to see at most distances, and some evidently move at altitudes where observers are not usually looking. Holt (2003) noted the probability in most species of animals of genetic variation in niche requirements and in dispersal tendencies among individuals. While dispersal confers advantages for colonizing new habitats and maintaining genetic diversity (Smith et al. 2009), it also leads to individuals temporarily occupying habitats in which their niche requirements are not adequately met (known as “sink” populations). This could be the case when *L. australis* adults disperse into Wisconsin, because the eggs or nymphs might not be adapted to survive the long, cold winters. If the teneral found at the Holmen pond on 24 July 2020 were indeed *L. australis* as is likely the case, then egg and nymph development could have been completed in as little as about 8 weeks. It is possible that *L. australis* is expanding its range northward in response to ecological factors like climate change or spatial variations in environmental conditions. Grewe et al. (2013) found that lentic species of some European Odonata have expanded their range boundaries northward by an average of 115 km per decade, but that lotic species in the same southern European group have not, on average, changed their boundaries. They concluded that lentic species are better adapted to disperse than lotic species because their habitats are less persistent in time and space. Dispersal could also result from shifts in abundances of interacting species in source habitats, or because of internal traits like tendencies to disperse or recent adaptations to niche characteristics (Holt 2003).

*Lestes australis* is not the only species of Zygoptera having some individuals that make occasional northern forays into Wisconsin from primary breeding areas to the south, as *L. hastata* evidently behaves in similar fashion, although with the difference that successful reproduction in Wisconsin of that species has been documented (Tennessee 2011). The term “facultative migrant” has sometimes been used to describe odonates that do not have annual, directed migration flights in the classical sense, but that disperse north only in years when drought conditions affect habitats within their usual breeding ranges, or when prolonged southerly winds facilitate long-distance northward transport (Soltesz et al. 1995, Russell et al. 1998). Short-distance flights of odonates have been called seasonal refuge flights (Corbet

1999, May 2013) and occasional or irregular flights have been called irruptions (Donnelly 2003, May 2013). In any case, gaining more knowledge about the movement patterns of widely dispersing or transient species of Odonata could benefit our ability to protect any habitats that might be valuable in their life history. We therefore urge observers to report Wisconsin records of Odonata to the Wisconsin Odonata Survey <http://wiatri.net/inventory/odonata/> and to OdonataCentral <https://www.odonatacentral.org>.

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